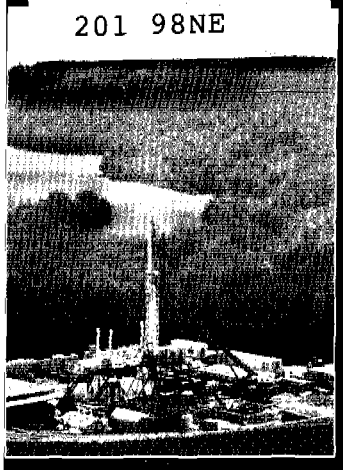
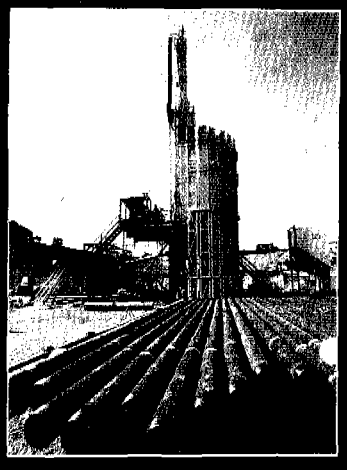
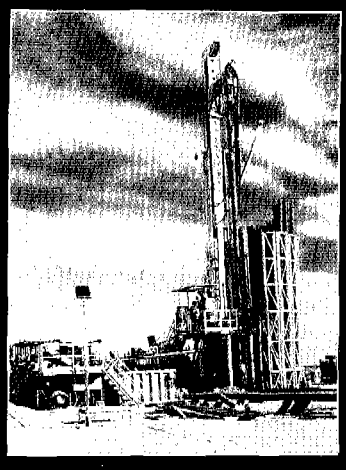
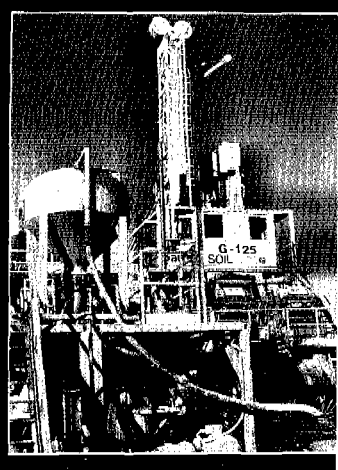








Soilmec S.p.A. Drilling and Foundation Equipment, 5819, via Dismano, 47023 Cesena, Italy
Tel: +39 547 391 111, Fax: +39 547 318 548

SOILMEC

NEW WORLD WATER

1998

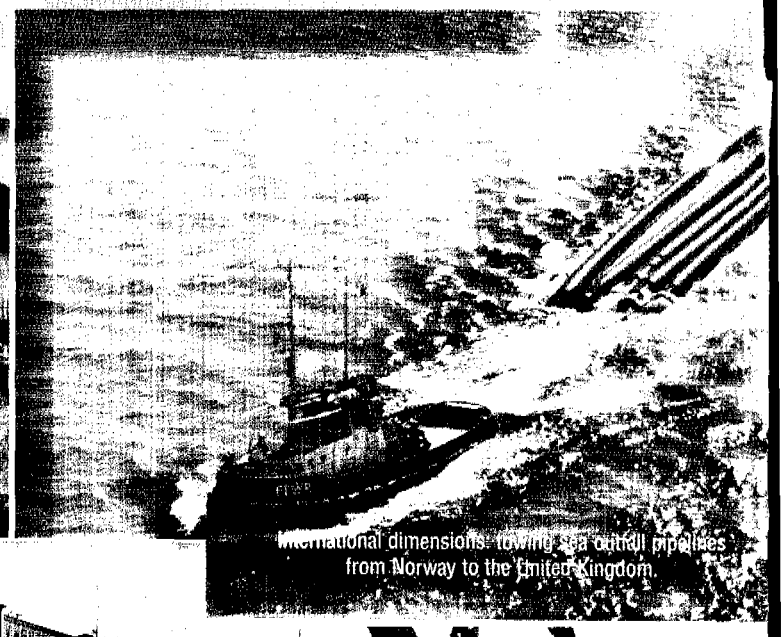
Published
collaboration wi

PUMPS & SYSTEMS

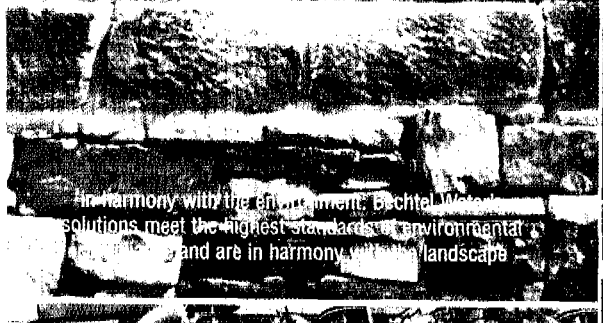
Bechtel Water

PURE SOLUTIONS

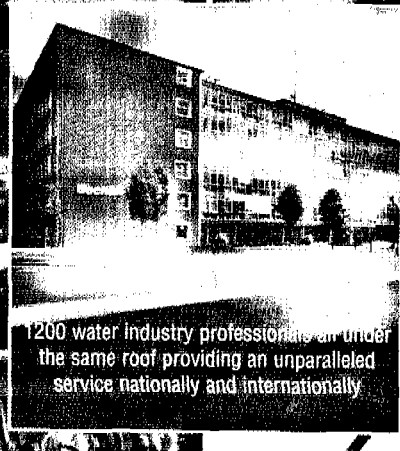
pure: unadulterated, uncompromised, perfect,...
solutions: answers to problems, means of overcoming difficulties, means of achieving ends,...
hence
pure solutions: THE answer to your water or wastewater requirements



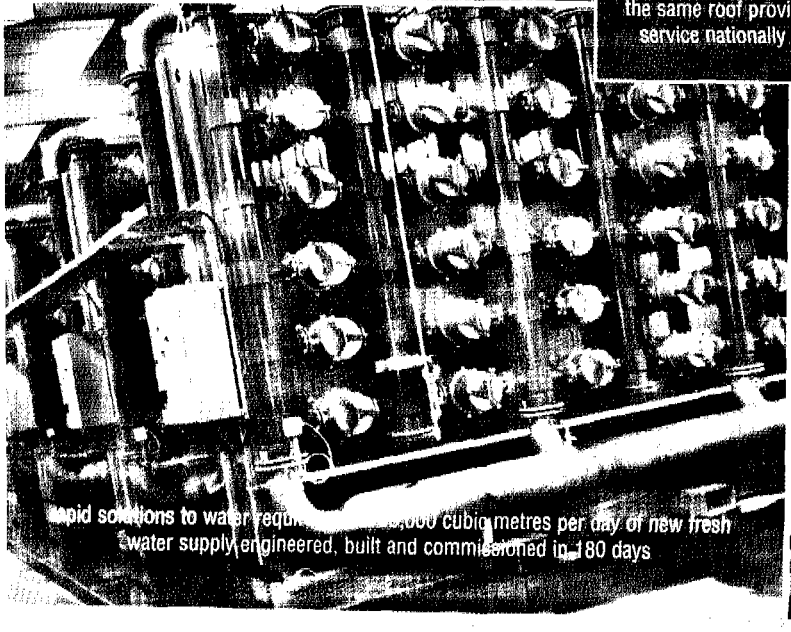
International dimensions: towing sea outfall pipelines from Norway to the United Kingdom.



In harmony with the environment: Bechtel water solutions meet the highest standards of environmental and are in harmony with the landscape.



1200 water industry professionals all under the same roof providing an unparalleled service nationally and internationally



Rapid solutions to water requirements: 45000 cubic metres per day of new fresh water supply engineered, built and commissioned in 180 days

Materials, technology and innovation in a team: managing the insertion of a water supply pipeline into a directionally drilled river crossing

Bechtel Water, the global master builder with the local touch, providing pure solutions to the water and wastewater business, municipal and industrial

Bechtel Water Technology Limited, Chadwick House, Warrington Road, Warrington WA3 6AE, UK. Tel: +44 1925 857533 Fax: +44 1925 857557

NEW WORLD WATER 1998

SPG

Published by
Sterling Publications Limited
a subsidiary of
Sterling Publishing Group Plc,
55a North Wharf Road, London W2 1XR
Tel: +44 (0) 171 915 9660
Fax: +44 (0) 171 724 2089
E-mail: 100632.1573@compuserve.com

ABC ANNUALS

Managing Director
Simone Kesseler
Group Sales Director
Laurence Garman
Head of Publishing
Sarah Dingley
Divisional Sales Manager
Philip Armstrong
Sales Manager
Klaus Zahn
Art Director
Henrik Williams
Circulation Manager
Jenny Roberts
Head of Editorial
Anna Leibowitz
Product Development Manager
Ana Barco
Head of Commissioning
Winston Swaby
Commissioning Editor
Elizabeth Renski
Sub Editor
Elizabeth Adams
Layout
Aaron Baum
Production Controller
Dave Stanford

Printed in Hong Kong
by Magnum International

ISSN [illegible]

Foreword:

Correcting the continued mismanagement of water resources

Pierre Najlis
United Nations Department for Economic and Social Affairs

As we approach the end of the twentieth century, we must face the stark reality that in many countries, both developed and developing, current patterns of water development and utilisation are not sustainable.

A recently completed comprehensive Assessment of the Freshwater Resources of the World, prepared by organisations of the United Nations system, together with the Stockholm Environment Institute, illustrates the magnitude of the problem. There are some regions of the world, notably Sub-Saharan Africa, where economic and institutional constraints limit the development of the available, albeit limited, resources. At the same time, however, approximately one third of the world's population currently lives in areas suffering from moderate to severe stress on their water resources as a result of excessive use. By the year 2025, as much as two thirds of the world's population could be living in areas facing stress conditions. In some areas withdrawals are so high that the flow of rivers decreases as they move downstream, and some lakes are shrinking. Groundwater supplies are being heavily overused, and ecosystems are being neglected in our drive to supply ever-increasing amounts of water to profligate users. Often, the amount of wastes discharged into waters have outstripped nature's absorptive capacity.

The wastefulness in the use of our limited water resources is coupled with disparities in the availability of basic water supply and sanitation services to the urban and rural poor. As much as 20 per cent of the world's population lacks access to safe drinking water supply, and 50 per cent to suitable sanitation. In spite of progress in the provision of services since the launching of the International Drinking Water Supply and Sanitation Decade in 1981, the rate of progress has remained insufficient to cope with rapid population growth, particularly in the large cities of developing countries.

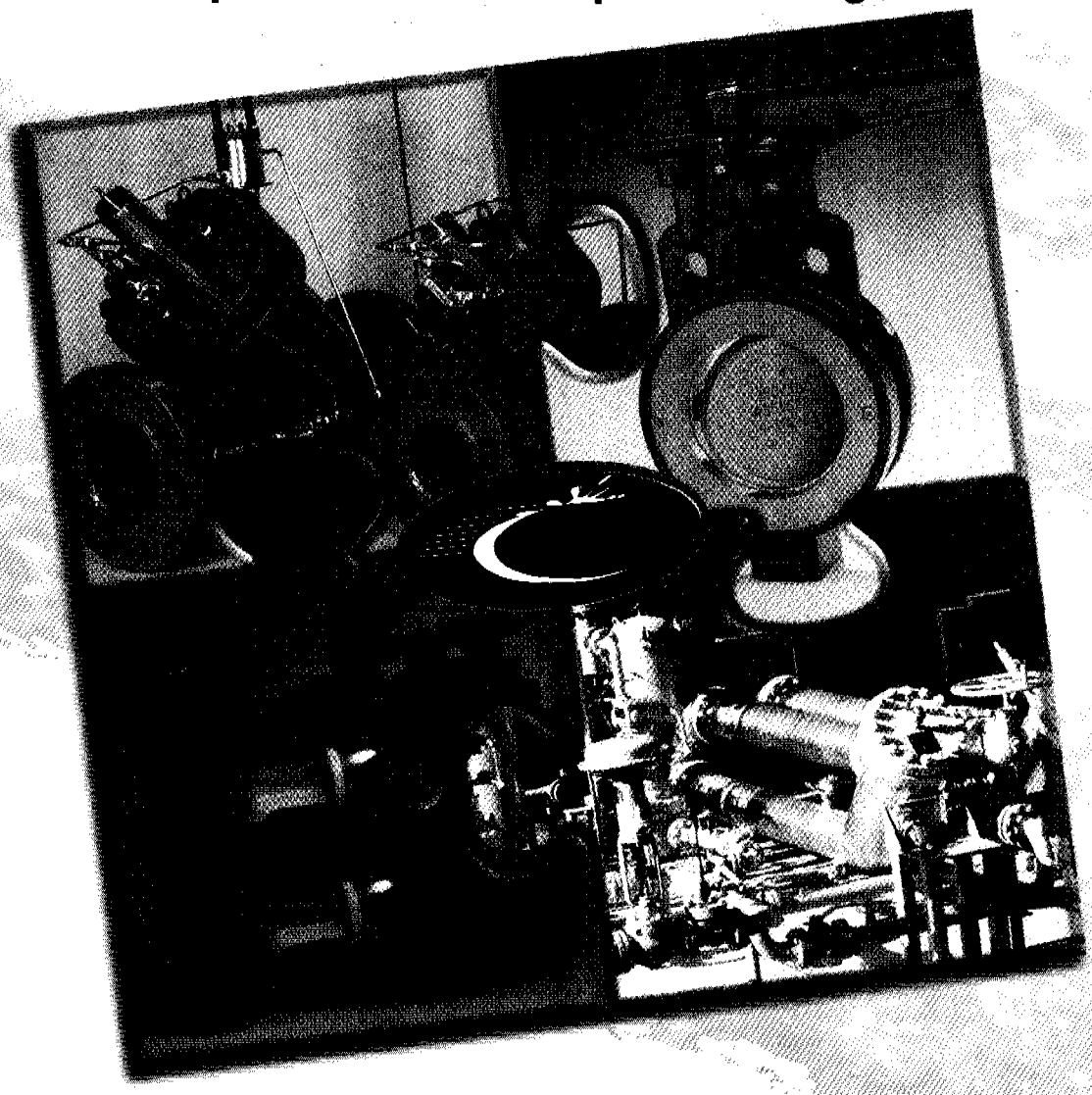
The continued mismanagement of water resources is likely to have serious global implications in terms of global food security, socio-economic stagnation and irreparable damage to ecosystems. Although the prognosis is bleak, a crisis is not inevitable. The knowledge and tools to reverse the current trend are available. Good practices exist and are being replicated. There is an urgent need to implement policy recommendations from the United Nations Water Conference in 1977, the International Conference on Water and the Environment, held in Dublin in 1992, the United Nations Conference on Environment and Development held in Rio de Janeiro in the same year, and the Ministerial Conference on Drinking Water and Environmental Sanitation, held in Noordwijk, The Netherlands in 1994.

Water can no longer be treated as a free commodity. Policies concerning the allocation of scarce resources must become an integral part of the socio-economic development process so as to maximise their value. Their development and use must contribute effectively to the eradication of poverty and to the satisfaction of basic human needs. We can no longer assume that supplies can be increased without unacceptable economic or environmental repercussions. We can no longer afford to use water indiscriminately as a repository of waste. We cannot remain indifferent to the plight of the millions of human beings who lack access to safe water supply and suitable sanitation. As pointed out by Mr Nitin Desai, United Nations Under-Secretary-General for Economic and Social Affairs, in his foreword to the Comprehensive Assessment: 'Nothing short of a firm commitment to action by Governments, the international community, non-governmental organisations and major groups will suffice in order to redress the increasingly alarming situation.'

The General Assembly, at its nineteenth special session, in June 1997, called for the highest priority to be assigned to water resources issues nationally, regionally and internationally. As a result, an international dialogue is being initiated within the Commission on Sustainable Development, in the context of its forthcoming sixth session, in April 1998. The dialogue aims to define strategic approaches for concrete action at local, national, regional and international levels, including non-governmental organisations and the private sector.

Pierre Najlis is currently the chief of the Energy and Water Resources Branch in the Division for Sustainable Development of the United Nations Department for Economic and Social Affairs. He acquired a Bachelors degree in Economics at the University of Ottawa in Canada, and pursued graduate studies in economics at Columbia University in New York. He joined the United Nations in 1965 and has since been dealing with natural resources issues, particularly water resources.

FCD puts the best pieces together.



Let the Fluid Control Division (FCD) fit the right pieces together for your fluid control puzzle. As a group of companies offering a broad range of flow control products, FCD combines quality, innovation, performance and delivery. From specialty strainers and filters, to ball valves and butterfly valves . . . from check valves to backflow preventers FCD offers a wide range of flow control products for water, oil, gas chemical and petrochemical applications.

FCD Provides Flow Control Solutions Worldwide:

- Mueller Steam Speciality
- Mueller/Davis Filters
- Mueller Flow Technology
- Mueller Asia
- FEBCO Backflow Preventers
- Polyjet Severe Service Control Valves
- K-FLO AWWA Butterfly Valves

Fluid Control Division
A United Dominion Company

1491 NC Hwy 20 West • St. Pauls, NC 28384
Tel 910 865-8241 • Fax 910 865-8245
Email: exportmm@interpath.com

CONTENTS

FOREWORD

Correcting the continued mismanagement of water resources **1**

- Pierre Najlis
  United Nations Department for Economic and Social Affairs

OVERVIEW

Doing things differently in the sector **11**

- Jan Teun Visscher and Dick de Jong
  IRC International Water and Sanitation Centre

AFRICA

South Africa: partaking in progress **15**

- A M Muller
  Department of Water Affairs and Forestry

Innovative water and sanitation solutions **19**

- Doreen Walton and Nick Fairclough
  WaterAid

Geosynthetics: technological advance in protecting the enviroment **23**

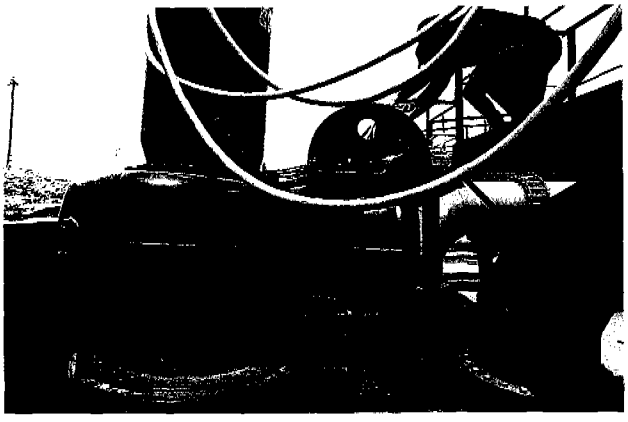
- Gast International (Pty) Limited

PROCESS CONTROL

An industrial wastewater register for the city of Adana in Turkey **25**

- Clemens Wittland
  GKW Consult GmbH

WaterAid



New utility environment drives water change **29**

- Simon Hobson
  IBM Utility & Energy Services Industry

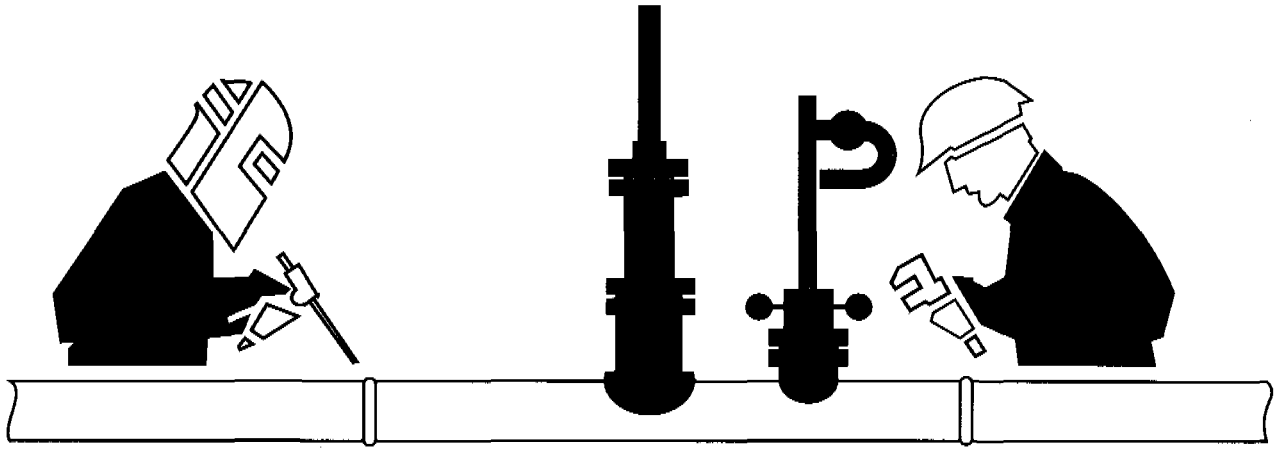
Paving the way to automated meter reading **33**

- Schlumberger Resource Management Services

WATER AND WASTEWATER TREATMENT

Solving problems of contaminated waters and wastewater **35**

- Jamie Bartram and Patrick Marchandise
  World Health Organization



DO YOU USE OR REQUIRE PIPELINE SERVICES?

We are considered specialists in pipeline rehabilitation and maintenance both in the UK and overseas.
We provide services to the Gas, Water and Petrochemical Industries and Local Authorities which include:

LINING SERVICES
Using either swagelining, insertion or size for size bursting techniques, including preliminary CCTV survey, cleaning and winching operations for both supply and drainage work.

CERTIFICATION
Hydrostatic and Pneumatic testing of polyethylene and metallic pipework and installations.

HOT TAP / WELDING
Pipelines and fittings including NDE services.

POLYETHYLENE
Jointing and large branch offtakes.

GUIDED BORING
Sizes from 63 mm to 1 000 mm diameter.

FLOW STOPPING / UNDER PRESSURE DRILLING
Throughout the pressure range from low to high pressure.

FOR FURTHER INFORMATION PLEASE CONTACT

Construction Services,
Hitchin, Hertfordshire.
Tel: 01462 450861 Fax: 01462 451932

Pipeline Maintenance Centre,
Ambergate, Derbyshire.
Tel: 01773 852003 Fax: 01773 856456

A part of BG plc

For further information circle (4)

Alternative disinfection in potable water treatment **41**
- A M Morsi
  Zagazig University

The regulation of lead in drinking water **47**
- Pierre Leroy
  Centre de Recherche et de Contrôle des Eaux de Paris (CRECEP)

The alternative to chemical pretreatment **51**
- Alamo Water Refiners Incorporated

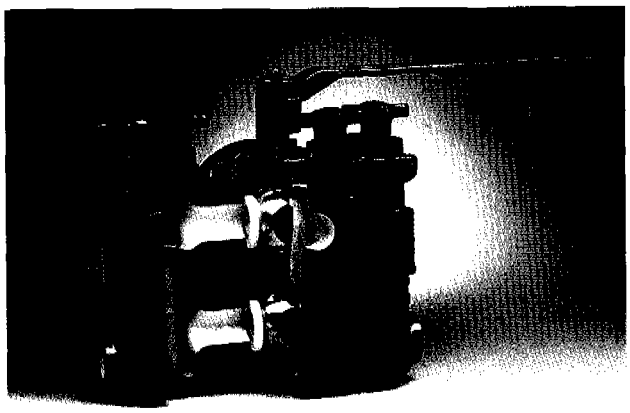
PIPES AND PIPELINES

Developments in plastic pipe technology **53**
- David Hill
  Durapipe – S&LP

Valves to control air in pipeline design **59**
- Professor S J van Vuuren
  University of Pretoria

Structural rehabilitation of sewer systems in developing countries **65**
- John Cant
  Water Research Centre plc

WaterAid



The North Coast Superaqueduct Project **71**
- Thames-Dick Partners

Plenty of water ...in the wrong place **79**
- European Owens Corning Fiberglas SA

Distribution solutions **80**
- Georg Fischer Piping Systems Limited

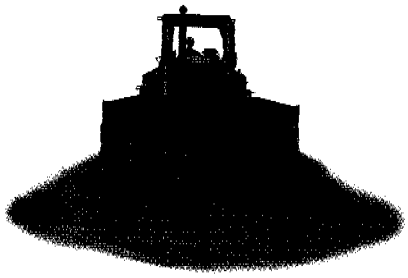
PUMPING AND VALVES

Pumps & Systems Asia '98 **81**
- HQ Link Pte Ltd

Trends and challenges in water supply technology **85**
- Dr Erich Holzhüter
  European Association of Pump Manufacturers

Where a drop of water is a piece of gold **89**
- Alexander Farnsworth
  New World Water

Taking a closer look at penstocks **95**
- David Lewis
  Biwater Industries Limited



Everywhere we go in the world we have a stabilizing effect.

Currently being installed in countries all over the globe, geosynthetics products from Synthetic Industries are engineered to meet the demands of today's construction.

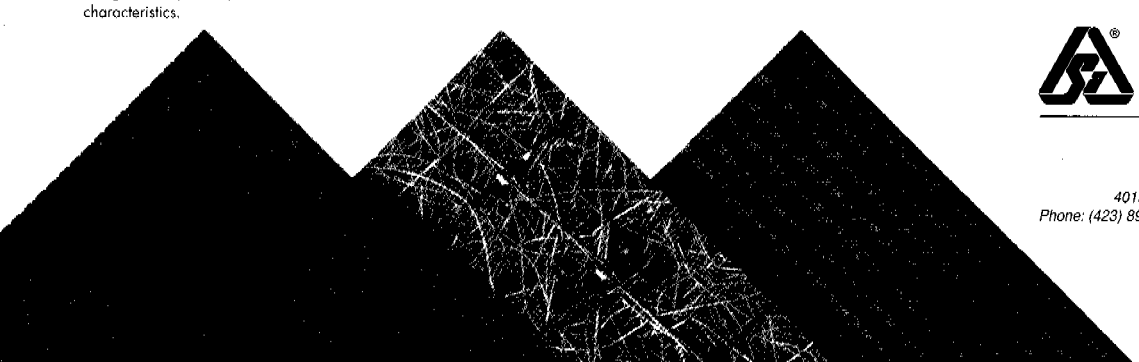
Our system of geotextiles offers innovative solutions for drainage, reinforcement, separation, and stabilization of soils and subgrades. It is widely used for roadway stabilization and landfill containment. Our *Landlok*® system of erosion control products provides the answer to temporary and permanent sediment concerns. And all of our manufacturing facilities have achieved ISO-9002 certification, assuring world-class quality.

Geotextiles

Geotextiles provide exceptional strength and superior hydraulic characteristics.

Synthetic Industries utilizes authorized distributors throughout the world. Together with our knowledgeable staff of professional engineers, we provide assistance in determining which products will best match the needs of your next project—whichever corner of the world you happen to be working on.

For more information, or to talk about distributor opportunities, you can contact us on the world wide web at www.fixsoil.com.



SYNTHETIC INDUSTRIES

Smart Solutions in Synthetics™

4019 Industry Drive, Chattanooga, TN 37416 USA
Phone: (423) 899-0444, Fax: (423) 899-7619, www.fixsoil.com

For further information circle 5

WaterAid

Uniquely-designed strainers and valves **99**
- Fluid Control Division, a United Dominion company

Centrifugal pumps for a host of applications **101**
- Weir Pumps Limited

DESALINATION AND FILTRATION

Desalination for the twenty-first century **103**
- Wayne McRae

GROUNDWATER AND WATER SUPPLY

Working together for safe drinking water **107**
- Bevin A Beaudet
  American Water Works Association

Drinking water supply and sanitation in Asia Pacific **110**
- Dr Ali Basaran
  World Health Organization
  Western Pacific Regional Office

Turf reinforcement mats for culvert and bank protection **115**
- Synthetic Industries Incorporated

Advance hydraulic rotary drilling rig **116**
- Soilmec Spa

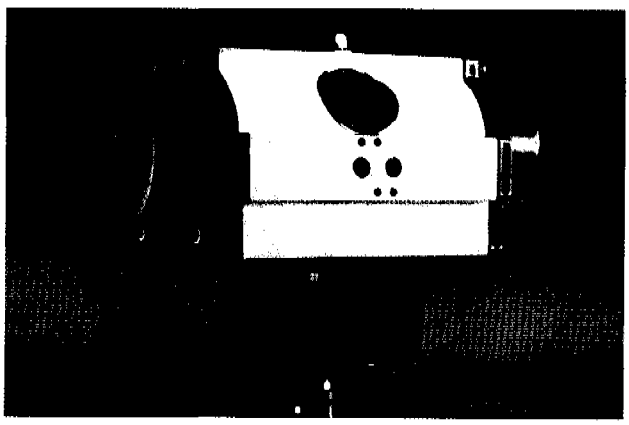
CONSULTANCIES

An action-oriented network for water resources development **117**
- Johan Holmberg
  Global Water Partnership

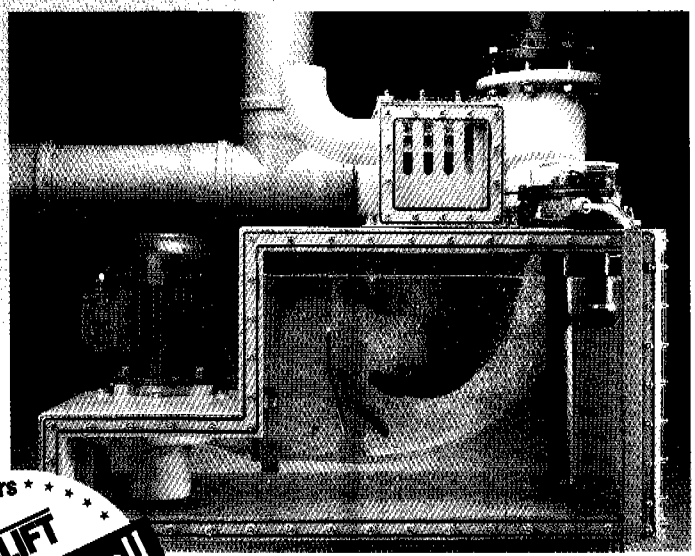
PRODUCT SHOWCASE **120**

PRODUCTS AND SERVICES **137**

ALPHABETICAL LIST OF ADVERTISERS **140**



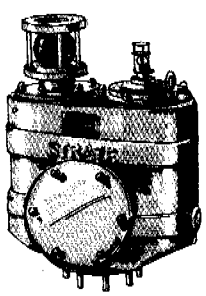
The Original!
AWALIFT
Sewage Pumping Stations.



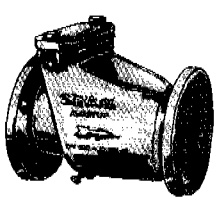
40 Years AWALIFT The Original! Sewage Pumping Station STRATE Manufacturers of Sewage Systems

STRATE AWALIFT sewage pumping stations are designed for use wherever there is no natural gradient to help the transport of sewage into the sewer network or to the sewage treatment works. What makes AWALIFT stand out from other systems is its special use of a centrifugal pump and a clogging matter container. This guarantees blockage-free operation and minimal maintenance costs.
For further details please contact:

BEV



AWASTOP



EVA

STRATE GmbH
Hildesheimer Straße 350
D-30880 Laatzen · Rethen
Phone 0 10 49 51 02 70 01-0
Fax 0 10 49 51 02 70 01-12

STRATE
Manufacturers of Sewage Systems

Doing things differently **in the sector**

General trends in the sector in the developing world include an emerging water crisis, persistent sanitation problems, growing urbanisation, decentralisation, increased involvement and responsibility of users, and privatisation. The IRC International Water and Sanitation Centre is responding to the challenge.

Jan Teun Visscher and Dick de Jong, IRC International Water and Sanitation Centre

The subject of water resources is now, for the first time, on the agenda of the Commission for Sustainable Development. The recent establishment of the World Water Council and the Global Water Partnership indicates a call for stronger collaboration to enhance sustainable water resources management and to match the interests of different stakeholders. Initiatives are also helping to put environmental sanitation on the political agenda, and new opportunities are emerging to generate employment and earn revenues from sector investments.

The 1994 Ministerial Conference on Drinking Water Supply and Sanitation in Noordwijk indicated that human resources development and a more human-centred approach are perhaps the most crucial areas for development in the sector. This meeting also embraced the important shift in the role of governments from provider to facilitator.

Whereas agreement exists at the policy level concerning the key principles for the sector, practice lags behind. A participatory review of 12 projects that were indicated by their supporting ESAs as being more on the forefront of development shows that:

- In most cases national governments have started to address water resources management (WRM), although often limiting their efforts to resource inventories and not to developing effective WRM policies
- While awareness about the fact that water is a limited resource is growing at national, regional and local levels very few cases report concrete measures taken to start managing water resources in a comprehensive way; only in drought-prone areas users address this issue themselves
- In most cases the strengthening of horizontal (inter sectoral) and vertical (national, district, local) co-ordination and co-operation of various actors is poorly developed
- Different interpretations exist of who is a stakeholder, sometimes at the exclusion of communities; it is better recognisnised that women play a major role in WRM, but a clear distribution between roles of men and women is not made
- Too little emphasis is given to the need of providing an enabling institutional environment for individuals to whom new tasks and responsibilities are given, and
- There is increased emphasis on water having an economic value; in many programmes discussions are underway on modalities of charging for water use, but water rights and legislation are problematic and controversial.

Governments and institutions are gradually initiating a process of change in which they adopt a more integrated and demand-responsive approach to problem solving, and are more willing to place emphasis on sustainable functioning and effective use of the systems. We see increasing interest by public sector agencies in participatory approaches involving the community in their attempt to do more with less financial resources. They develop, for example, links with NGOs which have been using similar types of approaches. Another reason why government agencies are searching for alternatives and are amenable to participatory approaches is that over the past two decades 'blue print' development strategies have been shown to be ineffective in meeting the basic needs of large numbers of marginalised, vulnerable people.

Given this situation today, the question many public sector institutions are asking is not why to adopt participatory approaches, but how to go about it. What is needed is a learning process that develops and promotes new methodologies and changes prevailing attitudes, behaviour, norms, skills and procedures within the agencies.

The fact that the majority of the development funding flows through government channels underscores the importance of finding ways in which public sector agencies can learn to implement participatory approaches effectively. Not only does the agency staff need to learn to work with communities and to overcome the top-down approach from the past, but the communities themselves also need to come to grips with working with the agency staff in a horizontal relationship. In the future the change will be more radical if communities are to pay a large share of the cost. Then the paradigm of communities participating in agency projects will shift to one of the agencies participating in community projects.

It is obvious that a shift in emphasis is needed and that it is essential to look at the sector in a holistic manner, integrating issues of sustainable water and sanitation, waste disposal, water resources management, land and water use, health and nutrition and hygiene behaviour. The complexity of the problems involves potential conflicts between individual users, different sectors and between neighbouring states. Some of these conflicts are worldwide such as those related to possibilities of industrial production moving to locations where pollution legislation is least demanding. Against this background some important issues need to be high on the political agenda:

- Setting objectives and indicators with the stakeholders
- Effectively introducing the 'polluters pay' principle
- Adopting a learning perspective in capacity building and technology sharing
- Applying a gender-specific approach by taking into account that men and women have different interests, responsibilities, access to, and control over, resources
- Creating or strengthening platforms for decision making and resource negotiation, and
- Increasing funding that can be better accessed by communities to reduce the gap in water supply and sanitation coverage.

IRC's contribution

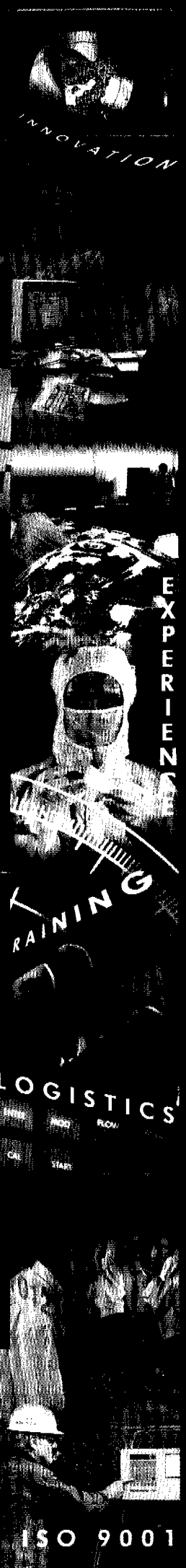
The IRC International Water and Sanitation Centre is an independent non-profit making organisation based in The Netherlands. It was established in 1968 as a reference centre, global publisher and information clearing house for sector information. It gradually evolved to a sector resource centre by adding research, publications, training, advisory services and advocacy to its work. UNICEF, the UNDP/World Bank Water and Sanitation Program, the World Health Organisation, the Secretariat of the Collaborative Council and The Netherlands Government are represented in its Governing Board.

The specific subject areas of IRC's expertise include: community-based water supply and sanitation technologies (rural and urban); participation and community management; gender awareness; hygiene promotion; operation and management; monitoring and evaluation; information management; and water resources management.

Most of IRC's end products are developed together with, and for use by, staff from government agencies and NGOs and help them to guide processes at community level. Developing these products together with staff from sector agencies in the countries in question implies that knowledge and capacity is being developed that remains in these institutions and can further support sector development. The IRC staff follow three key working principles that make an important contribution to capacity building in the sector: they act as facilitators, work with partners on an equal basis, and create learning opportunities.

IRC will build on the Internet and the World Wide Web and is promoting the development of a 'virtual library' for the sector: it will also act as a help-desk for sector professionals. ●

ELGEF® Plus –
Your plus for PE systems.
Extensive, economic, safe.



The complete PE electrofusion system for gas, water, waste water and industrial applications:

- couplers
- reducers
- elbows
- tees
- caps
- saddles
- pressure tapping valves
- transition fittings
- MSA control units

Fax or call us – we would be glad to send you our full documentation.

ELGEF® Plus – Grip the future.

Excellence in piping systems

Georg Fischer Piping Systems Ltd., CH-8201 Schaffhausen/Switzerland
Tel. +41 (0)52-631 11 11, Fax +41 (0)52-631 28 14
e-mail: piping@georgfischerpiping.com
Internet: http://www.georgfischerpiping.com

GEORG FISCHER +GF+

Fi 2241/4

South Africa: **partaking in progress**

South Africa is still persevering on the road to a better life for all — and successfully so. The Department of Water Affairs and Forestry has identified neglected areas in the supply of adequate water and sanitation services and has already repaired some of the past wrongs.

A M Muller, *Department of Water Affairs and Forestry*

In the period following South Africa's first free and fair election, tremendous changes took place — changes that would work toward a better future. This is also true for this Department, where many goals have already been reached. As part of a Departmental transformation, a new Community Water Supply and Sanitation Programme was established.

Community water supply and sanitation

In September 1994, the Department was authorised to start 12 Presidential Lead Projects (PLPs) at a cost of R282 million. The PLPs are large projects which, when complete, will serve 1,237,000 people. Some were ready to begin and some still had to be designed, but all needed to engage the communities involved in their management and implementation. The smallest village project takes a minimum of 12 months. Four PLPs have been completed and a further four are already delivering water to parts of their target communities.

There is now R1585 million allocated to 706 specific projects to ensure that a total of 6.4 million people gain access to basic water supplies and 100,000 to adequate sanitation.

By September 1996, R265 million had actually been spent on project implementation with 600,000 people already receiving basic water supplies. Some of these projects have been implemented in areas of the country where poverty and poor administration have proved major burdens. Fifty eight separate villages were supplied as part of the Transkei PLP, benefiting more than 100,000 people in this poorest part of the country.

Co-operative water resource management

On the regional front, there has been a concerted effort to make contact with neighbouring countries with whom we share river systems. The establishment of a formal joint water commission with Mozambique is an example. Another highlight was the conference of SADC Ministers involved in water resources management.

The planning of the development of water resources continued, with particular focus on some of the larger water systems, namely the Vaal, Orange and Mgeni systems. The Orange River replanning study will guide the provision of water to the five provinces in the heart of the country for the next 30 years. Emphasis was placed on public participation in the planning process.

Construction and development

The implementation of major projects was constrained by financial factors and new ways and means are being sought to finance projects off-budget. The use of water boards, which are public utilities, receives special approval to raise such finance from the public sector.

Excellent progress was made with joint international projects between South Africa, Lesotho and Swaziland. Phase 1A of the Lesotho Highlands Water Project will be completed as scheduled, despite tragic labour disputes. Initiation of Phase 1B is also on track. Decisions on future phases will depend on the results of planning studies and also on the establishment of an implementation framework that ensures that the interests of all parties are adequately addressed.

Construction of the Driekoppies dam on the Komati is also approaching completion, permitting further expansion of irrigated agriculture in the Mpumalanga lowveld. Agreement has recently been reached with Swaziland on the second phase of the Komati project, the construction of the Maguga dam inside Swaziland. Water from this will be shared between the two countries and the project will ensure that Mozambique receives its share of Komati water.

The completion of the first phase of the Injaka dam and associated Sabie-Sand transfer means that the residents of the Bushbuckridge area will not face the collapse of water supplies in dry years again, while completion of the Qedusizi dam will protect Ladysmith from a further recurrence of the floods which have devastated communities repeatedly.

Procurement and construction approaches on these projects have been adapted to increase job creation and to provide opportunities for black entrepreneurs. In the community water supply programme alone, far more than 6000 person/months of paid employment were created and more than 15,000 person/days of training had been given.

Permits, subsidies and social transformation

The Department is responsible for the granting of permits to build dams, allocations of water from them and subsidies to support their construction. Historically, these activities have benefited parties which have the means to exploit them. This has been changed.

In northern Kwazulu/Natal, an area not known for its political tolerance, a remarkable coalition of interests is

being formed between the white farmers of Pongola and the thousands of rural residents. To enable the irrigated farming areas to expand, the Department has authorised, and partly funded, the construction of the Paris dam.

In exchange, the farmers have agreed to make a substantial portion of land available to 70 black farmers and to use the water of the dam first for water supplies to the surrounding communities. This is in addition to those directly affected by the dam, who are compensated under a separate programme. The difficulty of negotiating such arrangements are immense, but hopefully a win-win situation has been created for all the communities of the region.

Similarly, in the Northern Cape, an allocation of water will be made to the residents of Schmidtsdrift, who have returned to their land from which they were removed to make way for a military training ground. Since they were not on the land when permits for the water available in the Lower Vaal Government Water Control Area were allocated, they have no access to the water they will need if their land is to provide a livelihood.

Conservation

Poor communities will not gain, and equity and reconstruction in the country will come to nothing if a nation's scarce water resources are not husbanded. A new culture is thus required in which the water is valued not as a commodity for the enjoyment of the few but as the basis of life for all.

The promotion of a culture of conservation has been an important objective of the first two and a half years of the new government. The 'working for water' project to remove alien vegetation and reduce unnecessary water losses in sensitive catchment areas involves local communities and provides jobs and training. A much broader consciousness of the need to conserve water has been promoted. This has enabled other initiatives to move forward. A national tariff policy has been approved by the Cabinet, which recognises the economic value of water, and new tariffs based on this policy are already in force. A a pilot urban conservation project has been started in Hermanus and a host of other activities are being undertaken by other agencies.

International co-operation

The Department of Water Affairs and Forestry has one of the largest programmes of international co-operation. South Africa's first concessionary loan agreement since the 1960s was signed in 1996 with Japan's Organisation for Economic Co-operation Fund and it is already being disbursed, to augment bulk water supplies to the area of former KwaNdebele where a contractor recently moved onto site.

Over the past two and a half years, South Africa has had the benefit of visits from world leaders in the fields of geohydrological mapping, water conservation and social forestry.

Building the legal foundation

A major focus is currently the review of South Africa's water law. This will enable the country to deal effectively with the growing pressures resulting from increased water demands, which have to be met from the same limited and finite resources. The water law review will establish a framework consistent with the Constitution in supporting the public interest, as well as the rights and obligations of all parties. More specifically, it will actively promote the values enshrined in the Bill of Rights.

Consultations have demonstrated that, throughout the world, governments have had to facilitate the reallocation of water from one use to another – that what may have been regarded as permanent rights of ownership of water are in fact uses permitted by the State as custodian of the resource. Although this is a complex area, a great deal of work is being done, both inside the Department and by other stakeholders.

Since the 1994 White Paper on water supply and sanitation established broad policy for what are recognised by the Constitution as 'water services', legislation in this area will proceed. A draft Water Services Bill was prepared by the end of February 1997. The Bill is supportive of local government as the sphere of government responsible for service provision. It also enables central government to ensure that basic norms and standards are achieved in this vital area of national life, as is demanded by the Constitution.

A feature of the approach to be taken is that we will not be proposing the creation of a new Water Regulator, but rather promoting a form of 'developmental regulation' which will support local government in its efforts to plan and provide services on a sustainable ongoing basis. These regulations will also permit the ordered entry of the private sector into water service provision.

Maintaining the pace of delivery during the consultations on the water law review, it became obvious that more rational water management arrangements will only gain popular support if the benefits are shared with all. It is thus vital that the Community Water and Sanitation programme continues to address, in a targeted way, the backlogs in access to this basic service.

This planning is intended to guide investment in the sector to ensure that the Government's policy of addressing basic need first is implemented effectively. One problem is that there is no system of multi-year budgeting. The Department has outlined a programme of investment focused on the rural areas where the bulk of present day need is found. This will address the water services backlog by 2004 and planning is proceeding on this basis. The allocation of funding for the 1997/8 budget has enabled another set of projects to be initiated in 1997, with an estimated cost of R900 million. ●

A M Muller is Director General, Department of Water Affairs and Forestry, South Africa.

Innovative water **and sanitation solutions**

WaterAid works to support sustainable, community-managed solutions to the water and sanitation problems of the world's poor. Community involvement is an important aspect of WaterAid's approach.

Doreen Walton and Nick Fairclough, WaterAid

WaterAid's work over the past 16 years has enabled nearly 4.5 million people to gain access to safe water. We are committed to working towards a world where everyone has access to clean water, and one in which people do not jeopardise their health every time they have a drink.

WaterAid's approach to solving water and sanitation problems hinges on three important features. The first recognises that, to be truly sustainable, any project should ultimately aim for a situation where indigenous organisations can start to work without outside help. WaterAid passes on knowledge, skills and funds to local partner organisations who implement projects and continue to maintain and monitor them long-term. Secondly, all members of a community involved in a project, both men and women, are given a chance to participate in identifying their own needs and allocating their available skills and resources. This creates a sense of ownership and empowerment leading to self motivation. Thirdly, water, sanitation and hygiene education activities are integrated for greater impact on health.

WaterAid forms partnerships with local government bodies or non-governmental organisations (NGOs). A 'partner' may specialise in water supply, primary health care, rural education, urban poverty or a combination of these. They also have crucial skills ranging from understanding local government to speaking dialects.

WaterAid provides the financial and technical contributions and advice, and helps partners to develop their own organisational capacity. Support might include training scholarships for key staff in management or fundraising. The relationship sometimes appears unequal from the partner's point of view, particularly if they are heavily dependent on funding. Monitoring requirements can seem inflexible or compromising to the partner. So mutual respect and feedback are crucial to allow the partnership to strengthen.

Since 1984, WaterAid's approach has evolved away from using 'technical only' expertise in combating problems. Local people are consulted and simple, appropriate technologies are used.

The commitment required for ongoing success comes when the whole community and their wishes have been respected and they feel a sense of ownership of the project.

Water alone is not enough

Access to clean water only has a limited effect unless it is accompanied by good hygiene behaviour. The World Bank estimates that almost 30 per cent of disease in the developing world overall is linked to poor hygiene practices and sanitation in the home. Safe water can quickly become unsafe if people do not have adequate sanitation facilities or the chance to learn about hygiene. WaterAid always tries to tackle water supply, hygiene education and sanitation together, to make a greater impact on health.

WaterAid-funded projects always include some form of hygiene promotion, often targeted at children. Hygiene specialists give advice on sanitation and training may be provided for health educators. Young people have proved to be invaluable communicators in this area, especially where there is widespread illiteracy among adults. WaterAid's 'Child to Child' campaign recognises that young people are more open to discussing and changing their hygiene habits. They educate younger siblings -and ultimately the whole community.

Two African case studies

Projects in 2 of the 13 countries in which WaterAid works demonstrate how WaterAid's approach to the challenges of solving water and sanitation problems can be adapted to two quite different areas of the world.

WAMMA: A Government/NGO partnership. The WAMMA programme in Tanzania shows how a Government/NGO partnership can be effective in delivering powerful support for communities. Since 1991, 270,000 people from 86 communities in the Dodoma region of Tanzania have gained access to water. During this period, the villagers themselves have raised the equivalent of £25,000 (US$40,000), demonstrating the motivation, resulting from empowerment, of the communities involved.

For many years in Tanzania, water was regarded as a basic service to be provided by government. But the government water projects were unsustainable. Many villages had deep boreholes equipped with pumps and diesel engines which should have been maintained by government using central funds. During the economic downturn of the 1980s they were neglected, leaving in a legacy of distrust among villagers for government programmes. Introducing the concept of payment for dependable services was particularly difficult.

Teams of government fieldworkers were formed mainly of men and women from the Water, Health and Community Development departments. Most were demotivated by low

pay and poor job satisfaction, and lacked practical experience. Initially they behaved directively towards the villagers, being used to the top-down, directive government management style. Many of the fieldworkers found it hard to understand why they should respect the views of the community because they had worked so hard to 'pull themselves up' from the village. However, it was possible to empower these fieldworkers by involving them closely in the decision making process. They then responded by empowering the communities they worked with.

Support for the WAMMA teams from their government departments was sometimes disappointing. But line managers started to take greater interest when the work being done by their field staff led to real success and enhanced credibility for their department. This also increased respect for fieldworkers and enthusiasm for the participatory approach. Participation of government staff was eventually institutionalised, by formalising project links with senior managers. This was done at a stage when fieldwork was well established and producing visible results, when the participatory integrated approach had been accepted by the government staff, and when lack of support from managers was blocking further programme development.

Several factors helped the partnership to grow successfully:

- Tanzania's National Water Policy, adopted in 1991, explicitly permits a community-based approach to water supply
- Sufficient, appropriate resources were available enabling community development to be given a very high profile; this included WaterAid staff who were experienced in working in participatory methods
- The government and NGO/donor were patient, allowing time for training and for experience and links to develop, rather than pushing for quick results; it was emphasised by the WAMMA teams that continued WaterAid support would be necessary for some time, and
- The coverage and long-term support provided by the government, combined with WaterAid's expertise and experience, created a powerful agent for change.

The Hitosa community managed water supply scheme. Only 19% of rural Ethiopia has access to safe water and most of the population still obtains water from unimproved sources. Since work began in early 1993, over 62,000 people in the Hitosa region of Ethiopia have been supplied with safe water through WaterAid-funded projects. A 140km long pipeline delivers water for human consumption, from two springs on Mount Bada, to 31 villages and three small towns. The project includes 24 reservoirs and tanks, and 122 waterpoints as part of an enormous gravity-fed scheme delivering water at the rate of 25 litres per head per day. The whole system is managed by the benefiting communities.

A project even of such a large scale is a model of community management due to the peoples' commitment to take on responsibility for managing, maintaining and financing the scheme. Enthusiasm and trust characterise the relationships between local people and the partners. This has been of enormous benefit as elaborate planning has been required to ensure equal work is put in by all members of the communities involved. From the beginning, the objective has been for the user community to manage the whole scheme after construction. In the words of a village leader at Boru Jawi 'It is like our house. We have to be responsible for our family, so we should be responsible for our water'.

The local people dug their own trenches for the distribution lines servicing the villages and were consulted about the location of standpipes, and other design features. Each village formed a voluntary water committee and elected two men and three women to be trained in technology, hygiene and management, with a possibility of being selected to be a paid tap attendant, labourer or member of the Water Administration Office. Initially the water committee organised labour and financial contributions from the villagers, ensured security, and co-ordinated public meetings and community attendance for health education sessions.

Two members of the water committee from each village were chosen to meet as the Woreda (Regional) Water Management Board. The Board has been responsible for managing all aspects of the water supply, including finances, and support and training for all staff. The Board employ the Water Administration Office which consists of six village trainees who received further training in management and technology. The Office now manages the tap attendants, and carries out day to day management and maintenance of the water supply.

The complex management system is successful because the benefiting communities understand and are involved in the project. Communities above the spring first objected to water being carried away. After careful negotiation and explanation that their supply would not be affected, they were happy for the scheme to go ahead, once provided with a tapstand and ensured that charges would not be introduced. The community organiser was extremely effective in communicating with and listening to the local people.

The major limiting factor for community participation was a lack of transport for the community organiser who was not able to visit all the villages to hear feedback as often as desirable. Despite this the village water committee members are now happy with the responsibility of community management. ●

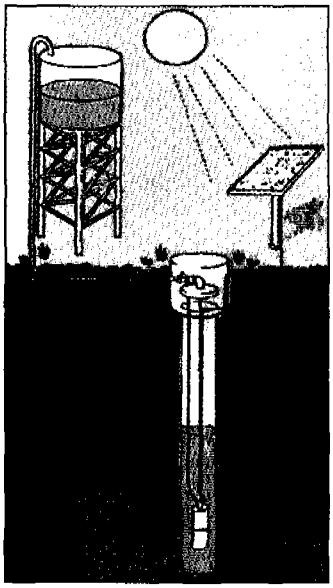
Doreen Walton works in WaterAid's communications department. She has previously worked overseas and has specialist knowledge of water and sanitation issues and technology.

Nick Fairclough is WaterAid's newly appointed Press and Publicity Manager.

How to pump more water for less money.

With the new SOLASTAR submersible solar powered water pumping system

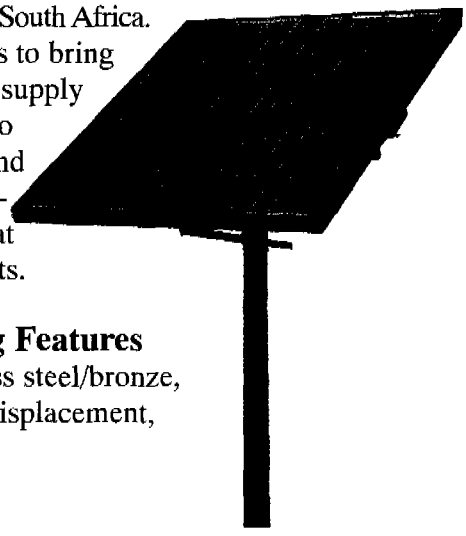
High efficiency, low maintenance and total reliability make Divwatt's SOLASTAR a natural winner. And what's more, this range of solar powered pumps is specifically designed for rugged reliable use.



Product of the Year

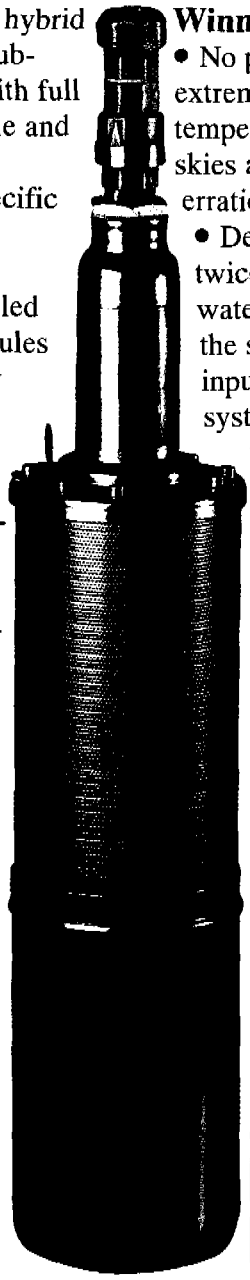
WINNER TOP PRODUCTS 1996

That's why Divwatt's SOLASTAR won Engineering Weeks' prestigious "Product of the Year" in June 1996 in association with the Engineering Society of South Africa. It promises to bring a reliable supply of water to farmers and rural communities at lower costs.



Winning Features

- Stainless steel/bronze, positive displacement, piston/diaphragm hybrid type cylindrical submersible pump with full length power cable and connector
- Application-specific DC powered submersible motor
- Factory assembled photovoltaic modules boosted by highly efficient solar electronics
- Compatible with all 6" diameter and larger boreholes
- Minimum starting torque due to its mechanical design (patent pending) and patented built-in electronic auto start circuit
- Can run "dry" indefinitely without water passing through the wethead – important in boreholes with fluctuating static water levels

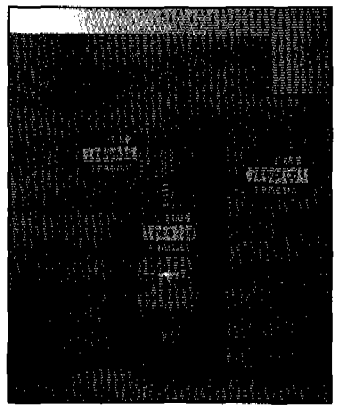


Winning Benefits

- No problems handling extreme ambient temperatures, overcast skies and deep and erratic water tables
- Delivers about twice the volume of water per day with the same energy input as other solar systems and many times that of windmills – notable at pumping heads deeper than 75m
- Flexibility – designed as a modular system to suit different water requirements and borehole depths (1-150m; 2 000-20 000ℓ per day)
- Starts at first light
- Unique 2 year guarantee – double the industry standard
- Designed for zero maintenance for a 7 to 10 year period
- Compact packaging – easy to send to remote areas
- Quick installation by unskilled labour with a spanner and screwdriver
- Low purchase price per volume of water delivered

Applications

- Agricultural areas – for cattle, sheep, goats, game farming and parks
- Subsistence water supply for communities, schools and clinics.



SOLASTAR

For more information on SOLASTAR, please fill in this coupon and fax/mail it to Divwatt at the below address, or phone (Int) +27 11 794-3825.

Name: _____

Address: _____

_____

Tel No.: (code) _____

Postal Address: _____

_____

_____

DIVWATT

Agricultural Holdings 313, Boundary Rd
Northriding, Randburg, Gauteng.
P.O. Box 3926, Honeydew 2040, South Africa.
Tel: +27 11 794-3825/6 Fax: +27 11 794-1244
email: divwatt@iafrica.com
web site: http://www.divwatt.co.za

For further information circle (15)

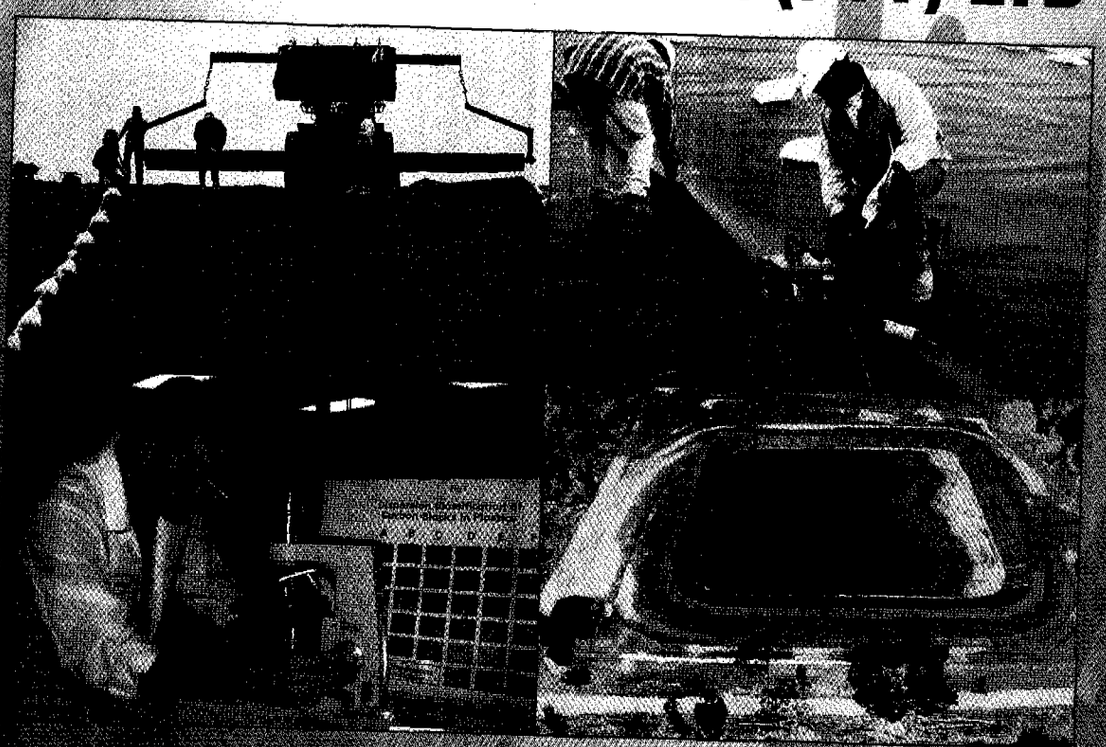
single point RESPONSIBILITY

Tel: +27 - 12 - 660 1616
Fax: +27 - 12 - 660 2093
e-mail: gast@iafrica.com

PO Box 9516,
Centurion, Pretoria,
South Africa, 0046

1961

GAST INTERNATIONAL (PTY) LTD



applications include leachpads, sludge ponds, dam , land fills, certain walls, & secondary containers. We time to QA-QC anywhere.

GSE

The Zero Risk Option

GSE MEMBRANES

Geosynthetics: technological advance in protecting the environment

Geosynthetics are contributing in a large way to reducing or minimising the negative impact of man's activities on the environment. A number of case studies are available on request.

Gast International (Pty) Limited*

The last decades have seen impressive progress in geosynthetics technologies and applications and substantial development of testing and design methods. The principle component of these lining systems is a geosynthetic membrane ranging from 0.5mm to 6.00mm in thickness. More complex liner systems may consist of several membrane liners interlaid with geosynthetic clay liners, geotextiles, reinforcing geogrids and drainage materials. The flexible geomembrane lining panels are generally welded together on the customer's jobsite using either an extrusion or a fusion (hot wedge) process. The welded seams are tested both on site and in a private laboratory to form part of a comprehensive quality assurance/quality control (QA/QC) document.

A wide variety of products have been developed to provide environmental lining solutions. These include geomembranes, geonets, geocomposites, vertical barrier systems, concrete protection systems, geosynthetic clayliners, concrete attachments and other prefabricated products. Various types of resins, including, for example HDPE, FPP and other polyethylene configurations such as very flexible polyethylene (VFPE) have been developed and have proven to be highly successful in the specific applications for which they have been developed. These resins can be used to manufacture geomembrane with a smooth surface or with texture on one or both sides to improve the friction factor and safety on steep slopes. These products can also include a white or other colour surface, as well as other characteristics such as a spark-testable conductive side for non-destructive testing of the entire surface of the sheet after installation. The geosynthetic industry has provided successful environmental lining solutions for containment, prevention of ground water contamination and environmental damage in the following fields:

- Hazardous waste landfills
- Landfill caps
- Heap leach pads
- Storage and treatment ponds
- Dam liners
- Evaporation, ash and sludge facilities
- Canals and recreation facilities
- Sewage lagoons
- Vertical curtain walls
- Secondary containment systems
- Solid waste landfills
- Floating and suspended covers
- Overflow and rinse ponds
- Methane barriers, and
- Subways and tunnels.

Manufacturing QA

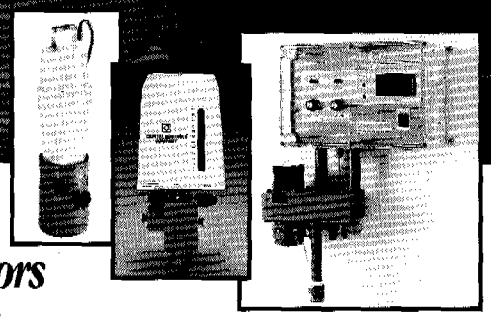
QA is of vital importance during the manufacturing process. Conventional round die extrusion has been upgraded and improved to have co-extrusion capabilities. The unique 'flat-cast' extrusion method was developed by the world leading manufacturer, GSE (Gundle/SLT Environmental Incorporated). This method is controlled by a fully computerised control system which monitors parameters, pressure, speed, thickness and sheet quality. On completion, a sample is taken from each manufactured roll for testing and a roll test data sheet is issued. This forms part of a QA/QC document which is handed to the client on completion of the project, complete with 'as-built drawings'. GSE also developed a system by which each roll of material is 'finger printed'. This means that it can be traced back to exact date of manufacture, resin lot number, and so on, which enables the end user to have a method to trace the data on a roll of installed materials any time in the future, even if he no longer has the 'as-built drawings'.

Installation QC

The installation QA technicians are independent of, but work closely with, the appointed installation crew. As the liner is installed, the QA technicians undertake a four-step QC procedure. First welding is performed by experienced technicians extensively trained in the use of seaming equipment. A number of trial welds are carried out on 'test weld' sheets of ± 3m in length. Each trial weld is tested, and only once the optimum weld is achieved is the technician allowed to proceed with welding on the actual liner. This procedure is repeated after every stoppage. Second, all weld seams are visually inspected. Third, non-destructive tests of all weld seams are done to verify there are no defects. Finally, random coupon samples of completed welds are tested, with a tensiometer on site, for peel and shear strength to ensure the weld complies with the specific seam properties. All day activities, trial welds, tests and welds are noted down in the QA/QC document and witnessed by the resident engineer or other responsible party. ●

*This article was written by GJ Muller, Director of Gast International (Pty) Limited.

Capital Controls



Your Ultimate Source for...

Disinfection Equipment

Industry-leading disinfection equipment for water, wastewater, and industrial process applications.

Our offering includes all-vacuum ADVANCE® gas feeders for proven safety; the CHLOR-A-VAC® chemical induction unit for efficient mixing and reduced chemical costs; safe and economical on-site generation systems for sodium hypochlorite and chlorine dioxide; and ultraviolet disinfection systems.

Water Quality Monitors

The most comprehensive line of water quality monitors for water, wastewater, and industrial process control.

Ask us about our reliable, maintenance-free AZTEC® monitors for continuous on-line water analysis of ammonia, phosphate, nitrate and other parameters; and chlorine residual analyzers for stable, accurate and cost-effective measurements.

Instrumentation

Process control and safety instrumentation preferred worldwide for recording variables, detecting gases and weighing.

We offer chlorine, sulfur dioxide and ammonia gas cylinder scales; a complete family of chlorine or sulfur dioxide gas detectors; process controllers; and circular chart recorders.

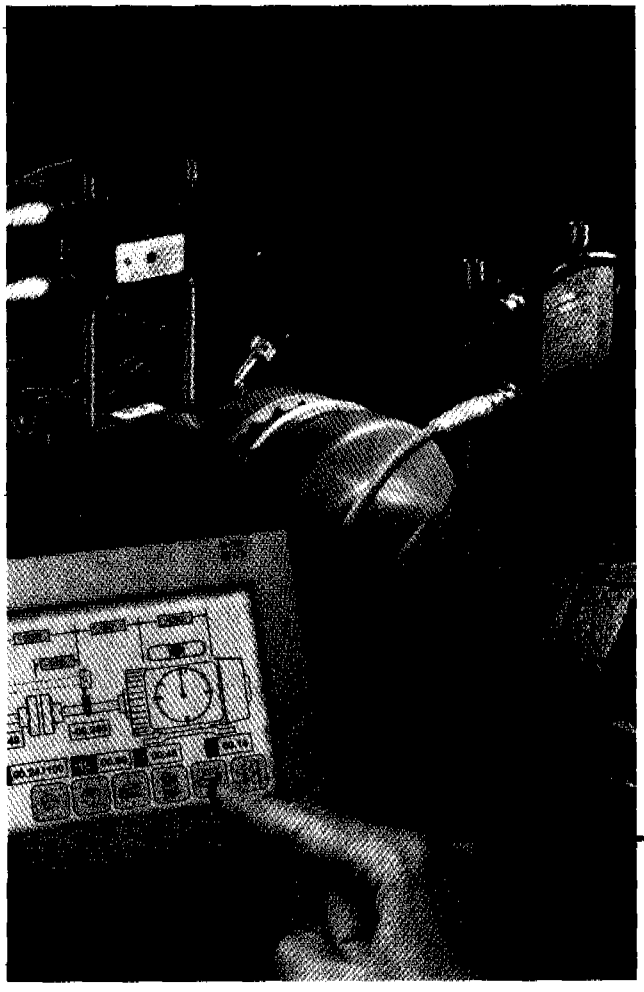
The Capital Controls Group™
Worldwide Water Quality Solutions

3000 Advance Lane Colmar, PA 18915 Tel: 215-997-4000
Fax: 215-997-4062 e-mail: marketing@capitalcontrols.com

Capital Controls is unequaled for its reliability, safety and quality. Our off-the-shelf delivery, comprehensive network of service experts, and ISO-9001 standards make us the preferred choice worldwide. When you need disinfection and monitoring equipment, go right to the source. Capital Controls. Call or visit us on the Web.

Via the Web: www.capitalcontrols.com

For further information circle (17)



TOUCH ME!

The world's first touchscreen alignment systems
The world's easiest alignment systems

We think so. So easy to learn, you'll be doing alignment right out of the box. The Fixturlaser Shaft 100 and 200 are the new generation of shaft alignment systems putting the user in focus. Easy-to-use programs for alignment of horizontal and vertical machines, machine trains, offset mounted machines and functions for softfoot measurement, thermal growth compensation and base bound or bolt bound solutions.

Full documentation facilities with permanent memory and printer support.
Easy, accurate shaft alignment saves money! Talk to a Fixturlaser representative and get all the details. You can touch the future of shaft alignment now!

FIXTUR LASER
Alignment has never been easier!

FIXTURLASER AB, ÖSTERGÅRDSGATAN 11, S-431 53 MÖLNDAL, SWEDEN PHONE: +46 31 706 28 00
E-mail: info@fixturlaser.se, http://www.fixturlaser.se

For further information circle (18)

An industrial wastewater register **for the city of Adana in Turkey**

Since 1994, the Turkish Ministry of the Environment has obliged all industries to comply with the national wastewater discharge standards. This requirement led to the German-financed Adana Wastewater Feasibility Study, the results of which are presented here.

Clemens Wittland, GKW Consult GmbH

With a population of more than one million inhabitants, Adana is the fourth largest city in the Republic of Turkey. It is located on the Eastern Mediterranean Coast, in a highly industrialised area which specialises in cotton and the corresponding textile and vegetable oil processing industry.

Within the framework of the Adana Wastewater Feasibility Study — financed by the German financing agency Kreditanstalt fur Wiederaufbau (KfW) and finalised early in 1994 — the requirement for the correct measurement of industrial wastewater discharges has led to the need for detailed investigation of the industrial sector.

Due to financial restrictions, an Amendment Study financed by the European Investment Bank (EIB), was carried out in 1996 in order to investigate alternative solutions, especially related to the concept of two separate wastewater treatment plants, one for Adana West and one for Adana East. Within this amendment study the industrial wastewater situation has been revised and significant improvements have been observed.

The main objectives of the study were:

- To investigate the industrial wastewater situation of the city of Adana, and
- To define an appropriate concept for future industrial wastewater management.

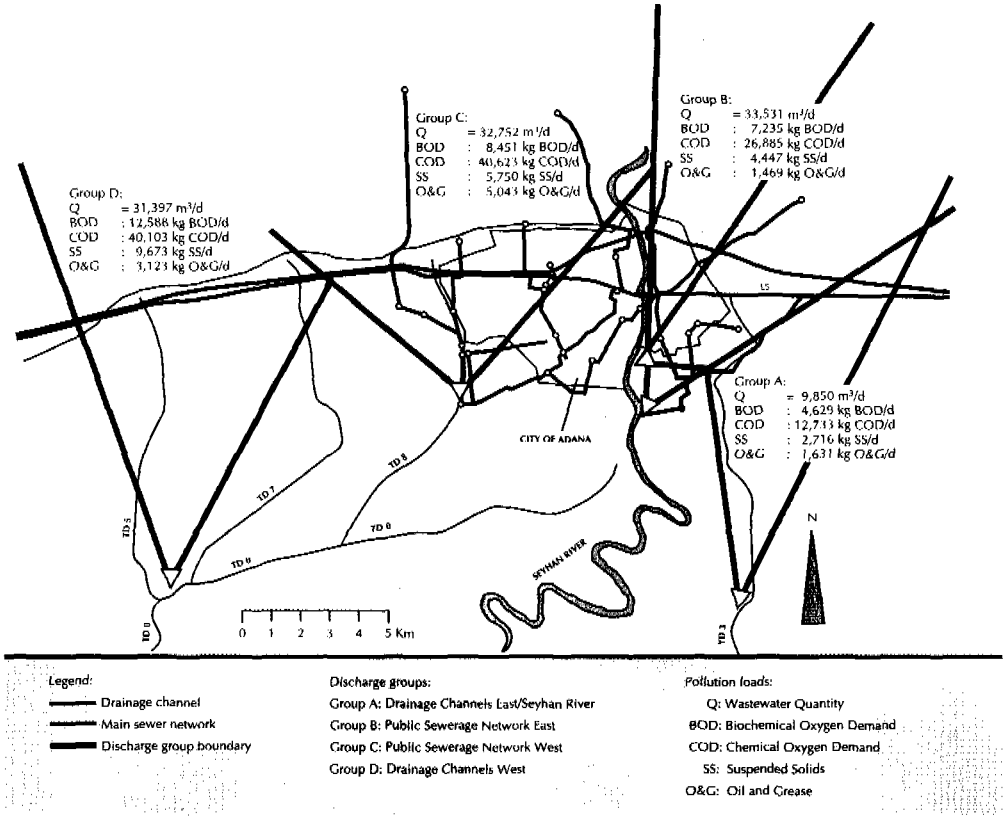


Figure 1. Local distribution of wastewater discharges and pollution loads

Industrial wastewater register

The industrial wastewater register project has been subdivided into the following five phases:

Phase I: data collection. The main objective of the data collection is to register all relevant industries within the project area. This comprises the collection of all relevant information about these industries available at public authorities and institutions related to the industrial sector and the corresponding water and wastewater quality control.

Phase II: preliminary evaluation. The main objective of the preliminary evaluation is to draw up a priority list on the basis of the data collected within the first phase. Since this evaluation is based on data obtained from authorities and institutions, as well as on key documentation on pollution, this step is called preliminary evaluation, as it has to be verified by means of the results of the following phases, before the final evaluation.

Phase III: inspection of pre-selected industries. The main objective of the inspection of individual industries is to verify the results obtained within the framework of the preliminary evaluation, by means of a detailed examination of pre-selected individual companies. The inspection of these companies has been carried out on the basis of a detailed questionnaire.

Phase IV: industrial wastewater analysis programme. The main objective of the industrial wastewater analysis programme is to verify the specific industrial wastewater quality by means of on-site and laboratory analysis. Furthermore, the analysis campaign forms the initial step for the implementation of a long-term industrial effluent-monitoring programme.

Phase V: final evaluation. The main objective of the final evaluation is to identify and characterise the most important individual industrial water pollutants, as well as to obtain a general overview of the total industrial wastewater situation in terms of wastewater quantities and specific pollution loads.

Industrial wastewater management concept

Based on the results of the above register, the future concept for industrial wastewater management, that is, the collection, treatment and continuous control of industrial effluents, has been drawn up.

The main factors for the definition of the appropriate industrial wastewater management concept were:

- The location of large water-polluting industries
- The potential discharge of toxic pollutants
- The technical capacity of the industries to operate and

Industrial Sector	No. of Industries		No. of Employees		Wastewater Quantity		BOD Load		COD Load	
	–	%	–	%	m^3/d	%	kg BOD/d	%	kg COD/d	%
Textile Manufacturing Industry	123	21.0	21,819	43.8	58,406	54.3	17,993	54.7	69,762	58.0
Raw Cotton Processing Industry	39	6.6	1362	2.7	210	0.2	21	0.1	50	0.1
Vegetable Oil and Soap Industry	30	5.1	8812	17.7	25,296	23.5	8415	25.6	35,564	29.6
Metal Industry	162	27.6	6442	12.9	3835	3.6	440	1.3	950	0.8
Chemical Industry	35	6.0	1303	2.6	3577	3.3	423	1.3	895	0.7
Food Industry	46	7.8	3,363	6.7	9,332	8.7	5,468	16.6	12,543	10.4
Wood Processing Industry	59	10.1	1149	2.3	115	0.1	23	0.1	46	0.0
Soil Products Processing Industry	81	13.8	4079	8.2	5330	5.0	48	0.1	391	0.3
Others	12	2.0	1539	3.1	1429	1.3	71	0.2	143	0.1
Total	**587**	**100**	**49,868**	**100**	**107,530**	**100**	**32,902**	**100**	**120,344**	**100**

Table 1. Wastewater quantities and pollution loads of different industrial sectors

supervise on-site treatment facilities, and
- The technical capacity and advantages of centralised industrial effluent control.

Study results

The main purposes of the implementation of the industrial wastewater register are:

- The identification of the most relevant industrial sectors
- The identification of the highest polluting individual industries
- The determination of the corresponding wastewater amounts and pollution loads, and
- The local distribution of these wastewater amounts and pollution loads.

The main results of this register related to the total industrial sector of the city of Adana are shown in Table 1.

The three main industrial sectors in Adana are the textile industry, the vegetable oil and soap manufacturing industry, and the food industry.

Another essential result of the register was the fact that out of nearly 600 individual industries the most important 18 individual industries are responsible for the following percentages in terms of wastewater amount and pollution loads:

- Total industrial wastewater amount: 57.2
- Total industrial wastewater BOD-load: 62.3
- Total industrial wastewater COD-load: 65.5
- Total industrial wastewater suspended solids load: 65.9
- Total industrial wastewater oil and grease load: 77.0

The local distribution of industrial wastewater discharges and pollution loads is shown in Figure 1.

Based on the general findings of the industrial wastewater register, the initial concept for future industrial wastewater management in 1994 envisaged the connection of all major industries to one central wastewater treatment plant for the city of Adana.

Subsequently, the amendment study carried out in 1996 in order to investigate alternative, more cost-efficient but environmentally sustainable, solutions led to the concept of two separate wastewater treatment plants — one for Adana West and one for Adana East. Within this amendment study the industrial wastewater situation has since been revised and the following significant development observed.

Since 1994, the Turkish Ministry of the Environment has obliged all industries to comply with the national wastewater discharge standards. Comprehensive efforts to encourage industries to implement individual on-site wastewater

treatment facilities have led to significant improvements in the industrial wastewater situation.

These efforts resulted in investigation, design and construction activities for the implementation of individual industrial wastewater treatment plants, with a certain number of plants already being put into operation in 1995 and 1996.

This significant development in the industrial sector has led to essential cost savings for the overall wastewater treatment concept, mainly due to the fact that the hydraulic and the pollution load of industrial effluents to be connected to the public wastewater treatment plants was able to be reduced by approximately 40–45 per cent, resulting in a reduction of the loads of the two wastewater treatment plants of approximately 20–25 per cent.

Conclusion

The implementation of an industrial wastewater register was proven to be a highly efficient tool to meet the specific requirements of industrial wastewater control.

One of the most important results of the industrial wastewater register for the city of Adana has been the fact that, out of a total number of nearly 600 industries registered, only about 20 individual industries represent about 60–70 per cent of the total industrial wastewater and specific industrial wastewater pollution loads of the total industrial sector.

With regards to the general industrial wastewater management concept, this case shows, that — initiated and encouraged by the legal authorities and with motivation from the industries concerned — significant efforts can be undertaken in a relatively short time in order to drastically reduce industrial water pollution, and at the same time to minimise investment and operation costs for central wastewater treatment facilities. ●

This article is based on a paper presented at the 7th Stockholm Water Symposium/3rd EMECS Conference, Sweden, 1997.

Clemens Wittland is Head of Department, Process Engineering/Industrial Wastewater Treatment, GKW Consult, Mannheim, Germany.

New utility environment **drives water change**

Since the 1980s, privatisation of the water industry has been a major factor in determining how customers, governments and companies have had their expectations of the industry changed.

Simon Hobson, IBM Utility and Energy Services Industry

Our industry is changing. There have been some major changes in the past, such as the formation of the UK's catchment-based water authorities in 1974. Now, however, the water industry is being driven by the apparent success of the privatisation of electricity and gas companies (the other 'utilities'). This change is one of regulation, comparative competition, and increasing customer expectations.

Across the globe, increasing customer expectations have made the need for ever-improving and more competitive customer service levels a priority for business strategies in the 1990s. As the leaders in the industry progress through these strategies, companies have also tended to consider core business functions and their cost base for the service delivered. The 'cost of quality' debate on the affordable service levels in the water industry is separate and likely to continue.

The focus on core competencies can be illustrated by the value chain of a utility company (based on Porter's value chain concept).

From Figure 1 we can see that the principal 'value add' functions can be divided into supplier management, asset management, management of product delivery, and customer service management. These reflect the key parts of many processes that have been defined during the recent years of business process analysis. By contrast, the current organisational and functional structure of water companies is often far more complex, hiding or confusing the core business functions and resulting in inefficiency.

Business strategies have changed emphasis in recent years. The public service company became the customer service company. The latest transformation is into the asset management company. Therefore, we see a variety of strategies depending on the state of the industry environment in the locality, and on the international leadership of the company.

Business strategies are based upon:

- Excellent customer service, exceeding customer and regulatory expectations to protect and increase revenue streams
- Operational efficiency enabling lower unit costs than comparative suppliers, and
- Best use of technology for competitive advantage.

IBM has chosen these three strategies as the basis for solutions for water companies as they move toward the models provided by the electricity and gas industries.

Excellent customer service

As water companies move out of government control and funding, billing becomes a critical function requiring major information systems. The next phase is the customer service company.

While water companies do not have the same competitive market as other utilities, it is still true that managements who deliver poor customer service are unlikely to remain for long. In regulatory markets, customer service measures are key weapons used to put pressure on management and to justify whatever price controls are imposed.

Whereas operational efficiency has become the major long-term competitive weapon of global water companies, poor customer service can destabilise a company very quickly in modern markets if not given correct priority.

Customer service support systems are far more than the simple billing systems of the past. IBM's customer service system focuses on providing information to the customer agent to answer as many calls as possible while on the telephone. This, together with the effective design of call centres and computer-telephony integration, enables higher customer service levels to be achieved at lower cost.

Operational efficiency

As companies move to more process-oriented, as opposed to functional, models there is a change from 'activity management' to 'asset management'. This change reflects the issue in operational and engineering functions of many separate information systems, each with different data definitions. Supporting process across so many systems has been inefficient and the systems have often prevented any real

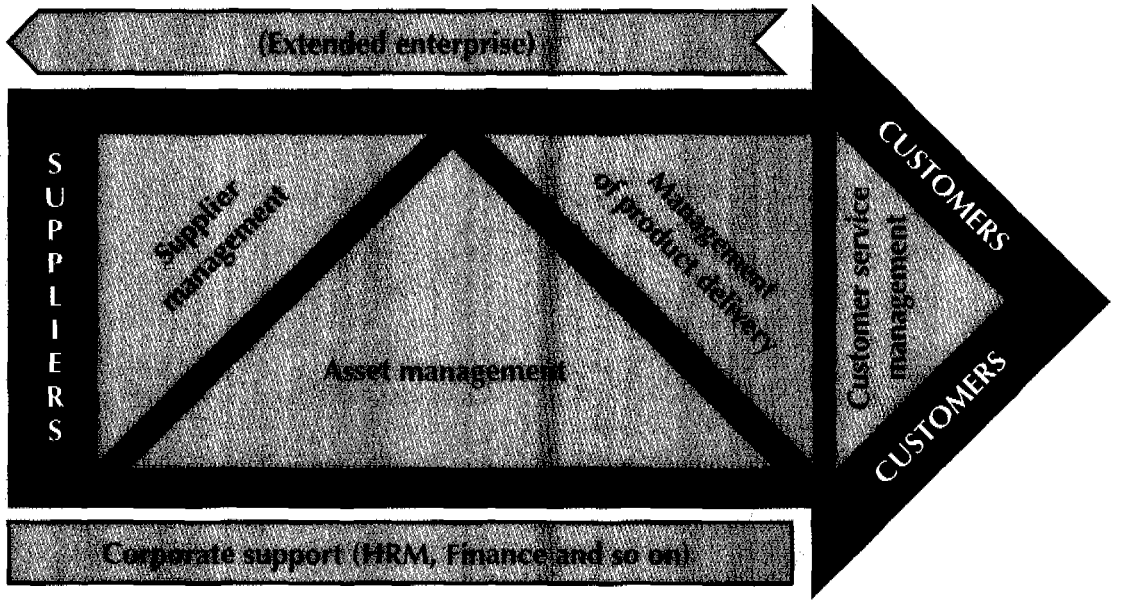


Figure 1. Value chain in a utility company.

process control. More critically, the fragmentation has caused the operational cost base of the business to be hidden within the external financial reports.

Responding to leaders in the industry and learning from other asset-intensive industries, IBM has developed a work and asset management solution to address both required aspects: maximum efficiency ('doing things right') and maximum effectiveness ('doing the right things'). By providing management information on the life cycle cost of assets, IBM can enable significant changes in the cost base. This information allows management to question (and answer) fundamental operational and engineering policies, as well as to improve resource efficiency. Effectiveness is proving to be far more significant in delivering cost-saving benefits and improving the health of the company.

Best use of technology

The two strategic areas above are examples of technology enabling the business to change more dramatically than would otherwise be possible. Information technology is a key enabler of business strategy and, increasingly often, a source of competitive advantage. When combined with visionary management, information technology is undoubtedly a powerful tool. What business is now demanding from information technology providers is not just the technology but some industry vision as well. IBM's Utility and Energy Service Industry solution unit delivers this balance between best-of-breed technology and industry vision.

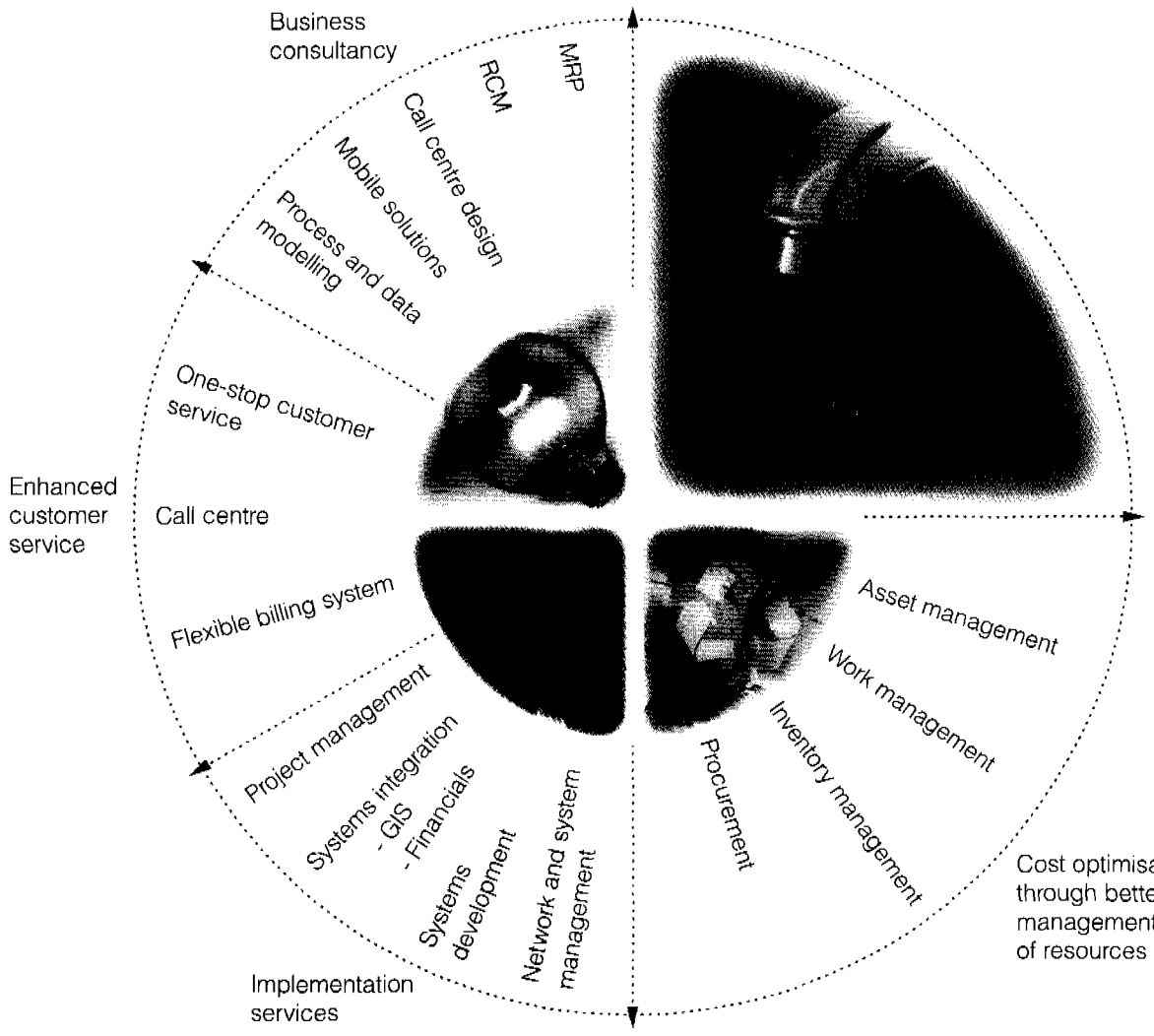
In an increasingly competitive industry, the use of information technology to enable business change and reduce costs is critical. IBM's focus on leading edge technology plus a vision of utility management from working with industrial leaders around the world provides a unique set of offerings for water companies. ●

For more information contact:
Richard Canner
IBM Worldwide Work and Asset Management Segment Manager
Tel: +44 1926 464425;
E-mail: richard canner@uk.ibm.com
or Helen Trollman, IBM Worldwide Customer Service Segment Manager
Tel: +1 415 966 660; E-mail: helen trollman@us.ibm.com

Utility and energy services industry solutions

IBM

World-class solutions for utilities around the world



Many water utilities around the world have benefited from a partnership with IBM, a trusted name in the utility industry.

Together with leading utilities we are delivering critical business systems that respond to the new pressures of the marketplace.

See our entry in Water Management International for more information.

For further information circle (21)

Paving the way to **automated meter reading**

The Cyble™ concept is a major new meter communications technology between the water industry, designed to bridge the gap between manual meter reading techniques and fully automated systems. It is the first universal signalling technology, compatible with all types of automated meter reading, including RF, M-BUS power line carrier and telemetry-based systems.

Schlumberger Resource Management Services

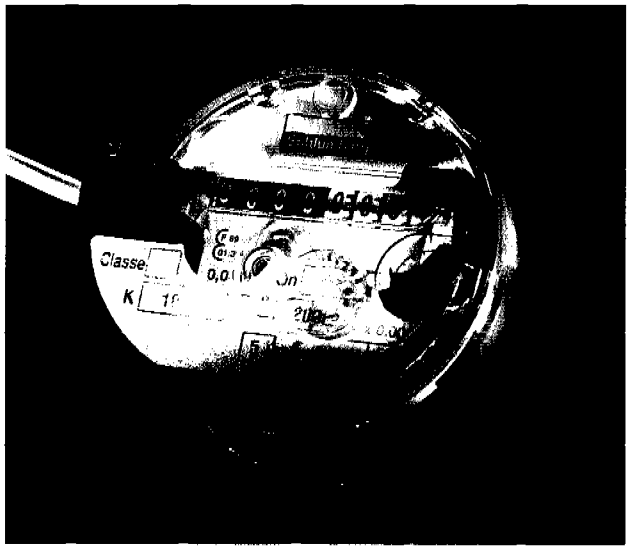
Pre-equipped Cyble water meters — which cost no more than their standard counterparts — can be converted for automated reading at any time by simply retro-fitting the appropriate communication module in-situ. This simple and easy-to-implement strategy provides utilities with a cost-effective and future-proof path to automated meter reading (AMR) allowing them to migrate smoothly from manual meter reading to automated strategies while preserving their current metering investment.

Cyble is a universal technology, independent of the measurement technique or meter size. It can be used for RF, walk-by or fixed network communication architectures, and is reliable and tamper-proof. It can distinguish between forward flow and back flow and is 100 per cent accurate.

Every time the water meter register moves one digit, the Cyble pointer which is connected to the register via a simple gearing system completes one revolution. As it does so, it moves through multiple pickups which sense the pointer rotation. On completion of one revolution, the system transmits a signal. By using multiple pickups the intelligent emitter is able to determine the direction of water flow in the meter. Initially developed for use with heat meters some years ago, the technology is field-proven.

Francis Hauber, Director of R&D for Schlumberger's European operations explains how Cyble technology differs from other emitter technologies. 'Using a mechanical analogy, if we regard the totaliser in the water meter as a gear-wheel, and the Cyble device as a second gear-wheel meshing with the first, then it is impossible for one wheel to turn without turning the other. The technology offers the guarantee that the transmitted values are precisely the same index as the meter. There are no other comparable solutions on the market that offer a universal communications capability. Traditional reed pulser technology, which emits a pulse for each revolution of the meter index, is neither universal in its application nor as reliable and accurate as Cyble.

A series of communications modules for Cyble is already in development by Schlumberger. Cyble M-BUS, which is compatible with the new European M-BUS communication standard, is available in a prototype version. The module is designed to fit into a hard-wired architecture, and allows the use of an existing telephone line or dedicated link to transmit meter readings directly to the utility's billing office. it can also be operated in an 'off-site' remote reading configuration using an inductive plug on the outside wall of the property. A wireless communication module, known as Cyble-RF is also in development and other modules are planned to follow.



A Cyble™ meter

Cyble is the latest addition to a range of innovative metering systems and service solutions from Schlumberger's Resource Management Services division. The division has been set up to help energy and resource suppliers worldwide to secure their revenues, manage their resources and strengthen relationships with their customers through innovative metering systems and service solutions. Within Resource Management Services, the Electricity and Gas, Water and Heat and Systems and Services groups develop the most advanced technologies for optimising the distribution facilities of their respective resources and offer the expertise needed by utilities around the world to exploit metering capabilities to the fullest.

Schlumberger Resource Management Services employs more than 15,000 highly skilled people operating in more than 30 countries. ●

Solving problems of contaminated **waters and wastewater**

Recent years have seen a dramatic escalation in the technology available for solving water and wastewater problems. Both new products and new technologies have been introduced at a pace which would have seemed unbelievable only a few years ago.

Jamie Bartram and Patrick Marchandise, World Health Organization

A browse through any of the professional journals reveals a list of companies offering services to solve what appear to be an infinite number of possible pollution problems, and other companies offering the hardware (and software) products to support them.

To some extent such a profusion is a simple result of increasing recognition of the importance of environmental pollution (leading in turn to increased attention to waste clean-up). In addition, and as a result of the polluted and densely populated nature of our finite planet upon which we all live and depend, there is an increasing need to treat water before it is suitable for uses as diverse as drinking, irrigation, fish farming and recreation, and to treat wastewater before its discharge back into the water cycle.

The human health dimension

In all of these areas, human health concerns are of paramount importance worldwide. While drinking water provides the focus of much health-based concern — justifiably so because of the potential of drinking water supplies to propagate outbreaks of disease — other water uses are also relevant to health. Shellfish — especially filter-feeders which can concentrate pathogens from sewage are well-recognised for their potential to spread disease but are also economically important for many countries. Similarly, irrigation waters may be of concern for public health. However, available evidence still suggests that water polluted with human excreta may safely be used for irrigation purposes with a limited range of simple controls to prevent the spread of disease, and that the availability of nutrient-rich wastewater for irrigation may contribute positively to economy, nutrition and, arguably, pollution control. Fresh-waters and coastal waters are used for recreation almost worldwide, both in the natural environment and through swimming pools, spas and similar environments; and evidence is slowly accumulating that use of recreational waters with even a moderate level of pollution may have a significant effect on the health of users.

It is important to note the common feature of the importance of water uses not only for public health, but also for social and economic development. Bringing together these three areas: health, social development and economic development makes the protection and use of water resources one of the key theme areas for sustainable development.

An ecosystems approach

This range of environments in which water can have an impact on health draws us towards an ecosystems approach. For a single use it may appear less costly to accept a polluted water source and to treat it as required for use. However, in the intensively re-used water environment we find towards the end of the twentieth century, protection of water resources and ecosystems contributes to multiple beneficial uses and may help to ensure that the ecosystems them

selves contribute to maintenance of water quality. Protection of the integrity and functioning of the ecosystems upon which beneficial uses depend is therefore increasingly seen as the primary protective measure.

Wastewater treatment

Protection of the integrity and functioning of the ecosystems is the first step of a multi-barrier protection process towards human health protection. In wastewater — especially sewage — treatment, even basic texts now refer to a simple sequence of primary, secondary and tertiary treatments. The listing is logical and yet somehow under-emphasises some of the most important concerns for public health.

Across most of the globe, human excreta and sewage is of special importance because of its actual or potential impact upon public health. That impact derives principally from the disease-causing microbes shed with human excreta into sewage. It is therefore conspicuous that many of our conventional treatment processes are relatively poorly adapted to the removal of these pathogens. In fact one process promoted by WHO and other authorities for this purpose — lagooning or use of sewage stabilisation ponds (Cairncross and Mara, 1989) is little used in absolute terms while it is intrinsically suitable for many parts of the globe.

End of pipe drinking-water treatment

The increasing availability of technologies for treating contaminated source waters for drinking is in a phase of rapid development. While greatly reassuring, it should be recalled that for much of the globe many of these drinking water treatment technologies are either technically or financially beyond reliable reach. Recent years have seen a worldwide recognition that measures intended to protect drinking water quality at source rather than to treat polluted waters are often both more effective and less costly. It is therefore conspicuous that certain

technologies which have been long-accepted and are well proven have not become more widely adopted in recent years. One example is river bank filtration, which has a long history of use across several continents and still provides the water for Budapest from the River Danube as well as to other communities in Europe and elsewhere.

Maintaining water supply

Drinking water supply represents the most important single interaction between water and human health and the role of water in ensuring health and in transmitting disease has been recognised since the earliest times: *in aqua sanitas*. As we approach the end of the second millennium, a series of new challenges exist to those with responsibility for promoting safe drinking water supply. One of the greatest challenges is presented by the accumulated stock of drinking water supply infrastructure. Thanks to the enormous efforts over the International Decade for Drinking-water Supply and Sanitation and since that time, the number of persons supplied with drinking water and the infrastructure in place to assist in this has consistently increased. Discussions focussing on the tragically large percentage of the global population which still has no access to drinking water supply may detract from the importance of maintaining the efficient functioning of this infrastructure.

Studies worldwide have demonstrated the unnecessarily short working life of much infrastructure. In rural areas, for example, wells and hand pumps with a projected life of 10 to 20 years may sometimes remain usable for as little as a period of months. Billions of dollars have been invested in infrastructures all over the world but are not providing the expected services due to lack of adequate management.

Possibly the most common and important group of challenges to those managing water supply systems today relates to the continuous supply of drinking-water. In many parts of the world where piped water supplies exist, their benefit to human health is limited by intermittent supply. Discontinuous water supply may arise for a range of inter-related reasons which include deliberate rationing or rotation of supply; low pressure in distribution; inadequate supply capacity (either in production or distribution) and losses — whether in distribution or in the household. Discontinuous water supply is a major public health concern. It limits the important health benefits associated with the use of water for personal and domestic hygiene; it forces users to store water, often in an unhygienic way leading to contamination of water which may be later drunk; and it leads directly to contamination in distribution from negative pressures in supply systems.

In general, the largest single area of cost in water supply relates to the distribution of water produced to users. Nevertheless, as greater reliance is placed upon drinking water treatment, so the costs treatment becomes a significant proportion of the total. The loss of water in distribution and in households represents a direct loss of expenditure in expensive treatment and pumping. Furthermore, plants which are grossly overloaded in an attempt to supply levels of demand outside normal limits and far in excess of the needs for health and hygiene are not only costly, but fail to operate effectively. Finally, investments in the control of excessive water losses may have an impact on sewerage collection and treatments as excessive dilution and flows are brought under control.

As is so often the case, many of the answers to continuous

Efficient water supply service management

The following criteria help to assess the efficiency of the water service management.

Quantity

The water supply system should be capable of collecting, transmitting, treating and distributing volumes of water adequate to meet the domestic, commercial and industrial demands of the population.

Quality

Drinking water delivered to the population should meet recognised standards for drinkable water.

Continuity

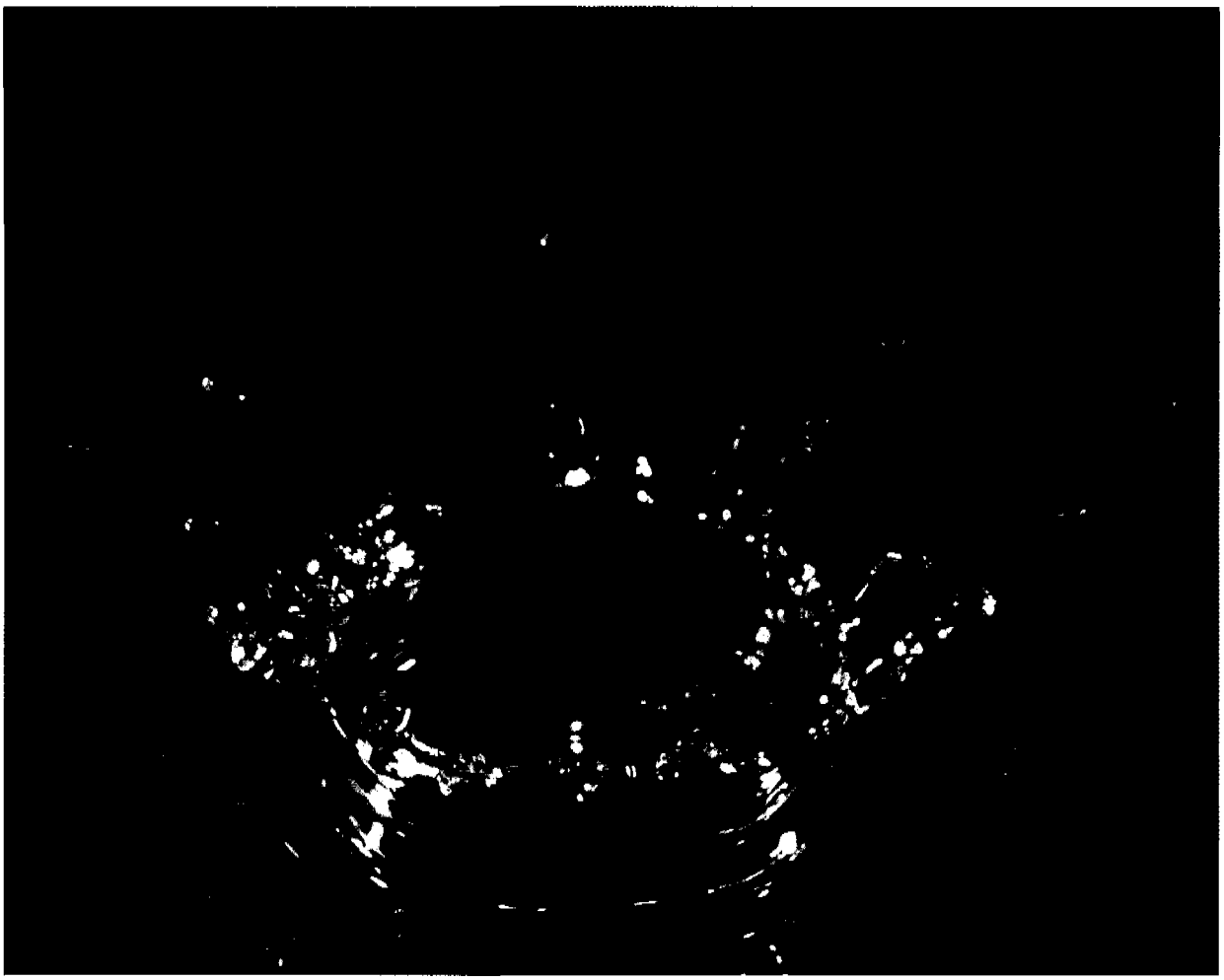
Water should be supplied to the population without interruption and at adequate pressure, including overcoming problems likely to affect the supply of water (reliability).

Cost

Water should be accessible to all members and strata of society. Across the globe experience suggests that people are both willing and able to pay for water supply. Indeed, it is the poor who often pay most for a sub-standard supply. Where population groups exist which cannot pay the full economic cost of water supply, then it should be recalled that water is a social as well as an economic good and that the protection of public health is of societal concern, and appropriate measures implemented to promote universal access to safe drinking water (adapted from Lloyd, 1987).

High-Tech Polymers

for potable and waste water treatment



PRAESTOL®-BRANDS are high molecular, organic, synthetic flocculants developed for various applications in municipal and industrial waste water treatment, especially for sludge thickening and -dewatering.

PRAESTOL®/TR-BRANDS are a group of flocculants applied worldwide for improving the quality of potable water as well as for enhancing throughput of flocculation and filtration units.

PRAESTOL®/TR-BRANDS are produced by a highly sophisticated process to comply with the regulations of the Department of the Environment -dwi- in Great Britain as well as to conform to the requirements of NSF "Standard 60" in the USA.

Stockhausen

A Company of the Hüls Group

For further information, please contact:

Stockhausen GmbH & Co. KG
Business Unit Industrial Auxiliaries
P.O. Box 570 · D-47705 Krefeld · Germany
Tel.: xx.49-2151-38.1712
Fax: xx.49-2151-38.1066
e-mail: industri@stockhausen.com
Web Site: http.www.stockhausen.de

For further information circle (26)

water supply are well-recognised. Both supply and demand management are required and are complementary. Major actions include control of losses in distribution; public awareness-raising and education in water use and conservation; and normalisation of pressure in distribution. In many areas metering at household level is being promoted or experimented with as a means to promote household water economy. Despite the fact that costs of installation and operation are high, metering may in some areas represent a cost-effective means of involving the users in the sharing of the resource by reducing individual losses. Furthermore, such a process may enable the water producer to know how much water is lost in the public part of the network, where distribution systems themselves are very deteriorated, and increases awareness of this unbeneficial production.

Monitoring and assessment

Similarities may be made with the area of monitoring and assessment. Equipment catalogues now list a great diversity of both sophisticated laboratory analytical; equipment and simplified field or on-site testing kits or for analysis of components and pollutants of water. Yet some of the most basic elements of monitoring and assessment remain poorly resourced both with expertise and with supporting methodologies and technologies. For drinking water, for example, despite the ability to analyse for any number of chemical substances, simple and rapid assessment methods for the most basic parameters (such as who has piped water or what is the effective continuity of supply) often remain often (Bartram, 1996).

The objectives of a loss control programme are to reduce losses to an acceptable minimum, to meet additional demands with water made available from reduced losses (often with benefit to fringe areas), to ensure that the water supply system functions as efficiently as possible for as long as possible, to increase the useful life of the facilities, to distribute water to as many users as possible and ensure that costs are shared equitably among all users, and to minimise the cost of production and distribution of water. Such a programme requires some basic flow monitoring equipment, but also a deep involvement of both the producers and the users.

New solutions

It is important to recognise the increased availability of more effective or less costly solutions to solve problems. A lot of professional journals may give the advantages of them, whether they are physical, such as membrane technologies; biological, such as reed beds; and so on. Nevertheless, sophisticated devices may be costly in investment, costly in operation and maintenance, and may require high skills to operate and maintain them. Where a real choice exists, increased emphasis upon protection and rational use of high quality water resources, rather than 'end of pipe' treatment, may be both cheaper and more effective in public health protection, as illustrated in the two following examples.

Experience shows that investment in increased treatment capacity alone is not necessarily sufficient to supply continuous quality water for the population. A new treatment plant may not be able to perform to its full capacity, for example due to the deficiencies of the distribution network. Furthermore, good quality water, which has been costly to produce with new technologies, may be lost or polluted if parallel improvements are not made in distribution and demand. This may in turn reduce the need for and cost of treatment.

No a single reasonable technology will enable disposal of sewage sludge to land more frequently if actions to separate industrial and domestic wastes are not undertaken. Answers, or at least partial answers to many priority issues for water and human health are not technologically driven and are readily available. For example the role of the public, either as direct actors (for instance in conserving water in the home) or as a constituency pressuring public or private authorities has been increasingly recognised.

Solutions for real problems?

It is germane to sometimes step back from the rush of new offers of expertise and equipment and review how these new technologies and methodologies are contributing to help us to protect human health across the globe. Certainly the availability of technologies to solve specific problems provides some sense of reassurance, but many of the more sophisticated technologies are — for practical purposes — unavailable to large populations worldwide. This is sometimes for simple financial reasons, but more often because they may not be depended upon in the real operating conditions that exist; or — more importantly — because the financial, technical and organisational resources they might call upon would be better or more cost-effectively used elsewhere in combating greater public health priorities. Communities could manage water distribution and sewerage services either by themselves or by delegating all or part to a private operator, motivated by the increasing complexity of tasks, increasing complexity of processes, and increasing number of consumers, but communities should always have control over the management method selected. ●

Jamie Bartram is Manager, Water and Wastes at the World Health Organization's European Centre for Environment and Health, and is based in Rome. He was previously the Head of the Environment and Health Division at the Robens Institute, University of Surrey, UK.

Patrick Marchandise is Water and Sanitation Projects Manager at the World Health Organization's European Centre for Environment and Health and is based in Nancy. He was previously the Head of the Water Division at Laboratoire Central des Ponts et Chaussés, Public Works Department, France.

SwyCo Well Cleaning Products, L.L.C. Introduces

PREMIER!
The Total Well Clean-out

***

SwyCo, the manufacturers of the industry-leading SwyCo S/C, B/E and S/R product line, proudly announces its newest product; **SwyCo PREMIER!**

PREMIER! is a complete well clean-out package in liquid form. It combats incrustation, rust, scale build-up and anti-fouling bacteria. It is designed to remove the hardest mineral, scale and anti-fouling bacteria as it changes the deposits into a solution which is suspended and easily pumped to waste. Some of the advantages it offers over powders are:

* easy-to-handle liquid
* no dusting problems
* begins working instantly
* works as fast or faster than our powdered products
* reduces required inventories as it combats properties of S/C and B/E

It is available packaged in 5-, 15- or 55-gallon drums for your convenience.

***

13509-C Railway Drive, Oklahoma City, OK 73114, USA.
Tel: +1 800 880 7172 / +1 405 752 4477 • Fax: +1 405 752 4482

Alternative disinfection in **potable water treatment**

Interest is growing in the use of ultraviolet and chlorine dioxide as an alternative to chlorine. Although the method depends on pre-treatment by multifiltration, and the use of ClO_2 before and after ultraviolet, its application does not require complicated technological know-how or involve high costs. It can be used both in large waterworks and by small communities.

A M Morsi, Zagazig University

About 70 per cent of the treatment plants currently serving cities with populations of more than 100,000 use free chlorine as their primary disinfectant. How many utilities will make changes in disinfection, and what disinfectants they will shift to — for example, ultraviolet (UV) ozone, the combined use of ozone/hydrogen peroxide, or the combined use of chlorine/chloramine and chlorine dioxide — is not clear. Even 'exotic' technologies, such as plasma beam and irradiation, are being researched for their inactivation potential on Cryporidium. But these technologies are still far from being used at large water treatment plants.

The use of other advanced drinking water treatment technologies, such as Granular Activated Carbon (GAC) and membranes, will also increase in the future. But the applications of these technologies will be much more site-specific than the increased use of alternative disinfectants.

The use of membrane technology will also increase in specific applications. Microfiltration is beginning to make inroads as an alternative to conventional filtration. This technology may have some potential for small system applications. Reverse osmosis (RO) is still the leading technology for applications such as desalting and reclaimed water for irrigation and indirect potable reuse.

Drinking water utilities will also work toward increasing the reliability of their treatment processes. Many outbreaks of disease have been due to human mistakes or mechanical breakdowns, or both. Increased reliability will include increased redundancy, real-time monitoring, and alarms. Utilities will need to include more redundancy in their treatment plant design and operations. Increased redundancy may lead to an increase in back-up equipment and spare parts for critical treatment process equipment, such as coagulant feed and disinfection equipment. The use of real-time monitoring will increase, as will the number of turbidimeters used in the treatment process.

UV and chlorine dioxide have been successfully used in drinking water treatment. They are very active disinfectants and strong oxidising agents, and in the pre-treatment stage they are also able to reduce the problems of bad tastes and odours, and control the algae growth in the system. At the same time, they can help to remove heavy metals such as iron and manganese, and in the final disinfection stage the UV sterilisation and low dosages of chlorine dioxide guarantee a constant and reliable control of the microbial quality of the water supplied to the community. It is well known that ClO_2 is not a chlorinating but a very strong oxidising agent, having usually chloride (Cl-) and chlorite (ClO_2) ions as final products according to the following reactions:

$$ClO_2 + 4H^+ + 5e \quad > Cl^- + 2H_2O \qquad (Eo = 1.51\ V)$$

$$ClO_2 + e \quad > ClO_2^- \qquad (Eo = 0.95\ V)$$

It has to be produced on application site, by means of specific equipment called a generator. In this reactor chlorine dioxide is the final product of a chemical reaction, usually based on sodium chlorite ($NaClO_2$).

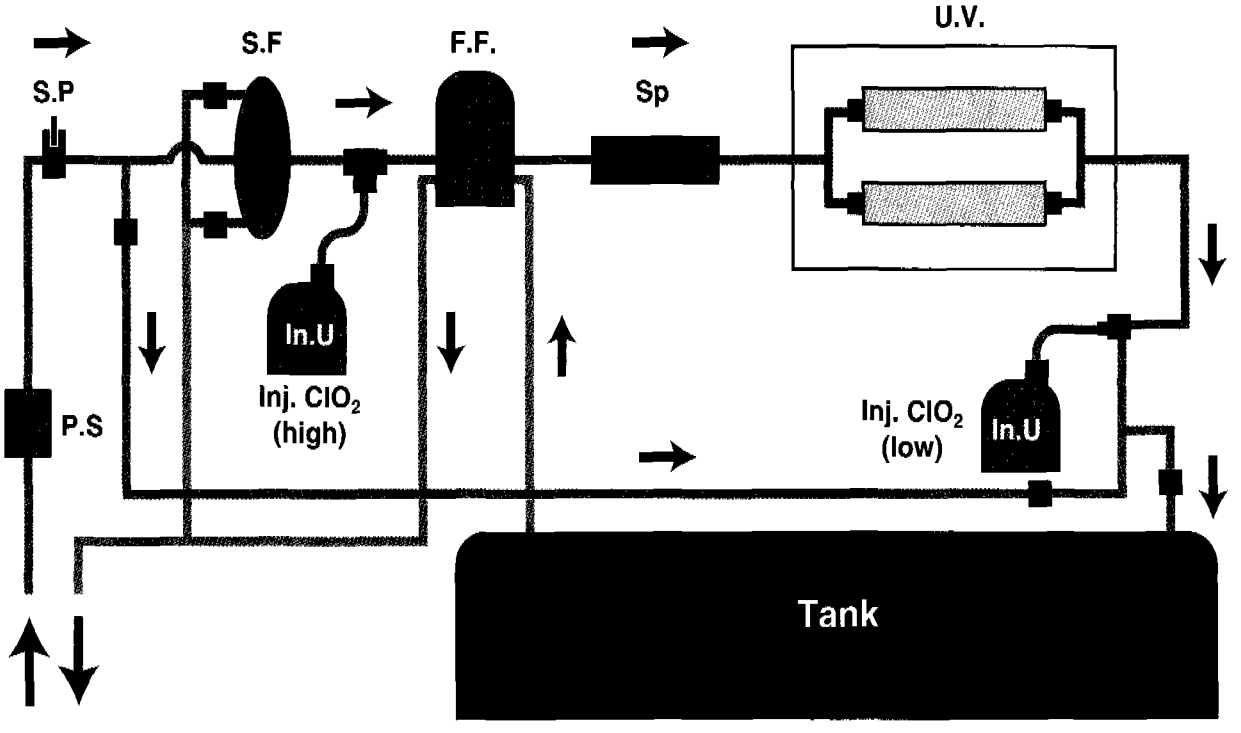
The main ways of producing chlorine dioxide are the following:

1. $2NaClO_2 + Cl_2 \longrightarrow NaCl + 2ClO_2$
2. $NaClO + HCl \longrightarrow HClO + NaCl$
   $HClO + HCl + 2NaClO_2 \longrightarrow 2ClO_2 + H_2O$
3. $5NaClO_2 + 4HCl \longrightarrow 4ClO_2 + 5NaCl + 2H_2O$

The last one is the most used and proves to be the best choice, especially for drinking water treatment, because it guarantees the best conversion to chlorine dioxide, limiting as much as possible the formation of by-products.

Chlorine dioxide is a very active and strong biocide against bacteria, viruses, algae and fungi. The biocidal action is probably due to its reaction with the vital amino acids of the cells; this is possible thanks to the permeability of cell walls to gaseous ClO_2.

UV light is a proven means of addressing microbiologically contaminated water. However, chlorine dioxide is used for the sterilisation of water because it has a long



General layout of the suggested pilot for treatment of groundwater

lifetime in the distribution network (pipes and reservoirs); is able to avoid possible troubles caused by the regrowth of micro-organisms; and does not produce halogenated by-products or other chlorine compounds. For these reasons, and that of the increasing concern about the toxicity of the disinfection by-products of traditional chlorination, chlorine dioxide has become widely used, replacing conventional chlorine disinfectants.

In the past few years, both the deterioration in quality, and the reduced quantity, of appropriate sources of drinking water have highlighted the need for advanced and reliable technologies able to meet the required standards at a reasonable cost — 'advanced' so as to limit as far as possible the adverse impact on human health, and 'reliable' in the sense of being able to be used at all times, irrespective of the lack of ideal conditions.

Among the chemical and physical treatments to make water potable, the disinfection stage has been widely studied and deemed essential in a complete drinking water treatment, not only when necessitated by the bad microbiological quality of raw water, but also because water is always the main carrier of dangerous diseases such as cholera or typhoid. For this reason, as late as 1993, the World Health Organisation (WHO) still recommended that 'an efficient disinfection must never be compromised' by any concern about cost or chemical by-products.

In the required treatment of raw water (mainly surface water) to make it potable, chlorine dioxide can be used both as an oxidising and disinfecting agent.

Results and discussion

Conventional treatment of this kind of raw water includes the following stages according to the system shown in Figure 1: preoxidation, clarification (with addition of inorganic coagulants, iron or aluminium salts), filtration (by sand and/or activated carbon), and final disinfection. UV, followed by chlorine dioxide, can be dosed in the pre-oxidation stage, just before coagulation, which gives the following advantages:

- Oxidation of Fe and Mn ions and consequent better removal of their relevant hydroxides, which are insoluble in water
- Destabilisation action of the suspended solids and colloids, resulting in a better settlement of the flocs during the clarification stage
- Elimination of the organic compounds (that is, phenols) which may cause bad odours and tastes, giving a higher organoleptic quality in the water, and
- Removal of THM precursors (organic substrate).

In this case the normal dosage range of ClO_2 is (0.5-2)

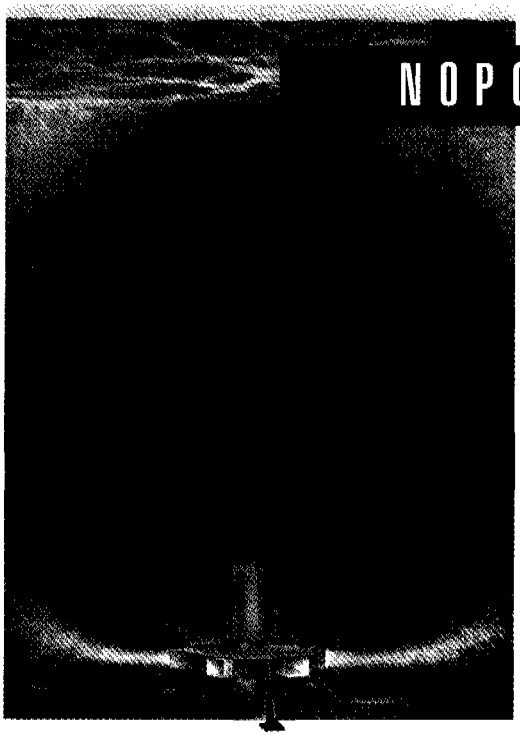
mg/l with a reference time of 15–30 minutes. A secondary notable effect is the control of the algae growth alongside the other treatment stages, which allows a more effective disinfection.

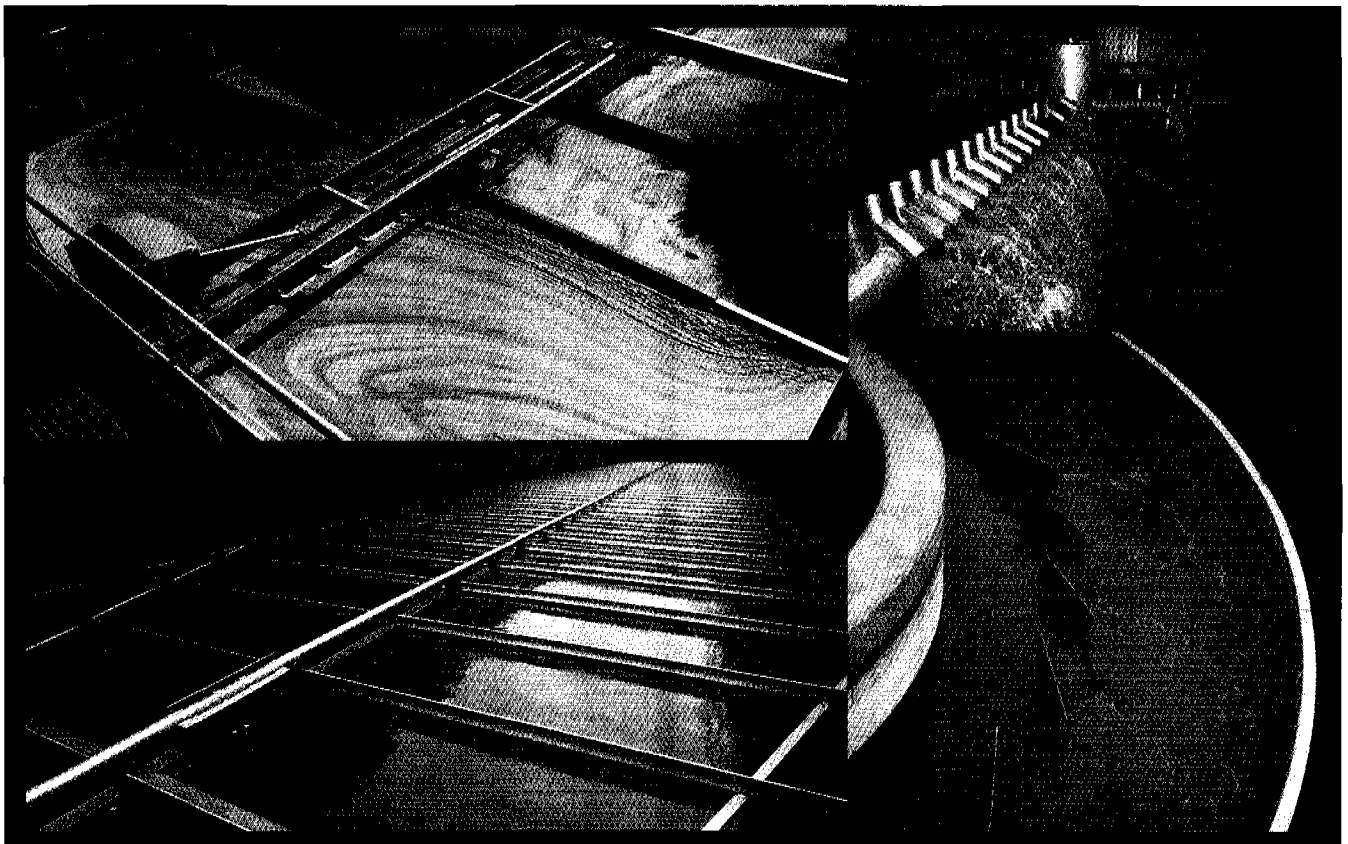
As disinfecting agents, both UV and chlorine dioxide were used. Micro-organisms encompass a wide variety of unique structures and can be grouped into five basic groups: bacteria, virus, fungi, protozoa and larvae. In simple terms, a micro-organism is made up of the cell wall, cytoplasmic membrane and the cell's genetic material, nucleic acid. This genetic material, or DNA, is the target for the UV light. As UV penetrates through the cell wall and cytoplasmic membrane, it causes a molecular rearrangement of the micro-organisms DNA, which thus prevents it from reproducing. If a cell cannot reproduce, it is considered dead.

Chlorine dioxide is used in the final disinfection, after the filtration, where at a dosage of (0.2-0.4) mg/l, it is able to guarantee an efficient and constant elimination of the micro-organism content of the finished water. As for other chlorine compounds, the demand for chlorine dioxide is a helpful, preliminary assessment to define the required dosage to be used case by case. It is the amount of ClO_2 which reacts with the raw water within a defined time of 5–60 minutes. This value could be useful to carry out the necessary laboratory tests and then to adjust the actual dosage in the field, also depending on the possible change of the quality of the raw water.

Series filtration and treatment have been used (see Figure 1), and were found to provide a more efficient, cost-effective water treatment system, which depends on removing all colloids and oxidising different metals ions followed by UV and ClO_2 sterilisation. Also, the residue of ClO_2 in the distribution network (pipes and reservoirs) is able to avoid possible trouble caused by the regrowth of micro-organisms, and does not produce halogamated by-products as well as other chlorine compounds. ●

A M Morsi is employed in the Chemistry Department, Faculty of Science, Zagazig University, Egypt. **He would like to thank Dr J El-Didamony of the Botany Department for his experimental work.**



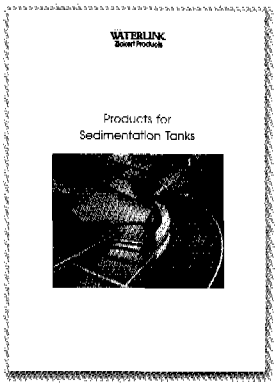


New catalogue packed with products for use in sedimentation tanks

The latest catalogue from Zickert contains full details of our range of tried and tested products for use in sedimentation tanks. They include bottom sludge scrapers, scum pipes, floc builders, sludge siphons and bio-distributors.

What they all have in common is that they are simple to install and easy to adapt to individual requirements, without the need for major reconstruction of existing tank installations.

So, whether you're building a new tank, updating an existing one or extending an installation, take a look at our catalogue. Contact us for your copy.



WATERLINK®
Zickert Products

Zickert Products AB

Fjärås Industriväg 19 · SE-430 33 Fjärås · Sweden · Tel: +46 (300) 332 00 · Fax: +46(300) 332 19
e-mail: zickert@ waterlink.com

For further information circle (35)

The regulation of lead in **drinking water**

World Health Organization guidelines recommend, as a long-term objective, a maximum weekly mean level of 10µg/1 for lead in drinking water. A forthcoming European Union Directive based on these recommendations may lead to the need for pH neutralisation, softening, or addition of orthophosphates, as well as the replacement of all leaded materials.

Pierre Leroy, Centre de Recherche et de Contrôle des Eaux de Paris (CRECEP)

Lead in drinking water comes from resources that generally either contain no lead at all or have few traces not exceeding 5µg/1, and it can be easily eliminated by water treatments such as flocculation and filtration. The principal source of lead in water is the lead pipes and leaded alloys often used for service pipes and domestic networks. These metals and alloys corrode on coming into contact with drinking water causing varying amounts of lead to be released into the water.

If the lead content of the water depends on the water's physico-chemical characteristics, it depends also on the design and use of the network. A possible way to reduce lead in drinking water consists of treatments applied in the potabilisation plant. Such treatments can decrease lead content below 25µg/1 but are not able to reach 10µg/1. Such low levels can only be obtained by replacing lead pipes or leaded alloys with other lead-free materials.

Origin of lead in drinking water

Historically, lead was widely used for service pipes and household plumbing, being considered to be a convenient and suitable material for the conveyance of water. Lead is easily formed, cut, and jointed, and its flexibility provides resistance to subsidence and frost. The thickness of the pipe and its resistance to pitting corrosion also make it a desirable and durable material.

Lead pipes, however, are not the only origin of lead in water. Currently, lead is widely used in tin-lead solder and as a result can be found in significant quantities in water in contact with copper pipes.

Lead may also enter potable water through its use in pipe jointing compounds, through dissolution of brass and bronze plumbing fixtures, and through its use for certain lead goosenecks, valves, or gaskets in water treatment plants or distribution mains. The contribution of lead from water tap assemblies is not negligible, brass and bronze containing about 5 or 6 per cent of lead.

An additional source of lead could be the coating on galvanised pipes that have a content of about 11 per cent lead. Plastic pipes, and specially PVC pipes, contain lead compounds that can exchange lead ions with calcium ions of potable water. Theoretically, several water treatment chemicals could be a potential source for contamination of the distributed water. But this contribution is estimated to be less than or equal to 1µg Pb/1.

Parameters influencing lead concentration

In contact with drinking water, metallic lead and leaded alloys corrode. The reaction of corrosion leads to a migration of lead ions in water. These ions can react with other ions such as carbonate, bicarbonate or hydroxide. A low solubility compound (lead hydroxycarbonate) can precipitate on the walls of the pipes, leaving them covered by this deposit after some months' operation. Then the lead content of water depends mainly on the different parameters that influence the dissolution of this deposit. The main parameters are:

- Thermodynamic parameters influencing the solubility itself: temperature, bicarbonate concentration, and pH, and
- Kinetic parameters: stagnation time of water in contact with leaded materials, diameter of the pipe, and length of the pipe.

It appears here that the lead solubility increases when the pH decreases from eight or nine to less than six. The influence of alkalinity is not so important but the minimum solubility is obtained for low alkalinity about 40 and 60ppm $CaCO_3$.

Evaluating the mean concentration at the tap

It appears that numerous parameters influence the lead concentration of water at the consumer's tap, mainly the length of the leaded pipe and the stagnation time of water in this pipe. It can easily be understood that the lead concentration of water varies strongly during the day, with a maximum value early in the morning during the first drawing and minimum value after a long and important drawing. The analytical result obtained on a sample taken at the tap depends on the time of sampling in the day, a possible drawing done before sampling and the technique of sampling itself. This variability can lead to great difficulty in assessing the real concentration of lead.

A possible method is to use a 'proportional sampling' technique that consists of taking a definite proportion of water at each drawing. Such a device exists, but its use necessitates it remaining at the consumer's tap for one week. Considering the time spent to obtain the sample and the nuisance to the consumer, such a technique can only be used for research or special experiments and is not

suitable for systematic monitoring. In fact, no sampling technique is available for lead concentration assessment. More research must be undertaken to get a representative and simple sampling technique.

Treatments

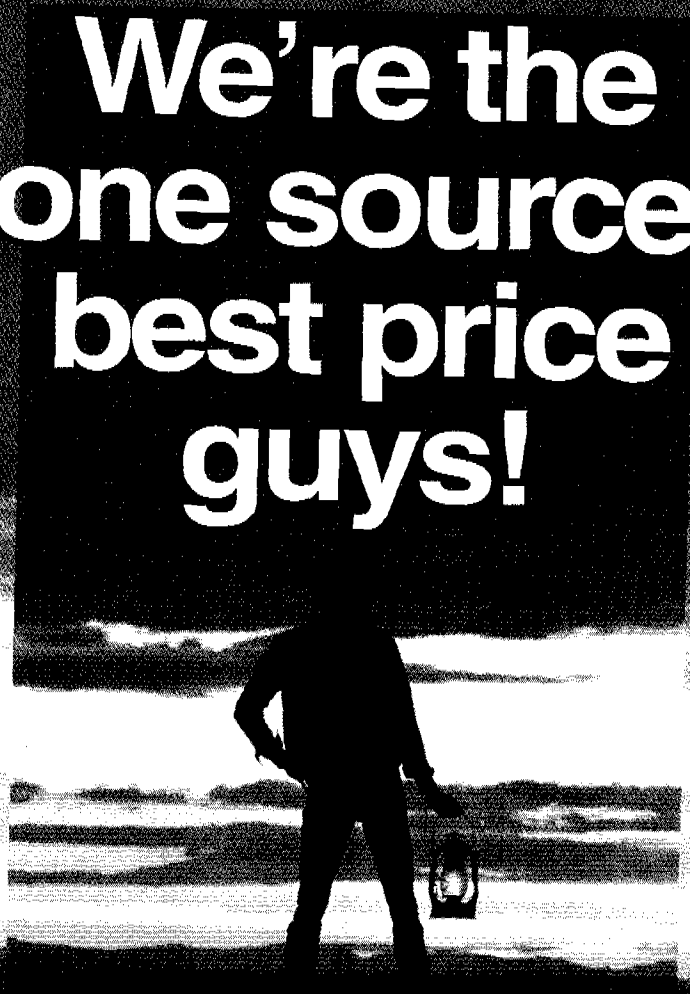
pH and carbonate adjustment. The solubility of lead can be greatly reduced in waters having a low alkalinity (soft waters) by increasing pH into the range of 8-10. Because lead forms strong carbonate complexes, only waters of relatively low carbonate concentrations are amenable to this treatment. Waters with high alkalinity and neutral-to-basic pH values may have to have carbonate removed or to be softened to enable the attainment of a mean lead concentration under 25ug/1, and (possibly) to avoid unwanted calcium carbonate scaling. Carbonate removal can be obtained by calcium carbonate precipitation by lime or caustic soda addition. It can be obtained also by nanofiltration and pH adjustment with lime or calcium carbonate. However, these treatments cannot achieve concentrations of 10µg/1.

Orthophosphate addition. Lead forms at least one orthophosphate solid of low solubility in realistic drinking water conditions, which can serve as the basis for corrosion control. Experiments with both lead and galvanised pipes at the US Environmental Protection Agency (USEPA) have demonstrated that supersaturation with zinc orthophosphate is not necessary for lead solubility control because the lead forms a passivating lead orthophosphate film.

Polyphosphate addition. Polyphosphates are strong chelating agents for alkaline earth metals and trace metals such as lead. Although they have useful properties for reducing scaling, cleaning tuberculation from distribution mains, and reducing 'red water' complaints through sequestration of Fe^{2}+ ions, they have not been proven useful in reducing the solubility of lead to sufficiently low levels to be safe from a health standpoint, even though they may be somewhat effective relative to non treatment, particularly in acidic waters. In water with high pH (above 7), for example, the chelating effect increases the solubility of lead. Such treatment is not available for reducing lead concentration in drinking waters. ●

Pierre Leroy is Chairman of the International Water Supply Association's Committee of Corrosion, CRECEP, Paris, France.

We're the one source, best price guys!



Serving independent dealers worldwide!

With our large inventories of major brand components and supplies we consolidate your purchases for container shipments or we can recommended freight forwarders in your part of the world • Our own brand systems include, filters, reverse osmosis, softeners and more, in sizes from residential to industrial. If we don't have exactly what you are looking for, we'll build it for you or help you find it • Call for our support today.

Wholesale Only

Alamo Water

The alternative to **chemical pretreatment**

The example of a small, central-American community serves as a case study. The use of acid-pretreated reverse osmosis to reduce the nitrate levels in drinking water was compared with the later installation of a multi-tank KDF filter. The latter resulted not only in a cleaner operation but also in a drastic cost reduction.

● **Alamo Water Refiners Incorporated**

The popularity of reverse osmosis (RO), along with increasing affordability, have allowed some units to be installed without the proper pretreatment or adequate consideration of the application. The challenge then is to maintain a cost-effective way to protect the membranes to ensure a lengthy service life as well as 'like new' performance. The application of chemicals for this purpose is certainly sound, as is ion exchange or oxidation. However, many times the end user has concerns about the chemical expense and the handling of these chemicals. Is there not a non-chemical way of protecting the membranes?

After the first month of operation, a 4 per cent improvement in pressure drop across the membrane was noted

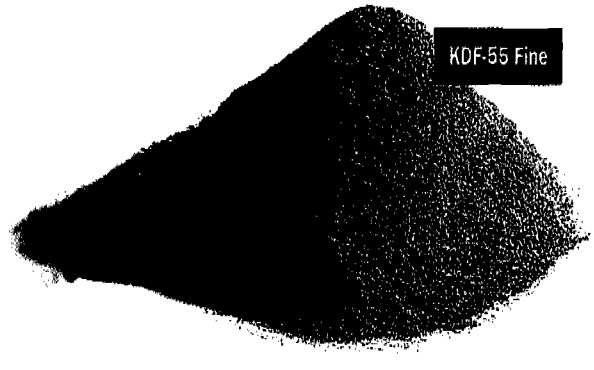
This was the case of a small, rural community in the central plains area of the USA. In 1994, a 120 gallon/min RO was installed to reduce the nitrate levels in the drinking water supply. Although the nitrates were of no real consequence to the function of the RO, a relatively high hardness level plagued the ground water supply. After some consideration, a multimedia filter followed by a chemical injection system was applied. Acid was fed to the RO to reduce the scaling conditions in the membranes at an approximate cost of $0.60 per thousand gallons produced. Although this treatment was effective, the expense was high and the remaining issue to address was the handling of the acid. In addition, an increasing pressure drop across the membranes, which indicates membrane fouling or scaling, was beginning to concern the operators of the unit.

Application of KDF 55

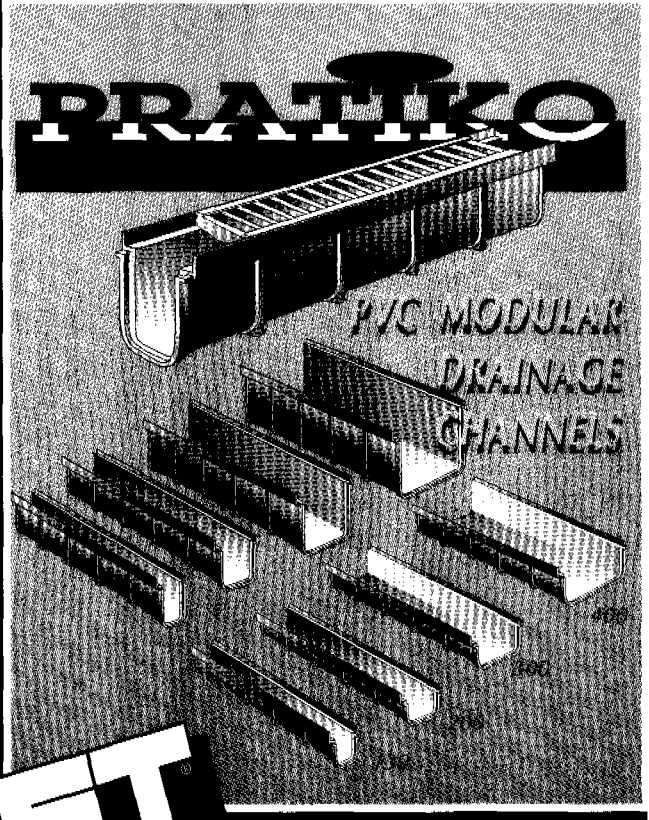
In July 1997, a multi-tank KDF filter assembly was installed in place of the acid feed system. To minimise pressure drop, two skids of four 16ins-diameter vessels were applied. Each vessel contains 400lbs of KDF 55 medium. The backwash flow rates are relatively low and are controlled by an economical time clock initiated stager/controller.

KDF 55 process media are high-purity formulations of copper and zinc alloy that use oxidation/reduction (redox) in patented applications to remove contaminants in water. These process media are used in place of, or in conjunction with, filtration, ROO, ion exchange and other water treatment technologies to lower total treatment cost, extend operating life, and minimise maintenance requirements. The reduction of contaminants is accomplished without significant increase in zinc or copper in the treated water.

After the first month of operation, a four per cent improvement in pressure drop across the membrane was noted. The second month revealed a further decrease in pressure drop, yielding an improvement in performance of approximately 10 per cent. This reduced pressure drop indicates that the membranes have been cleaned of accumulated scale and biological fouling by the application of the KDF media system. Also realised was a drastic reduction in production costs. The cost per thousand dropped to approximately $0.08, which represents savings of 86 per cent. To date, the operation is functioning smoothly and the chemical handling issues have been eliminated. ●



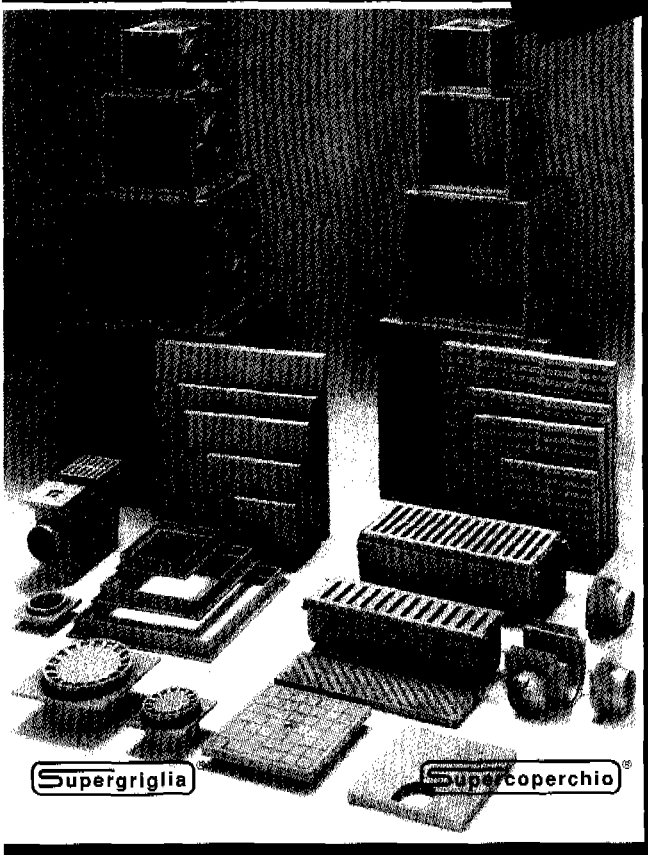
KDF 55 granules are most effective in removing chlorine and water-soluble heavy metals



FIRST PLAST

LOC. ISOLA GRANDE - ALTARE (SV) - ITALY

+39 - 19-58511 Fax 58305



DRAINAGE PRODUCTS

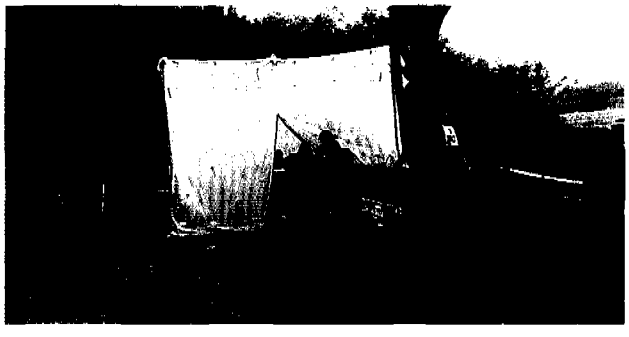
PVC PIPES & FITTINGS

Developments in plastic **pipe technology**

Now that polyethylene has usurped ductile iron's role as the premier pipe material, where next for plastic pipes in the UK water market?

David Hill, Durapipe – S&LP

Traditionally the UK's potable water mains were made principally of iron (Fe), and sometimes lead (Pb) or copper (Cu) for the smaller sizes. In the 1960s the use of low density and high density polyethylene (PE) began to be significant, but these materials remained most widely used for service pipe and house connections. In the larger sizes it was PVC-U which made the most progress against traditional materials. Gradually a large plastics pipe industry developed, principally around PVC-U. Despite promising beginnings, however, problems began to emerge. These were both of a technical and commercial nature, a position from which the material has struggled to ever fully recover. Meanwhile things were developing with PE, which continued to grow and maintain its position on the back of tremendous success as the sole material used by the UK gas industry for low-pressure distribution. In 1997, for the first time, sales of PE pipe for water overtook iron to take the leading market share. PE is very firmly established as the material for water distribution. Following behind is PVC-U, very much recovering its position as a mainstream material.



400ml PE being butt fused for the Bewl water transfer system

These two materials dominate the plastics scene, but are not alone; GRP, ABS and PP are also playing their part in the continuing rise in plastic pipe usage.

From these origins it is perhaps easier to understand how plastic pipes from different materials are being developed. Fundamentally, there are major differences in this, between the two major materials, PE and PVC-U.

Differences between PE and PVC-U

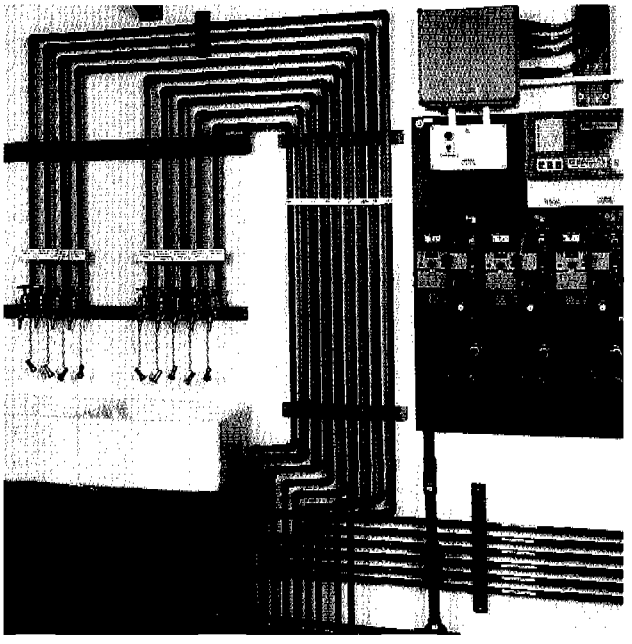
PE has won its position on the basis of steady, but rapid growth, with few hesitations over performance. Its application to long lengths in coils, makes it supreme for small diameters, but the same attribute of flexibility is also key to the ease of use with mechanised or no-dig pipe laying methods and larger sizes. The level of performance obtained is mainly controlled by the polymer producer, the material being less process sensitive than PVC-U. In addition, most PE pipe materials are supplied ready compounded, no additions being required. Thus, provided that the pipe maker selects high-quality PE materials, converts them appropriately, and carries out the required testing to confirm performance, quality is ensured. The only drawback with PE has been the sensitivity of the heat fusion jointing method to the skill or otherwise of the installer. The development of high-integrity electrofusion fittings has eliminated this problem with all but the most ham-fisted workman. PE is therefore known to be reliable and easy to use. From the early 1980s, medium density PE has dominated the smaller sizes, but the introduction of high performance PE100 in 1989 by Solvay has given this material the properties and economics to dominate the medium and large-size ranges. PE can now compete effectively with traditional materials right across the size range.

PVC-U has recovered from a weak position, by continual development and refinement. Problems with pipes installed only a decade or so ago required an urgent programme of development that could eliminate the bugbear of poor fracture properties and place the emphasis on strength. There is no doubt that PVC is capable as a material but, unlike PE, the way that it is processed matters as much as the base materials themselves. Developments therefore have been concentrated not on changing the PVC polymer itself, but enhancing the properties with additives or minor additions of other polymers, or by special processing. This is how it came about that PVC may be metricated, recoloured, toughened or oriented. Aside from this, there is the other very important consideration of the environmental issue. For various reasons, the fact that PVC is over 50 per cent chlorine is seen by some as a negative feature. Both are facts that cannot be changed, it seems. However, the other objection is more sentient; the use of heavy metals stabilisers is to be eliminated.

Current developments

The developments today in PE pipes are altogether different. No doubt subtle improvements to the polymer will come, but most of the activity is concerned with basic pipe structure, taking PE pipes into ever more niche market sectors. I am thinking here of multi-layered pipes that have combinations of properties, at sensible cost, in a single homogeneous pipe. Until quite recently, co-extrusion was regarded as 'trick technology' as far as makers of large water pipes were concerned.

The technique was known, but did not extend much further than external stripes used on some pipes (mainly continental Europe) for identification purposes. However, it simply became the obvious direction for developments to go, especially as the technology is already well established in other plastics manufacturing such as blow moulding, packaging film, and small bore pipe. It also offered a route for added value products, as far as the manufacturers were concerned, when margins were being squeezed everywhere else on standard pipe that had, in effect, become a commodity. Now, by virtue of this technology, we have a range of products being offered for water applications, for example, pipes with an additional external layer of strippable polymer, which is said to eliminate the need for pipe scraping when making an electrofusion joint (Uponor Profuse). Another pipe of similar structure provides external protection and is offered for pipebursting (Durapipe-S&LP Safeguard). For potable water pipes in contaminated land, pipes with external layers resistant to hydrocarbons are offered (Durapipe - S&LP Protecta-Line). In other markets, various multi-layered products are offered for use with hydrocarbon fuels. These frequently consist of a main pipe wall made from PE, with other layers of barrier materials such as polyamides or polyketones, and intermediate tie layers. Typically such products have from three to five layers or more of materials. Few of these would be possible, of course, without the availability of effective adhesive materials to perform as tie layers between differing materials. The mechanical aspects of manufacturing, such as the complex extrusion die design, have been improved by the power of the computer. This enables a much faster manipulation of theological and design data necessary to arrive at a suitable starting point. It could have been, and was, done before, but with so many more stops on the way!



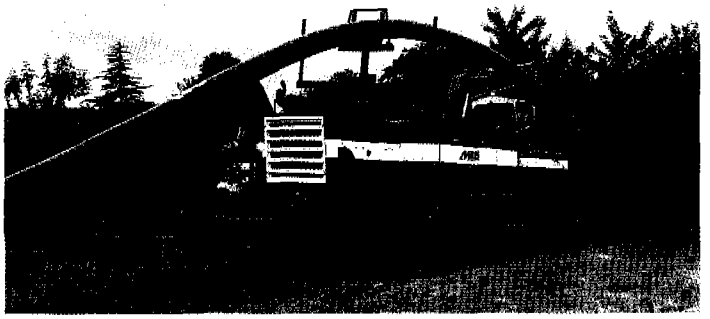
Small-bore PUC-U is used in this dosing plant at a bore hole for potable water in North Staffordshire, UK

Structured wall pipes

So far, I have not mentioned structured wall pipes of the type used for non-pressure, drainage, and so on, and these have shown at least the same, if not more, innovative thinking than those products already mentioned. Structured wall pipes are a brilliant way of giving something for nothing. For non-pressure applications, the key requirement for buried pipe is to resist ground loading. This could be done with a thick pipe wall or high modulus material, but when a requirement to resist internal pressure is absent, the result is much more cheaply achieved by employing design principles akin to 'I' beams, box girders, and so on. Therefore we have pipes with external ribs and similar geometric reinforcements, or with hollow channels, or even foam cores. Manufacturing has developed so that all manner of configurations may be reproduced over a wide size range. Some of these pipes are also multi-layered, having a smooth bore surface when required, or remaining simply corrugated in order to maximise flexibility. Materials used depend upon exact configuration and application, but the most common are PVC-U, HDPE and PP. The opportunity exists to use intermediate layers of reclaimed plastics, for example, from scrap pipe, plastics or milk bottles. Some questions have arisen as to the resistance of some of these pipes to cleaning by high pressure water jetting, but this has been shown to be a false premise, when sensible pressures and techniques are used. In reality these pipes offer considerable advantages over traditional materials, by virtue of ease of use, chemical resistance in service, and smooth bore quality. Jointing of such pipes is mainly by mechanical means, but there are also satisfactory methods of welding offered for some.

Possible developments

So where is development of plastics pipes likely to go in the future? Certainly the performance limits for PE will continue to be pushed back. There will be improvements to PE100, maybe leading to PE115 and so on (which means a lower wall thickness for the same pressure rating). Cross-linked polyethylene, PE-X, will be used in applications wider than just underfloor or district heating. Multi-layered pipes, principally of PE, will also continue to be developed, and this is likely to be a major avenue of development. The increasing impetus to reduce water leakage by the most cost-effective means, will encourage the development of increasingly thin wall liner systems, where the existing pipe is of suitable structural integrity. Such products will replace other lining methods such as cement mortar and epoxy resin, thus improving leakage as well as water quality. In PVC the position is less obvious. There is likely to be continued environmental pressure certainly, and this will be responded to, but it seems unlikely that polymer manufacturers will invest further in developing the material itself. On the other hand, the kind of enhancements in performance given by orientation and so on will lead eventually to a

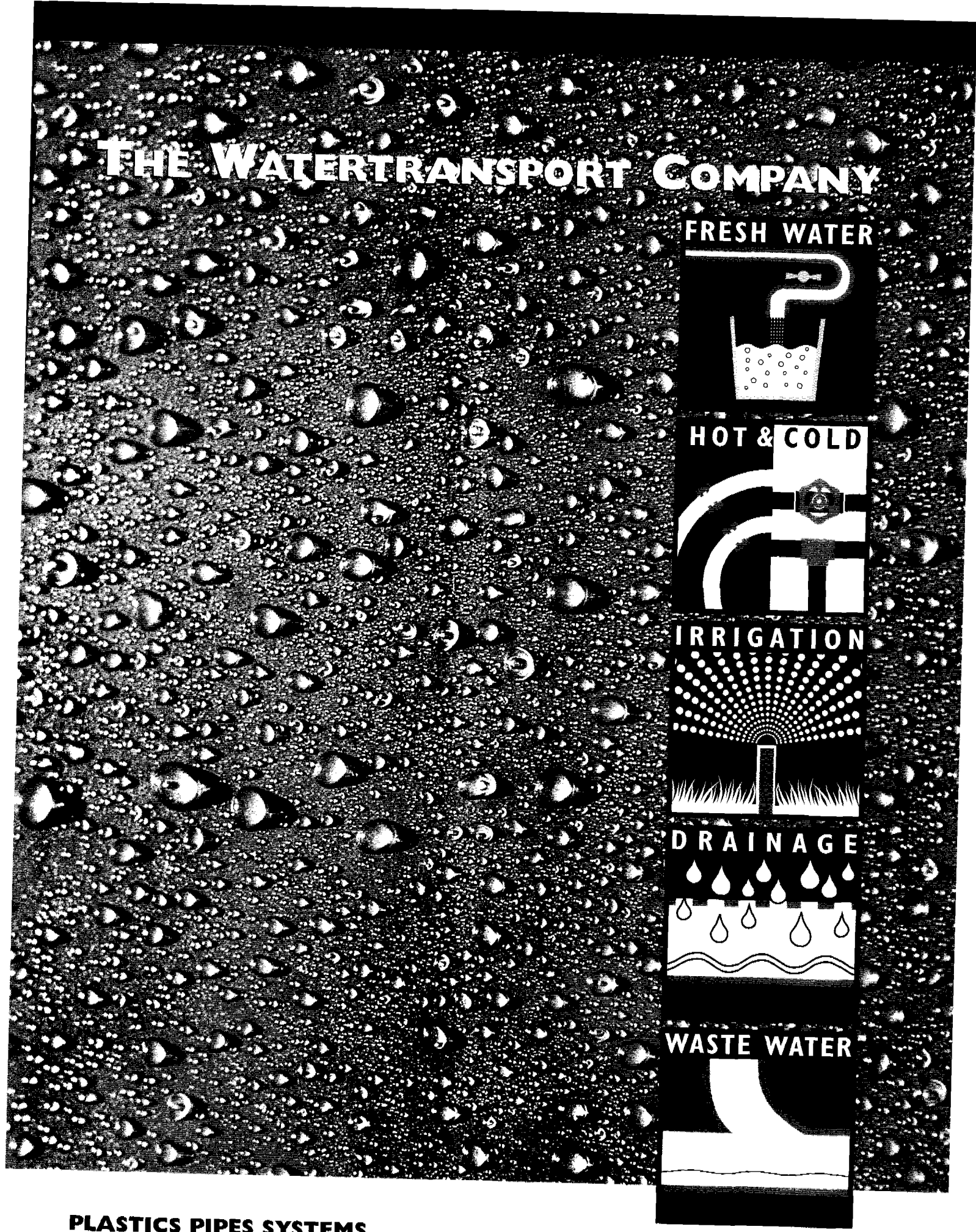


Continuous trenching of a 180mm rising main through an orchard at Marden in Kent, UK

softening of attitudes on performance and safety factors, given continuing absence of problems. PVC will continue to provide safe water distribution for many years to come. Structured wall pipes will continue to grow in importance against traditional materials such as concrete or clay, where huge weight and handling advantages become more important. Of the other materials GRP and ABS still have opportunities for growth and PP may yet make more of an impact than it has hitherto. For all of the polyolefins, further enhancements of the catalyst technology used during polymerisation will permit specialised performance properties to be developed. A willingness to respond to genuine environmental concern is already in place, and this activity can only become more intense. Apart from supplying a product that is crucial to our very being — the provision of a safe water supply — pipe makers will continue to strive to do better in all aspects of manufacturing and application. We use materials safely and wisely, recycle more material than ever before, take increasing measures to improve energy efficiency during manufacture, and down-gauge when prudent to do so.

There is no end to the development process. ●

David Hill is Technical Manager, Pipe Products, Durapipe – S&LP, Huntingdon, UK. He has been with the company (then Stewarts & Lloyds Plastics) since 1983, when he joined them as Product Development Manager. Prior experience was in the PVC industry, employed by a major sheet and film producer in a similar role. He is a member of the Institute of Materials, and holds a BSc (Hons) in polymer science and technology.



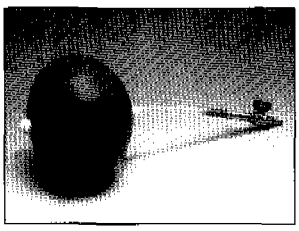
PLASTICS PIPES SYSTEMS
Transportation and Protection

PIPELIFE INTERNATIONAL HOLDING GmbH
IZ-NO SÜD, Strasse 1, A-2355 Wiener Neudorf
AUSTRIA / EUROPE
Tel: +43 / 2236 / 67 02, Fax: + 43 / 2236 / 67 02-5

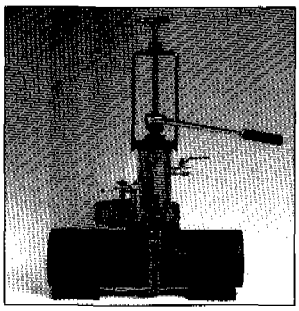
PIPELIFE

The tools that make your jobs SIMPLE

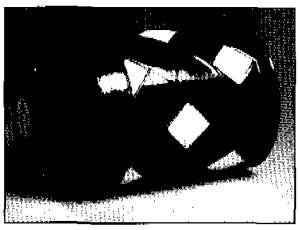
- Hot tapping tools
- Flow stopping tools
- Pipe stoppers
- Test equipment
- Construction tools
- Cleaning pigs
- Couplings
- Repair clamps



Inflatable stoppers, up to 30 bar and 1200mm (48")
(New, patented worldwide)



Hot tapping and flow stopping
Up to Ø 1200mm (48")

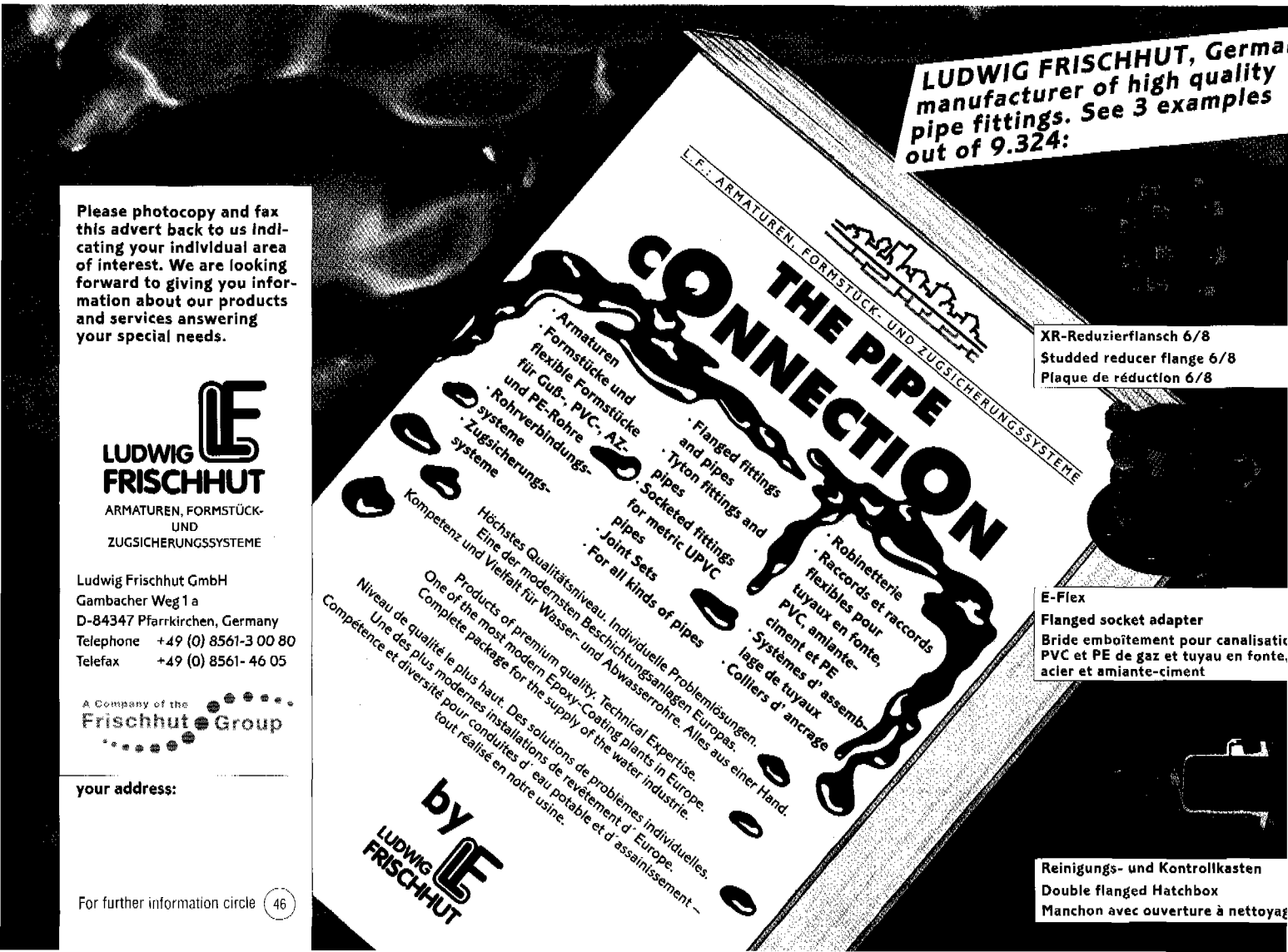


Cleaning pigs
Up to 64"

For more information please contact:

Kleiss & Co. B.V.
Postbus 253
3330 AG Zwijndrecht
Scheepmakersstraat 17
3334 KG Zwijndrecht, Holland.
Tel : +31 78 610 04 99 Fax: +31 78 610 20 73

For further information circle 45



Please photocopy and fax this advert back to us indicating your individual area of interest. We are looking forward to giving you information about our products and services answering your special needs.

LUDWIG FRISCHHUT
ARMATUREN, FORMSTÜCK- UND ZUGSICHERUNGSSYSTEME

Ludwig Frischhut GmbH
Gambacher Weg 1 a
D-84347 Pfarrkirchen, Germany
Telephone +49 (0) 8561-3 00 80
Telefax +49 (0) 8561- 46 05

A Company of the Frischhut Group

your address:

For further information circle 46

Valves to control air **in pipeline design**

Design engineers should be aware of the consequences that can result when air is trapped in pipelines and should do their utmost to prevent the presence of air, by alternating the design or providing facilities to de-aerate the pipeline. Contractors should be informed about the care that should be taken in the filling, testing and commissioning of pipelines.

Professor S J van Vuuren, University of Pretoria

Air in pipelines contributes toward the frustration of contractors, designers and operational staff. In water mains, the conditions which lead to free air entering and being transported in the pipelines are unavoidable.[1] First-time filling, temperature variations and normal operation are but a few conditions leading to the presence of free air in pipelines.

The following article focuses on an aspect which might seem irrelevant to this subject, but which is of vital importance to the pipeline designer: the de-aeration of pipelines by hydraulic and mechanical means. Since it is difficult to prevent the intrusion of free air into pipe systems, procedures have been developed to de-aerate pipelines. Hydraulic and mechanical methods of de-aeration are distinguished and discussed below.

Hydraulic de-aeration of pipelines

Research has determined the 'threshold' velocity for a given pipe at a certain slope, where the air bubble will become unstable and be transported through the pipeline.[2,3] The most commonly used equations that indicate the required velocity to transport the air are:

$$\frac{Q^2}{gD^5} = 0.707 \tan ø$$

Q = required flow rate, (m^3/s)
D = pipe diameter (m)
ø = slope of pipe (degrees)

and

$$V_c = \sqrt{gD}\,(0.25\sqrt{\text{Sin}ø} + 0.825)$$

V_c = critical velocity required for the removal of air (m/s)
D = diameter of pipe (m)
ø = slope of the pipe (degrees)

These two equations provide contradictory results, mainly because the second equation was derived from the observation of large air bubbles (d/D ~ 0.2, where d = the bubble diameter and D = the internal pipe diameter). Therefore, according to the second equation, conservatively high flow velocities are required to transport air downstream through the pipeline where it can be expelled.

Mechanical removal of air

In normal distribution systems, sufficient outlets are available to expel the air, or dissolve it due to the higher static pressures experienced during low demands. In other water infrastructure components, it remains important to consider the effect of free air in the system.

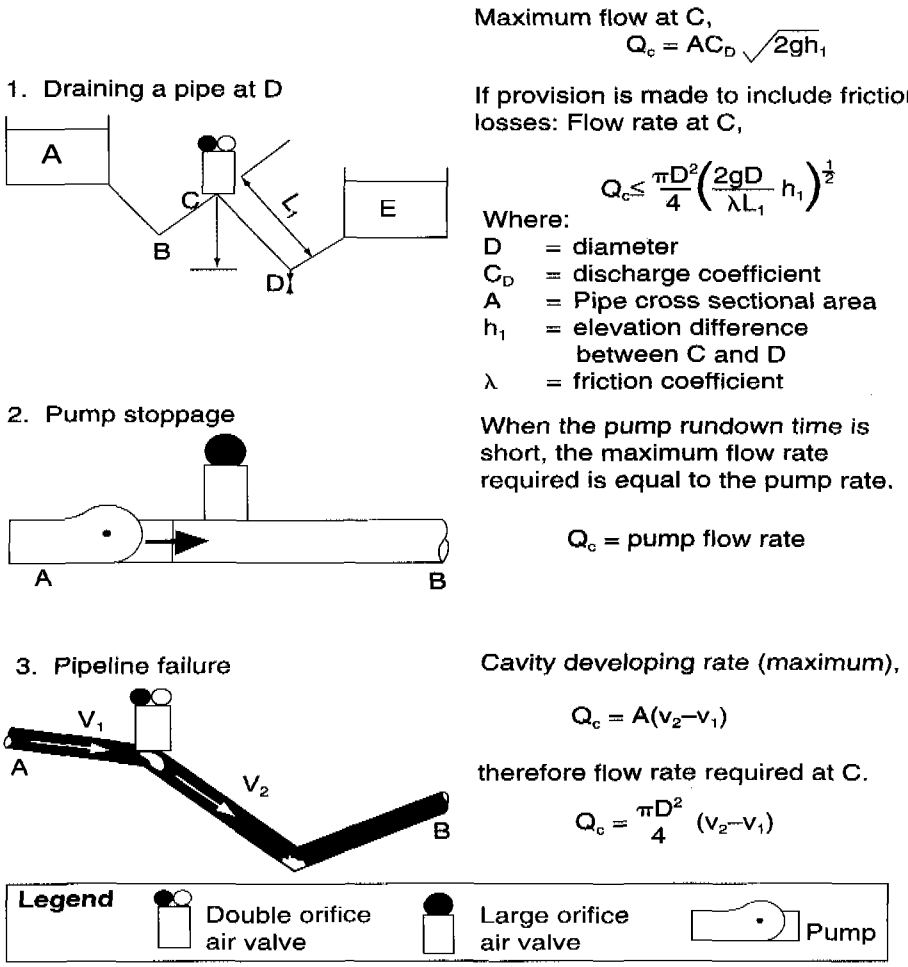
Contradictory statements have been made in the past regarding the need for air valves, and certain functional tests of these valves have not yet been included in the specifitions of water supply authorities.[4] Details on the sizing and positioning of air valves are avaiable and therefore only certain aspects are highlight here.

Large orifice air valve-sizing. These valves are mostly sized for intake. The differential pressure for intake should preferably be limited to 40kPa. With this as a guideline, Annexure A (as shown in Figure 1) can be used to determine the required flow rate and, following from this, the size of the large orifice air valve can be determined.

Large orifice air valves are also used to discharge large volumes of air during the filling of pipelines. This specific function, however, has been misrepresented, mainly because valve manufacturers focused on the discharge capacity, employing kinetic shields and other facilities to maintain the high discharge rate and, in most cases, ignoring the consequences that follow after blow-shut occurred or when the valve closes after all the air has been discharged.

Details are available describing the maximum allowable filling rate to prevent induced surge pressures resulting from the closure of the large orifice.[5]

Small orifice air valve-sizing. A small orifice provides the facility to de-aerate the system under normal operating pressures and the selection therefore should be a function of the operating pressure. Drop tests will provide proof to the designer that the small orifice will function under the operating pressures. The size of the small orifice is dictated by the operating pressure, the atmospheric pressure, and the characteristics (mass and buoyancy) of the float. In recent developments a slit opening was employed as the small orifice and the float virtually peals the seal from the opening when it drops.



Maximum flow at C,

$$Q_c = AC_D\sqrt{2gh_1}$$

If provision is made to include friction losses: Flow rate at C,

$$Q_c \leq \frac{\pi D^2}{4}\left(\frac{2gD}{\lambda L_1}h_1\right)^{\frac{1}{2}}$$

Where:

- D = diameter
- C_D = discharge coefficient
- A = Pipe cross sectional area
- h_1 = elevation difference between C and D
- λ = friction coefficient

When the pump rundown time is short, the maximum flow rate required is equal to the pump rate.

Q_c = pump flow rate

Cavity developing rate (maximum),

$$Q_c = A(v_2 - v_1)$$

therefore flow rate required at C.

$$Q_c = \frac{\pi D^2}{4}(v_2 - v_1)$$

Figure 1. The design of large orifice valves as vacuum breakers

The sizing of air valves has been discussed briefly, and some attention will now be given to the positioning of air-release and vacuum-break valves.

Although it might be necessary to install both large and small orifice air valves at specific points along a pipeline (double orifice), the functioning of these valves is so distinct that their positioning will be discussed separately below.

Positioning of air valves

The positioning of large orifice air valves as vacuum breakers. Sub-atmospheric pressures in a pipeline result from pump stoppage, valve closure, pipe failure, or the drainage of sections of the line.

The points along the longitudinal section of the pipeline closest to the hydraulic grade line (this does not necessarily constitute topographic high points), will first reach sub-atmospheric pressures (if the pressure drops that low), leading to the activation of the large orifice air valve.

A large orifice air valve, when used as an alternative for a one-way surge tank (or discharge tank), should be placed as near as possible, and just downstream from, the pump check valve.

Depending on the longitudinal profile and the positioning of the shut-off valves in the line, a large orifice air valve should be provided to prevent sub-atmospheric pressures in the line when it is drained. To supply flexible and effective operation of the pipeline (to isolate sections), shut-off valves are normally provided at intervals of 1500 to 3000m (or more). The result is that the spacing of large orifice air valves is more or less the same, due to the requirement to be able to drain any section between shut-off valves.

Where multiple peaks occur along a section of pipeline between the shut-off valves, a number of scour valves must be supplied to drain the pipeline. In this instance, the operation of each scour valve, and possible associated negative pressures, should be taken into consideration to determine the positioning of the air valves.

The results of surge analyses will indicate where sub-atmospheric pressures might occur and it is suggested that large orifice air valves should be provided wherever

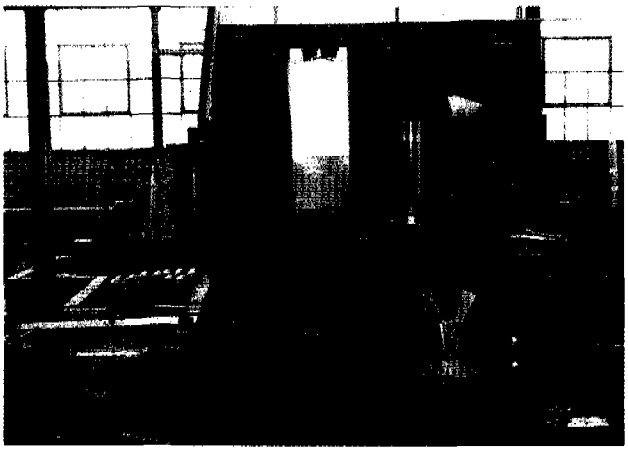


Figure 2. Experimental layout for flow rate research

the pressure drops to below 5.0m absolute.

However, visualisation of the operation of the system remains an integral part of assessing the problem to obtain the optimal solution, rather than to follow normative design criteria.

The positioning of large orifice air valves to release high volumes of air. Large orifice air valves release air only under low differential pressures and this operational feature is used when the line is filled.

If the requirements necessary to prevent low pressures in the pipeline are met, as discussed in the previous paragraph, most of the requirements concerning positioning of air-release valves will also have been met. Other points where large orifice air valves are required will depend upon the way in which the line is filled.

The positioning of small orifice air valves. During operation, air can be released only through the small orifice air valve. For this to occur, the air should be 'stationary' at the valve, although the pipeline simultaneously continues to handle the design flow. This emphasises the need to provide a collection chamber underneath the valve where the air will be captured temporarily and then released through the air valve. Although under normal conditions water can contain 2 to 3 per cent per volume free air, it is not necessary to install small orifice air valves to provide such a discharge rate. It is suggested that the following approach be used to determine the position of small orifice air-release valves:

1. Determine whether the available free air in the pipeline will be hydraulically transported through the pipeline along the downward-sloping sections. For a slope of less than 27°, 1.5m/s will transport all the smaller air bubbles, and for steeper gradients the first equation (above) can be used to determine whether the air will be hydraulically removed. Work through all the sections and identify those sections where air will not be removed hydraulically.

2. The points, identified above, where free air will not be transported, potentially constitute positions where small-orifice air valves will be required.

3. Define the points where small orifice air valves will be installed by evaluating all the potential points under 2., working downstream along the line. The valves will be of use to de-aerate the system, only if it is possible for the air to be captured at the small orifice air valve. The effectiveness of all air valves upstream of the point under consideration, therefore, will influence the motivation for the downstream small orifice air valve. If the distance between small orifice air valves is short (say 250m), it is not necessary to provide a small orifice air valve at all the identified points, provided that the line will effectively be filled and that the upstream small orifice air valve will effectively release all the air that reaches it.

The effective operation of the small orifice air valve necessitates the provision of a collector chamber to capture all the air. As a guideline, it is suggested that the small orifice air valve should be installed on a T-piece, the diameter of which should be at least 50 per cent of the pipe diameter. In the case of a double air valve, it is recommended that the T-piece on which the air valve is placed should be equal to the diameter of the line and that the length of the riser pipe should be at least 50 per cent the diameter of the pipe, but not less than 150mm. ●

1. Van Vuuren S J et al (1995) Preliminary results on the prevention of vortex formation at reservoir outlets. Not published. University of Pretoria, Department of Civil Engineering.

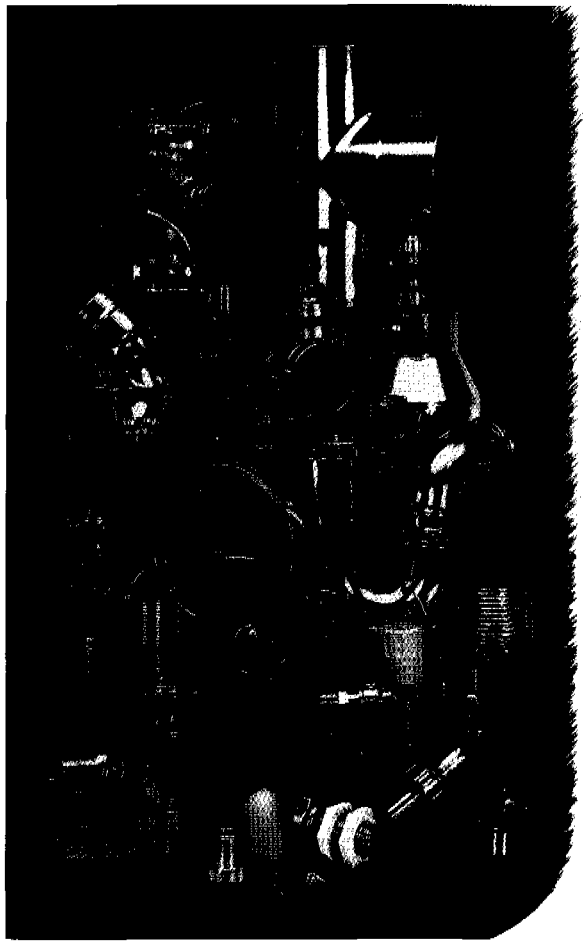
2. Kalinske A A, and Bliss. Removal of air from pipelines by flowing water. Civil Engineering Journal, ASCE, 13, pp480.

3. Wisner P E, et al (1975) Removal of air from water lines by hydraulic means. Journal of Hydraulic Division. ASCE, pp243-57.

4. Van Vuuren S J (1991) The purpose and location of air valves in pipelines. SAICE lecture course, University of Witwatersrand, Johannesburg.

5. Van Vuuren S J (1990) The effect of air in water pipes. One day course on pipeline engineering. South African Institution of Civil Engineers (SAICE) in conjunction with the Fibre-Cement Association (FCA).

S J van Vuuren is Professor of Engineering (Water Division) in the Department of Civil Engineering, University of Pretoria, South Africa.



PLUMBING AND INSTALLATION PRODUCTS

IBP is a major group with long established, international experience in sanitary, heating and plumbing technologies.

Partner for the living house

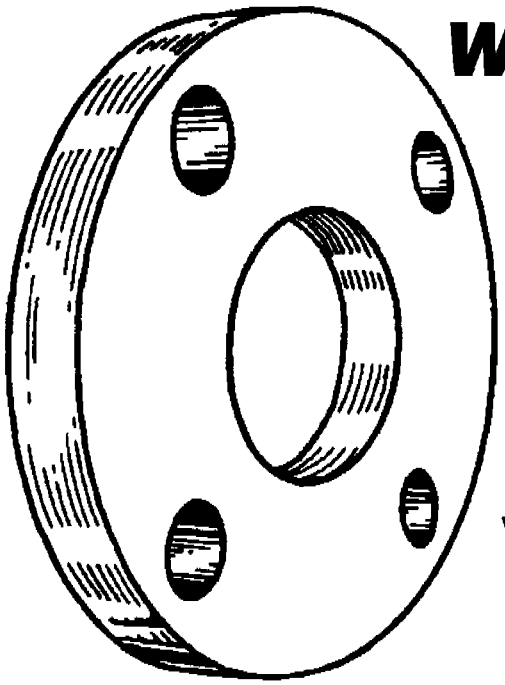
It is recognised worldwide as a leading manufacturer providing fittings and systems that enable the installer to complete any project, whatever the technique - capillary, compression, threaded or axial jointing.

DELCOP® IBP 3000 IBP 8000 TRIFLOW®
DELBRAZE® CLYDE CONEX® NAUTILUS®
SUPERGRIP® Bolivar® COAS

IBP CONEX

WHITEHALL ROAD TIPTON WEST MIDLANDS DY4 7JU ENGLAND
TEL: +44 (0) 121 557 2831 FAX: +44 (0) 121 520 8778

For further information circle (49)



Waterworks flanges

- AWWA class D, E & F 2 - 144"
- Special flanges up to 200"
- Ductile iron back-up flanges 1/2" - 48"
- Stainless steel plate flanges 304L / 316L
- A 105 ANSI B16.1 large diameter
- Class 125LW lightweight slip-ons

Your 'world class' flange source

Capitalize on our worldwide network of flange producers.

CAB Incorporated

For further information please contact:
5964-G Peachtree Corners East
Norcross, GA 30071, USA.
Tel: +1 770 662 3010 Fax: +1 770 368 8086

For further information circle (50)

Structural rehabilitation of sewer **systems in developing countries**

Many cities in developing countries have severe problems due to inadequate drainage. This is caused not only by a lack of foul and storm water sewers, but also by operational problems with the existing sewers. The Water Research Centre's approach to sewerage rehabilitation has been applied in many countries throughout the world to rectify structural deficiencies in the older sewer systems.

John Cant, Water Research Centre plc

The building of sewer systems in most developing countries follows the same general pattern. Typically, a city will have an older core system covering a relatively limited central area which was built at the turn of the century using traditional materials such as masonry and brick. Rapid expansion of the city has subsequently occurred and where a sewer system is installed and has been added to piecemeal, the existing system frequently overloads the older core system.

Sewers in poor condition can cause a large variety of problems. Siltation and blockages occur frequently causing foul sewage to flood and pollute the surroundings. Flow retention times are longer and sewage septicity is increased, leading to acidic corrosion of structures and odour problems. Sewer collapses can cause severe traffic disruption. Infiltration or exfiltration will cause a range of operational problems.

A particular threat to public health occurs where the water mains as well as the sewers suffer from leakage problems and the water supplies can be contaminated with raw sewage. This occurs in areas where the water supply system suffers frequent interruptions due to daily shut-downs, often in order to save water. This results in low pressures occurring in the system which causes groundwater to be drawn in where the water mains leak. If exfiltration from sewers has contaminated the ground, this polluted water is drawn in and mixed with the mains water.

Basic sewer system problems also occur due to poorly maintained manholes. Good quality covers made from materials such as ductile iron are expensive and may be stolen for scrap. As an alternative, reinforced concrete slabs are used but these are susceptible to damage, especially when being removed. If manhole covers are not maintained, rubbish enters the manhole causing blockages and access to structures can allow public contact with sewage or even in some cases the diversion of flows for make-shift irrigation schemes.

When resources are limited, sewer cleaning tends to be neglected. Jetting equipment is expensive and understandably not used, but manual techniques tend not to be used even though cheap labour is available. If cleaning is not carried out, septicity and the flow capacity of the sewer are both adversely affected leading to the rapid deterioration of many sewer systems. Overflows are frequently triggered and add to the overall problems.

Planned approach

The fundamental approach to the planning and implementation of sewerage rehabilitation work should be the same anywhere, as the aim is always to upgrade to the required levels of service using the most economic approaches possible.

Detailed planning is very important. Sewer records are used to identify the critical sewers on which resources should be concentrated. The sewers are inspected and assessed for rehabilitation work. Manhole inspections provide basic information on structural and service condition. System performance information is obtained through interviews with local operations personnel.

Internal sewer inspection should be carried out on critical sewers. The inspection costs can be kept low by using standard 35mm cameras to take photographs from within manholes. This provides very good information on which to base a condition survey and identify sewers requiring rehabilitation.

The Sewerage Rehabilitation Manual written by the Water Research Centre (WRc), contains all the guidance information necessary for hydraulically and structurally upgrading a sewer system.[1] Although originally written 15 years ago for the UK water industry, it has since been applied in many countries in different regions around the world, including South America, North America, Europe, South Korea and Asia.

Structural upgrading work and changes to operational practices are identified. Changes to sewer operation which are relatively inexpensive such as regular cleaning can be shown to provide huge benefits and justify the relatively low expenditure involved.

Sewer renovation

Renovation of the existing sewers can be the ideal solution as it keeps traffic disruption to a minimum. All correctly designed renovation techniques use the existing sewer fabric in order to create a new sewer structure. These techniques provide the opportunity to use the existing structure of the sewer to produce a thin-walled, cost-effective lining.

There are many sewer renovation techniques available

Typical brick sewer in poor structural condition

(over 40 in the UK alone). Some types of renovation techniques are particular appropriate for use in the developing world, especially those which use cementitious materials and keep the materials costs relatively low. These include ferrocement, guniting, segmental linings and concrete linings. Plastics, including epoxy and polyester resins, are relatively expensive, especially if used for renovating large diameter sewers. Most renovation techniques that have been developed in recent years make use of plastics. The requirements for specialist plant and specially trained personnel are also factors that preclude the use of some techniques.

Segmental linings use pre-cast units which are small enough to be taken into a sewer through the manhole. They are manufactured from a range of materials including gunite, ferrocement and glass-reinforced cement. The segments are assembled in the sewer to form a continuous lining and the annulus is filled with grout resulting in a composite structure. Both the manufacture and installation of these linings are labour intensive and not reliant on special plant, so lend themselves to application in developing countries.

Ferrocement is constructed in-situ using galvanised steel mesh formed to the shape of the sewer onto which mortar is placed. It is a labour intensive technique using readily available materials and has the advantage of being able to form any profile required. Careful design and installation is required to ensure the required level of strength and durability, but if correctly used is a highly effective technique.

Where high-strength linings are required, such as in deep large diameter sewers, then in-situ concrete linings are a well established option. Again, this is basically a labour intensive technique that is suited to the developing world, although a certain level of skill is required.

Local repair techniques provide a cost-effective alternative to full-length repairs. They are relatively new and only just becoming fully established as reliable techniques used in non man-entry sewers up to 600mm diameter for lengths up to 2m.

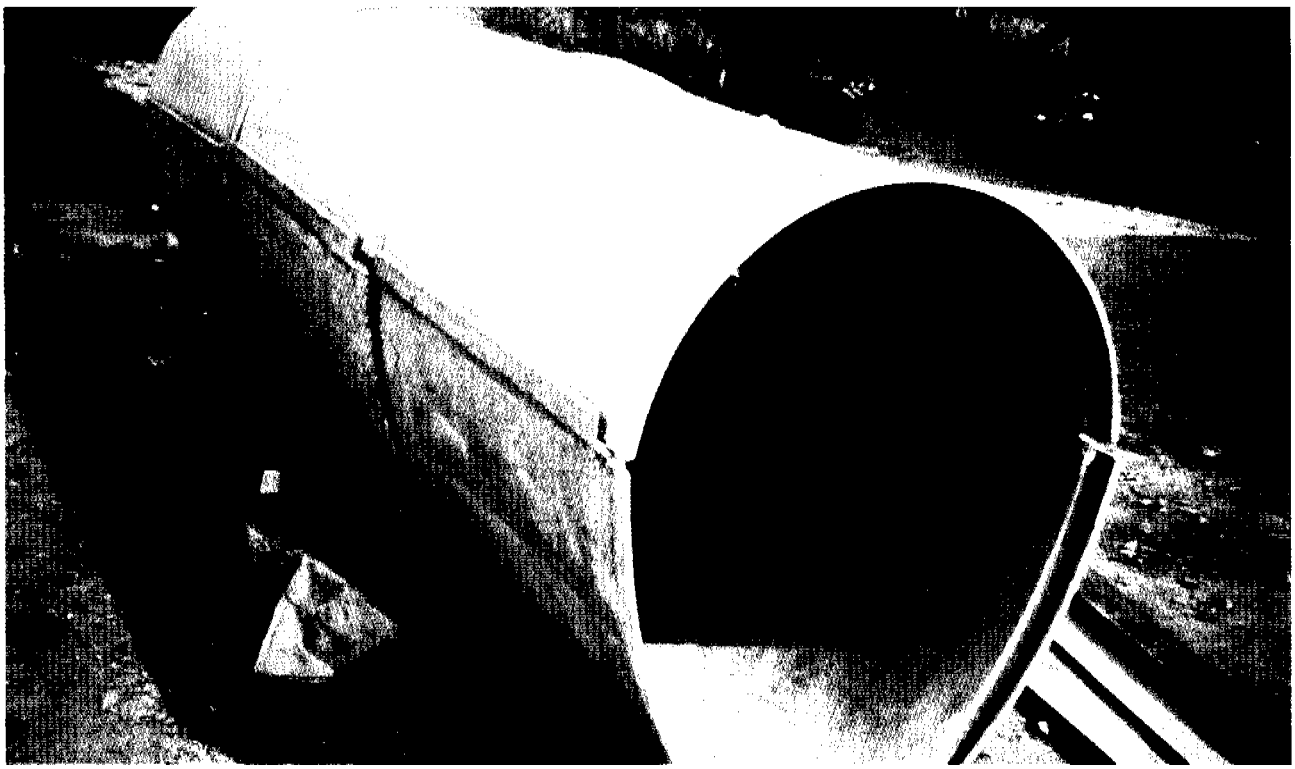
Detailed specifications are available for all the techniques described above.

Sewer replacement

Complete replacement of old sewers is frequently the most economic option, although it does have the disadvantage of being more disruptive than sewer renovation.

The planned approach is still important as lessons can be learnt from analysing the old systems which can be used to improve the design of new systems. For example, are sufficient self-cleansing velocities being achieved and are appropriate materials being used which have a long asset life and are cost-effective? Installation procedures can be improved, for example, a frequent mistake is the rigid jointing of pipes with mortar.

New sewer materials need to be appropriately selected in order to avoid problems previously encountered. The most commonly used material is concrete, but particular



Example of segmental lining system

attention must be given to the use of this material in hot climates. It is applied to all types of construction, mainly because of its cost advantages, so assumptions tend to be made by some designers that it is suitable for all tasks. Its shortcomings are often not understood or are simply overlooked. Quality is very important, as is a knowledge of its limitations. Plastic-lined concrete pipes may be an economic choice in many locations.

Asbestos cement, although disliked by many designers for health and safety reasons, has considerable advantages especially in terms of cost and should be given detailed consideration.

The use of plastic pipes, although more expensive than traditional materials, may have long-term advantages in aggressive environments such as those commonly found in cities as a result of effluent quality or ground conditions.

Safety

All sewer construction and rehabilitation work can be very dangerous and this fact is not fully acknowledged in many places. Most important is the provision of training to all those involved in the work including supervisors as well as labourers. Purchasing and maintaining safety equipment can be extremely difficult in developing countries so an understanding of the dangers and the measures which can be taken to reduce risks is even more important.

Conclusions

As cities in developing countries expand, the demands placed on the infrastructure increase, as does the need to maintain the existing sewers in good operational order.

Time and money spent on gaining a good understanding of the characteristics of existing sewerage system are always a good investment. An appreciation of the good and bad aspects of the existing system will help to ensure that costly mistakes are not made or repeated when structural rehabilitation of the sewer system is undertaken. New sewer construction can also be improved and reduced whole life costs and environmental impact coupled to longer asset life, will be achievable with time spent on the strategic planning stage of the rehabilitation programme. ●

1. *Sewerage Rehabilitation Manual (1994) third Edition, Water Research Centre, Swindon, Wiltshire, UK.*

John Cant is a senior civil engineer in the pipeline technology group at the Water Research Centre, Swindon, UK. He has undertaken many water mains and sewerage rehabilitation projects including a number for clients in South America and Asia.

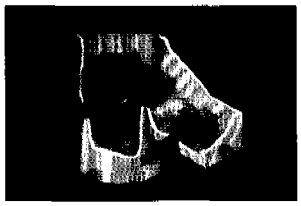
HYDRO INTERNATIONAL

The Hydro-Brake® and Reg-U-Flo® Vortex Flow Control

6000 installations

- Controls flow to +/- 7%, units up to 4000 l/s available.
- Outlet is 3-6 times larger than the equivalent orifice plate.
- Self-activating with no moving parts and with no power required.
- Blocking and fouling negligible.
- Storage reductions are 30% better than orifice options.

200 installations

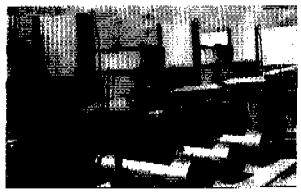


The Hydro Storm King® Overflow - ***for solids & neutrally buoyants removal***

- Prevents gross pollution of ecologically sensitive waters.
- Satisfies stringent discharge consent standards.
- The Swirl-Cleanse™ achieves 100% particle removal for 6mm in 2 directions.
- Removes gross settleable solids and floaters, even under extreme overload.
- Captures first foul flush, reduces suspended solids and BOD.
- No moving parts - negligible maintenance.
- Self-activating - no external power required.

100 installations

Grit Removal with Grit King® Separator



- Over 95% grit removal to 200 microns.
- Residual organics to 5% option dependant.
- Residual moisture to 25%.
- Low maintenance, with no power required for grit separation.
- Low headloss with easy integration to existing systems.

HYDRO INTERNATIONAL plc
Shearwater House, Clevedon Hall Estate, Clevedon, BS21 7RD, UK

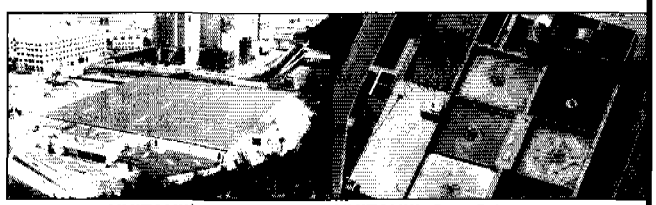
Tel.: +44 1275 878371
Fax: +44 1275 874979

For further information circle (54)

The BETTER technology for the environment

Fields of activity:

Advanced waste water treatment:
UNITANK® - *zero emission* UNITANK®
Drinking water: POTABLOC, POTAWELL
Industrial process water
Intelligent and adaptive process control:
BIOSCAN-BIOMASTER®
Biosolids treatment:
COMPOSTELLA®
Off gas treatment and VOC control:
SEGHOBIOCLEAN®
Manure treatment:
SKARABEE®
Laboratory for environmental technologies:
AQUALEUVEN
Problem Solver: WATER DOCTOR®
Soil Bio Remediation: UNISOL®



zero emission UNITANK®, Macao — UNITANK®, Coca Cola

SEGHObioclean® — SKARABEE®

BIOscan-BIOmaster® — WATER DOCTOR®

Hundreds of realisations worldwide

Offices worldwide : Spain, Singapore, The Netherlands, Portugal, USA, UK, North China, Malaysia, Australia Egypt, South China (Macau), Ireland, Vietnam, Argentina

SEGHERS The efficiency partner | BETTER TECHNOLOGY *for* WATER

Grote Baan 63, B-3150 Wespelaar, Belgium,
tel.: +32/16/60.82.11, fax : +32/16/60.61.64
e-mail: seghwat@pophost.eunet.be
Homepage: www.seghers-water.com

For further information circle (55)

Solutions in Pipe Systems - Worldwide

Many companies talk of their international distribution networks but lack manufacturing integration and product range. There is now a global organisation with a universal capability in high performance pipe systems for the water industry - Glynwed Pipe Systems.

Head Office: Glynwed Pipe Systems,
De Montfort House, High Street,
Coleshill, Birmingham, B46 3BP,
United Kingdom.
Tel: +44 (0)1675 467557
Fax: +44 (0)1675 465977
http://www.glynwedpipesys.com

GPS ME (Mainland Europe),
Pian di Parata,
16015 Casella,
Genoa, Italy.
Tel: +39 10 96211
Fax: +39 10 9621411

GPS (Asia) Pte Ltd.,
15 Tai Seng Drive,
#01 - 00,
Singapore 535220.
Tel: +65 2869555
Fax: +65 2819555

GPS companies serving the water industry include AVF - Astore Valves and Fittings, Calder, Capper, Durapipe - S&LP, Enfield, FIP, Harrington, Helden Couplings bv, Kunstoffwerk Höhn, MASA, Philmac, Valvestock, Viking Johnson, Vulcathene and Wask-RMF.

Glynwed

A Glynwed International company

For further information circle (56)

The North Coast **Superaqueduct Project**

A multinational consortium has been commissioned by the Puerto Rican government to design, build and operate a new water supply system to service the north coast of Puerto Rico. The $350 million contract will take 29 months, and be operational in early 1999.

Thames-Dick Partners

It is nearly eight years since the Thames Water Ring Main was commissioned, bringing London's water distribution system into the twentieth century. Since then, Thames Water has continued to build on its vast wealth of pipeline experience and lead the way in the field of planning, design, implementation and operating water transmission and distribution systems.

Armed with this wealth of experience, Thames Water has successfully ventured into the overseas market. It now boasts several major concessionaire contracts to supply people with water in China, Malaysia, Indonesia, Thailand, Puerto Rico, and Turkey.

Many of the current international pipeline project traverse lands of varying geology, topography, and usage which greatly differ from those encountered on home soil. Different land expropriation powers, cultures, climates, and design codes exist. These are but a few of the many issues which have challenged Thames Water and their partners over recent years in their international work.

Concessions have been awarded in areas where, for a host of reasons, clean and uninterrupted water supply cannot be guaranteed to the local population. The North Coast Superaqueduct Project is one such concession. The following paragraphs summarise how Thames-Dick Superaqueduct Partners are managing and tackling the task of building a water supply scheme in Puerto Rico.

Introduction

A multinational consortium (Thames-Dick Superaqueduct Partners) has been commissioned by the Puerto Rican Government (PRASA) to design, build and operate a new 400 million l/d water supply system to service the North Coast of Puerto Rico. This $350 million effort, which is known as the North Coast Superaqueduct, will be built over a 29-month period and then operated under a five year O&M contract.

Puerto Rico has a population of approximately 3.5 million people, of whom two million are concentrated in the north coast area around San Juan. During times of extreme weather conditions there are water shortages in this densely populated area. An acute water shortage during the 1994 drought left the North Coast without sufficient water for several months. This prompted the rapid implementation of the Superaqueduct Project. The threat of future droughts forced a requirement that the alignment, site selection and design permitted rapid right-of-way acquisition and construction.

The sponsors of Thames-Dick Superaqueduct Partners are Thames Water International of the UK and Dick Corporation from the USA. The latter is responsible for the design and construction of the project, while Thames Water is responsible for the commissioning, operation and maintenance of the works.

The design of the project is the responsibility of the consortium, however, the designers are directly employed by PRASA. Two teams head up the project design: VHL, of Puerto Rico, in association with Malcolm Pirnie, from the USA, are responsible for the Water Treatment Plant; and QDSA, of Puerto Rico, in association with Chiang, Patel & Yerby, from the USA, are responsible for the river intake, bankside storage reservoir, raw water pumping station and main, the treated water trunk mains, treated water storage tanks, the sludge lagoon supernatant discharge pipe and all ancillaries associated with these items.

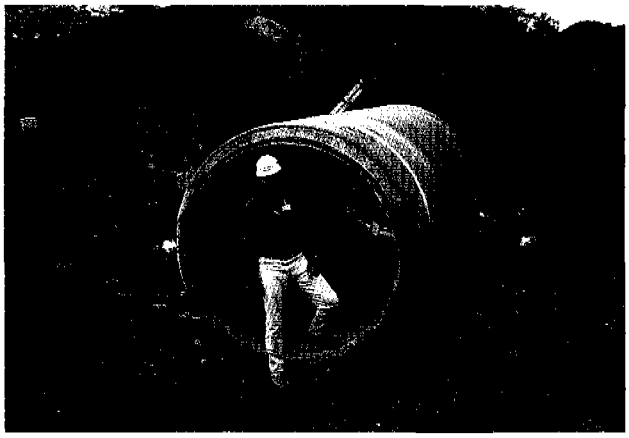
Project background

Raw water for the Superaqueduct Project will be drawn from the Arecibo River via an intake to a 1500-million litre bankside storage reservoir. The water will then be pumped via a 7km, 1.8m-diameter pipeline to the water treatment plant where it will undergo chemical/physical sedimentation, filtration and disinfection. The treated water will flow by gravity through a 57km, 1.8m-diameter pipeline from Arecibo to San Juan. There will be eight connection points along the pipe route, enabling potable water distribution to 15 north coast municipalities, including San Juan. The connection to Arecibo will be via a 10km, 0.9m-diameter pipeline.

Clarifier sludge and filter washwater will be treated in washwater recovery tanks and sludge lagoons prior to reuse or disposal back to the Arecibo River via a 7km, 0.6m-diameter pipeline.

Raw water intake and reservoir hydraulic design concept

The source of the Arecibo River is located in the mountains of central Puerto Rico. A hydro-electric dam is located near the head of the river. This dam is traditionally used to satisfy peak power demand and therefore the flow in the Arecibo



A typical 1.8m ID PCC pipe

River is extremely variable.

The scheme intake is downstream of the dam installation, and therefore a method of balancing the river flow is required. The design incorporates a 1500-million litre bankside storage reservoir and intake weir that captures water from the river during its peak time flows and leaves a minimum flow in the river to the downstream estuary. The river has a safe yield of about 450 million l/d. After the scheme abstraction of 400 million l/d, there will be an average residual flow in the river of about 50 million l/d.

The reservoir is sized to store three days' peak water demand from the water supply scheme.

The reservoir intake weir is a 60m-long concrete side channel structure. It allows water to flow from the river to the reservoir while the river is at a stage greater than 0.25m above downstream river control. The control is a shoal comprised of large stones.

To determine the optimum intake system, an HEC 2 computer model of the river and alternative intake systems were developed. Input to the model included detailed cross-sections of the stream channel upstream, downstream and through the shoal area. A mannings coefficient of 0.028 was used for the shoal area, consistent with cobble bottom channels. A value of 0.04 was used for the upstream backwater pool adjacent to the side weir, consistent with a clay and sandy channel floor with irregular side slopes, bottom and cross-section.

The model was also used to develop stage-discharge rating curves to predict the diverted flow and the downstream flows to ensure that both criteria of water supply and downstream estuary requirements were met.

Pipeline material selection

During the conceptual design stage of the project, various pipe materials were evaluated for the trunk mains. The final selection came down to steel pipe imported from Mexico or Europe and locally made concrete pipe. The project moved forward with the local pipe.

For the pressure pipe, that is, the 1.8m- and 0.9m-diameter pipe, pre-stressed cylinder concrete (PCC) pipe was selected. The 0.6m-diameter drain pipe is reinforced concrete (RC) pipe.

The PCC pipe is a composite, steel, prestressed concrete pressure pipe. It is being manufactured for this project by Atlantic Pipe Corporation at their Juana Díaz plant on the southern side of the island.

Each pipe is 6.1m-long and weighs 17 tonnes. About 10,500 pieces of 1.8m-diameter pipe will be required to complete the raw water pumping main and trunk treated water line. The 1.8m-diameter PCC pipe is manufactured in the following manner:

- A steel cylinder is coiled and helically welded out of 1.3m-wide 2.5mm plate
- Galvanised steel bells and spigots are welded to sections of cylinder to make a 6.1m-long pipe
- The cylinder and joint rings are hydrostatically tested
- The cylinder is embedded in a 50mm-concrete liner and 75mm-coating
- The concrete is stream cured
- A prestressing tendon is wound around the concrete coating
- A protective gunite coating is sprayed over the prestressed tendon (total wall thickness is approximately 175mm), and
- The coating is stream cured.

Some pipe bedding material is being selected from the excavated gravels from the bankside reservoir. The remainder is being supplied from local quarries.

All isolation valves are wafer butterfly type, and the air valves are double actuating floating ball type. These valves, along with bolts washers and gaskets, have been pre-packaged into kits and placed in safe storage prior to installation.

Aqueduct system hydraulic design concept

The system designers selected a water treatment plant location at an elevation of 100m above sea level. The top water level at the bankside storage reservoir will vary from 0.5m to 6m depending on the reservoir inflow and system demand. Water will be pumped from the reservoir via the 1.8m-diameter pumping main to the water treatment plant. At peak demand of 400 million l/d, the pumps duty pressure will be approximately 125m water head; the pipe class has been selected to accommodate this pressure. An instrumentation and control systems will protect the pipeline from over-pressurising during a closed valve situation.

From the water treatment plant, treated water will flow by gravity to all the interconnect discharge points. The pipe class for this section of the mains has been determined based on a static closed valve pressure situation.

The designers used the KY-pipe pipe network model to calculate the system hydraulic characteristics. The model used

Pipe installation in a 10m-deep trench

the Hazen-Williams equation for the friction loss calculations. A friction coefficient of 120 was used in the calculation.

There are two isolation valves at the water treatment plant at the head of the rising main. Along the treated water main from the water treatment plant there is an isolation valve at approximately every 7km. Each of these valves generally corresponds to an interconnection point with a municipality's local distribution. Washouts have been located at each of the major river crossings and at locations of significant depression along the route. Air valves are located at all significant negative changes in grade.

The engineers were challenged to design the pipeline in the shortest period of time to maintain the strict project schedule. A number of tools were used to aid the engineers in expediting their work. Aerial photographs of the entire route were obtained and digital maps prepared. The alignment was digitally input onto the maps. A software package known as GEOPAK was used to produce the pipeline vertical and horizontal geometry from the digital maps. The geometry calculations were confirmed using spreadsheet programs.

As part of the protection system for the pipeline, pipes are being electrically bonded. This is done by bolting three copper cables from the socket of one pipe to the spigot of the next. Cathodic protection is only being used where there are known unfavourable ground conditions that will set up a battery effect, and at the crossing of other pipes which are known to have cathodic protection on them.

The pipe system allows for jointing in three ways:

- A rubber ring jointed bell and spigot
- As above, but with a restraining snap ring which acts as a lock to hold the pipes together, and
- A rubber ring joint but fully restrained with a bolted connection.

In general, the system is jointed as per the first of these. However, the second system is used for changes in direction and where it is determined that there is an earthquake risk across geological discontinuities. Fully restrained joints have not been used on this project.

Pipeline route selection

The project schedule dictated that the route for the pipeline minimise the time required for right-of-way acquisition and the time required to secure environmental and other governmental permits. The region between the Arecibo River and the metropolitan area of San Juan is characterised by undeveloped areas with pockets of congested development. Most of the undeveloped areas are agricultural land or lie in the river flood plain or rocky limestone outcrops, known as Mogotes. Much of the undeveloped land harboured endangered plants or animal species or contained significant archaeological sites.

The initial routing of the pipeline was determined during the conceptual design phase of the project based on a preliminary assessment of topographical features, following a path, which minimised the human and environmental impacts. The selection process for the conceptual routing relied heavily upon a mathematical model, which weighted the area to be traversed by the pipeline in terms of overall sensitivity. In general, the preliminary design attempted to route the pipeline within public rights-of-way to minimise the crossing of private properties and to minimise working in previously undisturbed areas. During the preliminary design phase, the engineers went into the field to verify the assumptions which had been made about potential impacts, and to seek ways to further minimise them. Detailed walks along the proposed route and interviews with residents and businesses revealed additional information as to property ownership, location of structures and other property-related issues which was used to adjust the conceptual route. With regard to environmental issues, meetings were held with all of the pertinent agencies to identify their concerns and to obtain their comments on the conceptual route. Issues considered, among others, were the location of Superfund sites, protected parks, wetlands, endangered species, and the presence of archaeological deposits. Of these environmental factors, the one with the greatest impact on routing changes was archaeological sites. By conducting archaeological studies in a phased manner, in synchronisation with the fast-track method of project development, it was possible to perform the redesign without affecting the overall schedule.

Route land acquisition

PRASA negotiated an overall agreement with the Highway Department for installing the pipeline within their rights-of-way. This greatly facilitated land acquisition because over 60 per cent of the pipeline was sited within these public ways. PRASA negotiated a similar agreement with the Land Authority for all locations where the pipeline crossed publicly held farmland. Together, these arrangements reduced the total number of impacted private properties to 209 parcels. Through judicious fine-tuning of the alignment, it was possible to keep the number of family relocations at less than 10 for the entire project. Good co-operation was obtained from property owners; it was only necessary to condemn 25 parcels in order to obtain access for pipe installation. The remaining owners voluntarily provided access. While the land acquisition process was time-consuming, it did not delay the overall schedule.

Design and construction project management

Thames-Dick provides overall project management for the engineering, land acquisition, pipe procurement, pipeline construction and co-ordination with the Puerto Rico Department of Transportation and Public Works and Highway Authority. It also provides quality assurance/quality control (QA/QC) and the commissioning management for the pipeline. Each area has a manager or engineer in charge. There is one overall general manager supervising all pipeline activities. In addition there are 12 Thames-Dick staff members allotted to the pipeline works. They are responsible for providing design support, pipe fabrication QA, right-of-way acquisition co-ordination with PRASA and various support functions to meet the needs of the private and government agencies associated with the project.

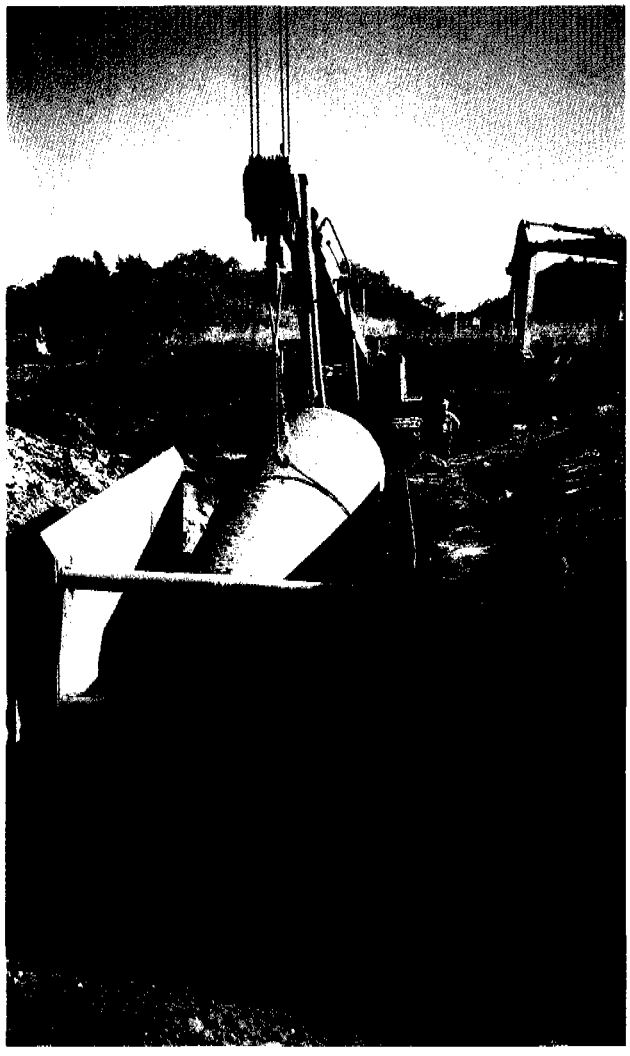
Pipeline construction

Pipeline construction is being undertaken by a single local subcontractor, Longo Construction of Puerto Rico. They have six installation crews installing pipe at various locations along the pipe route with the ultimate aim of connecting all sections to form the entire pipe system. There are two additional crews undertaking restoration work such as the other ground levelling, re-grassing, road repair, drainage restoration, and so on. A final crew is completing the mechanical installation of isolation valves, air valves, man-ways and hydrostatic testing. Each crew has a team of 15–20 craft personnel working in them headed up by a foreman who controls the operation at each site.

Due to the weight and size of the pipe segments, new equipment was purchased off the island to undertake the work. In general, the pipe is being installed with minimum cover, that is 1.2m below ground level. There are some exceptions. When the pipeline leaves the water treatment plant, the ground elevation climbs, so in order to ensure the hydraulic grade stays below the physical pipe grade, the pipe is laid some 10m below ground level. The greater part of the ground is easy going, open river plains, farm land and road verge. In some areas near the Mogotes there is hard limestone rock. To allow production rate to be maintained, some of the hard rock areas are being pre-blasted to enable excavation of the trench. For the pipe installed to date, the average installation rate per week is approximately 600m.

The method of installation is to complete one pipe segment at a time, that is, the excavation of the trench within a trench box approximately 10m long, the laying of bedding material, placing of the pipe, connection of the bonding straps, grouting of the joint, placing the selected back filling, moving to excavate the next pipe, backfilling and compaction.

River crossings are being achieved by sheet piling, diverting the river around the areas of excavation and using the same method of installation as along the remainder of the pipeline.



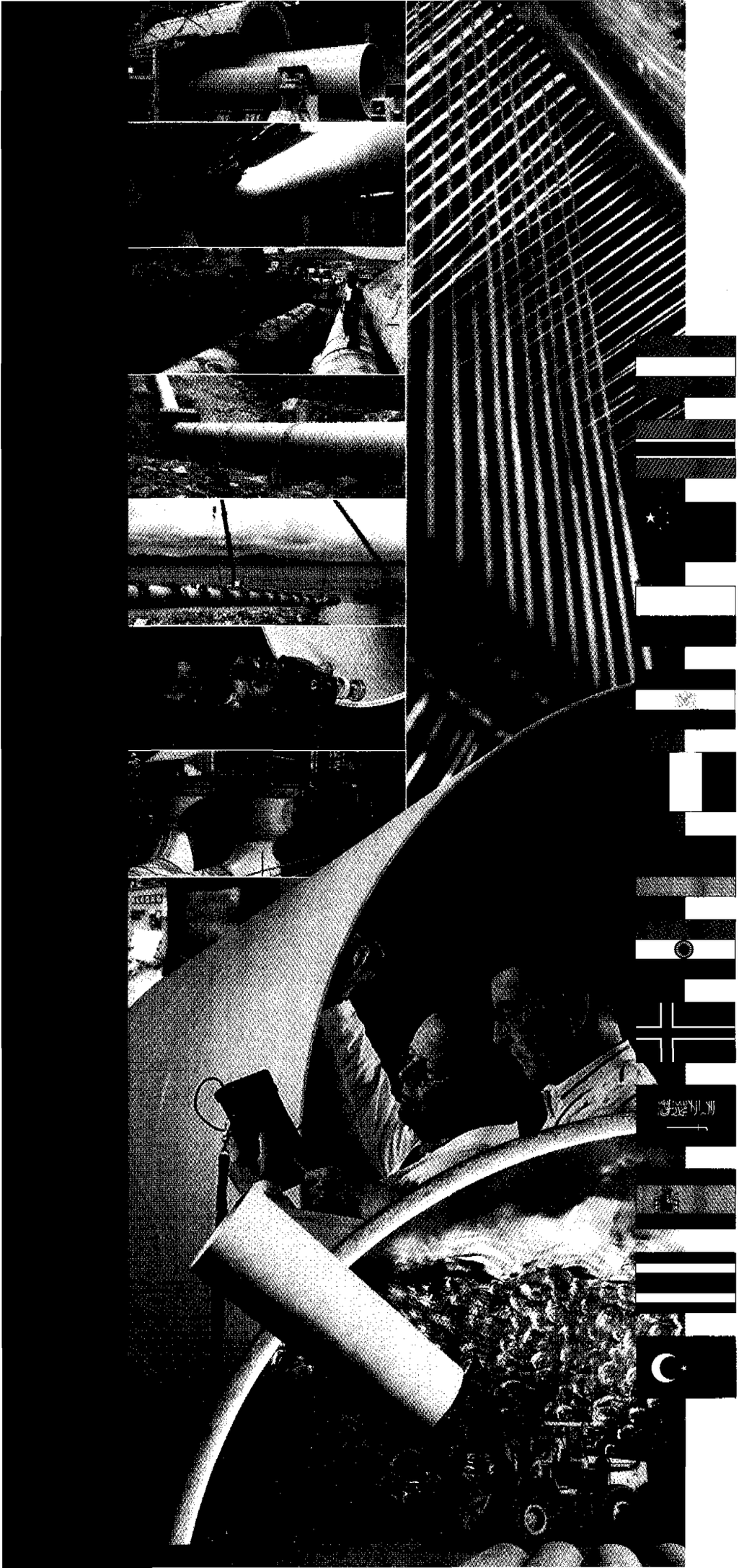
Typical pipe installation technique

Summary

The North Coast Superaqueduct Project will supply 400 million l/d of water to the people of Puerto Rico. The scheme will use prestressed cylinder concrete pipe for the conveyance of both raw and treated water. The total distance, 65km, of trunk main will be installed in 29 months at a rate of about 600m per week of pipe. The scheme will be operational in early 1999.

The significant features of the project are that the water will be taken from the western end of the island, treated and distributed along a 65km front of the north coast and supplement the current water supply to the metropolitan area of San Juan.

The design and construction teams have worked to minimise the social and environmental impact on the communities which are affected by the construction work. To emphasise this point, only 10 properties along the route have been impacted to such an extent that the families had to be relocated. ●



Integrated solutions from the global leader in GRP pipe.

Flowtite® Pipe from Owens Corning

Water is one of our most precious resources. It covers 80% of the earth's surface, yet less than 1% of it can easily be made suitable for drinking.

That's why some of the world's largest and most demanding water transport and waste water collection projects are counting on Flowtite® Pipe backed by the knowledge and capabilities of Owens Corning Pipe Systems, so it meets high demands for lasting performance and economy.

Our approach integrates total solutions that include optimization of product and installation to meet even the most demanding project requirements; high performance, long-lasting materials, more efficient delivery systems and faster installations – all of which translates into the most dependable and economical water supply and sewerage collection systems built today.

For more detailed information or technical assistance in writing your specification, please contact Owens Corning Pipe Systems today...

32.2.674.82.25
32.2.674.82.23 FAX
www.owenscorning.com

OWENS CORNING ™

OWENS CORNING PIPE SYSTEMS
CHAUSSÉE DE LA HULPE, 178
B-1170 BRUSSELS • BELGIUM

For further information circle (63)

Plenty of water ...in the wrong place

The notion that all of Africa has a shortage of the valuable commodity, water, is a mistaken one. Two major pipeline projects that are currently under construction in Southern Africa are designed to get the water to the right places.

European Owens Corning Fiberglas SA

The Pungwe to Mutare Water Supply Project in eastern Zimbabwe is designed to bring the city of Mutare, near the border of Mozambique, more than 20 million m^3 of water per year from the Pungwe river. The North South Carrier (NSC) Project on the other hand, will be moving water from a man-made reservoir (Letsibogo Dam) in the eastern corner of Botswana, 360km south of the capital city of Gaborone.

The 73km Pungwe/Mutare pipeline actually begins with a 4.3km tunnel which is being blasted through the solid granite mountains by the Skanska construction group, the prime contractor for the project.

Glass-reinforced polyester (GRP) pipes are being used in diameters from 630 to 860mm and a pressure rating from 10 to 32 bar. As a result of the unique and often very rough terrain, the water will be able to flow from the river to Mutare by gravity and require no pumping.

Environmental concerns are a major priority with this project, as it begins in one of Zimbabwe's national parks. As a result, many of the GRP fittings are being fabricated on site in order to permit 'custom' angles to be provided for routing the pipeline around the sensitive areas. The GRP pipes are considered to have a longer service life than similar steel piping and are more environmentally friendly than similar asbestos cement piping. GRP requires less maintenance which will mean fewer above-ground disruptions in the future. This was an important consideration when gaining the 'environmental acceptance' of the community. Restoring the natural scenery above the trench will be an easier task since almost all of the pipeline will be buried using existing cleared land (backfill) resulting in a virtually invisible pipeline.

The unique equipment helps speed the installation on North South Carrier project

Bedding crews work ahead to keep pace on the North South Carrier project

Workers backfill the trench on the environmentally sensitive Pungwe/Mutare project

In contrast to the mountainous and rough terrain of the Pungwe/Mutare project is the NSC Project. Currently one of the largest single water carrying pipelines under construction in the world, the NSC covers nearly 360km through relatively flat and open bush terrain. The pipeline begins at the Letsibogo Dam, which was completed in April 1997, but has had to wait for the rainy season to begin the filling process. The pumping station, which will be located at the dam, is currently under construction. The GRP pipes being used for more than 250km of this project range in diameter from 1000mm to 1400mm with pressure ratings from 10 to 16 bar. Unlike the Mutare project, the NSC carrier is nearly a straight run from the Letsibogo Dam to the capital of Gabarone with very few special fittings needed other than the more than 200 mechanical couplings used for the GRP/steel pipe transitions at the value chambers (clean out, pressure relief) along the pipeline. Using 18m lengths of the lightweight GRP pipe, the crews have laid, on average, more than 600m per day, which should make the completion date of late 1998 very likely, pending delays which could occur if the rainy season is longer or more severe than normal (El Niño effect). The construction of the NSC is being performed by a joint venture of three contractors: LTA (South Africa), Balfour Beatty (UK), and CCC (Greece), with the pipe being supplied locally by Owens Corning Pipe Botswana (Gaborone). ●

Distribution **solutions**

The Georg Fischer Piping Systems Group has manufactured plastic fittings since 1957. The Group has over 2400 employees with representations on all five continents offering their expertise and support to customers. Their products are used all over the world in water sourcing, treatment, storage, distribution and also in sewage plants. The wide range of different products and materials is also designed for tailored-to-needs solutions in the industry, gas distribution, telecommunications and irrigation fields.

Georg Fischer Piping Systems Limited

Drinking water is an important natural resource which cannot be replaced. This central point is gaining more and more acceptance. In less developed countries water sourcing, hygiene and easy distribution play an important part. In industrialised countries the focus is on water treatment and distribution due also to increasing pollution. This target creates a variety of challenges in which the piping system is of utmost importance. Water for drinking purposes is required to be hygienically sound, germfree, odourless and tasteless, without colorations and it should be available in sufficient quantities. Water consumption per capita is still increasing in industrialised countries. Water loss by leaking pipelines must be avoided therefore.

Plastic fittings

George Fischer offers plastic fittings in PVC-U, PVC-C, ABS, PP, PE and PVDF for pressure systems, for example, for water treatment where aggressive chlorine dioxide solutions act on the piping systems and where plastic has proven to offer excellent characteristics. Another application is water storage, which has the task of equalising fluctuations in water consumption in order to assure a regular supply of water at all times.

Local water supply has the largest share of investments and operating costs in water distribution. To keep these investments and costs as low as possible, rapid installation, low maintenance and operating costs and longevity with constant good characteristics at all times are a prerequisite. Eighty per cent of the pipe dimensions in local supply are between d 63 and 225mm. Many piping systems are made of plastic and the worldwide tendency is to use the same material in all piping systems. For this purpose George Fischer offers PVC-U fittings with the plastic gate valve as a centrepiece. The range includes all fittings such as injection moulded tees, reducers, flange adapters, to name but a few.

They can be installed into existing piping systems of any other material without problem using a plastic flange adapter and transition fittings. One outstanding transition coupling for various pipe materials and diameter tolerances is the Waga Multi/Joint coupling which George Fischer manufacture in The Netherlands. The range of Polyrac compression fittings in PP is ideally suited for use in irrigation or drainage where detachable systems are required.

Use of polyethylene

Polyethylene is coming into ever more frequent use in water distribution. George Fischer's PE 100 fittings range from sizes d 20 up to 400mm allowing operating pressures up to 16 bar for water. The most widespread methods for achievement of a homogeneous joint are electrofusion and butt fusion. The Elgef Plus electrofusion couplers, saddles and fittings have proved themselves in practice for years. All necessary tooling and fusion control units for these jointing techniques are available from one supplier. As installers have to work with a number of different systems on site, the need for a control unit for all systems is obvious. The so-called polyvalent MSA control units work with every kind of system. Existing piping systems that have to be replaced or extended are still in materials such as asbestos, cast-iron and steel. In order to allow installers to connect to these materials, all necessary threaded transition fittings from PE to brass or steel — also for electrofusion — are manufactured at George Fischer.

George Fischer is a competent partner aiming to support customers with all their available know-how, experience and innovative spirit. They offer in-house or on-site training. Training courses are also organised at their Schaffhausen premises. ●

Pumps & Systems **Asia '98**

Pumps & Systems Asia '98 — the largest pumps and related systems show of its kind in Asia and one of the top two in the world — will be back from 7 to 10 July 1998 in Singapore. In the process of rebuilding the infrastructure of the region, environmentally friendly products are currently top of the demand list, and enormous sums are being spent on water, sanitation and pollution control.

HQ Link Pte Ltd

The Fourth International Exhibition and Conference on Pumps and its Related Systems in Asia leads a group of 11 separate but related shows, and has as its theme 'Business and Technological Trends for the Pumping Industry in Asia'. This year's event is so large that the huge World Trade Centre has had to be supplemented with exhibition space at the nearby Singapore International Convention and Exhibition Centre (Suntec). The exhibition will feature more than 1000 exhibitors from more than 40 countries, and the event is expected to attract a bigger crowd of highly-qualified trade visitors and professionals from Asia and beyond than the 1996 events.

The last staging of the Asia show series in 1996 was well received by both the exhibitors and the visitors. The eight different, but related, exhibitions were a tremendous success, with the participation of more than 25,400 visitors and 1000 exhibitors from more than 40 countries or areas. Within 12 months of the show, sales and contracts committed to at the show hit US$350 million. Data from the 1996 exhibition demonstrates that the main purpose of overseas visitors is to seek out sourcing and sales opportunities in Asia.

With such a track record, the 1998 show series is expected to outdo its predecessors. With the staging of the inaugural forums and conferences simultaneously, the event has taken on the immense task of being the one-stop location for seeking products, services, global interaction and information exchange.

Support from associations

This biennial Asia series show is not short of keen support from various local and international prestigious associations. By the end of 1997, more than 44 associations had alleged their support for the event. The ever-increasing list includes Australia Trade Commission (AUSTRADE), British Pump Manufacturers' Association (BPMA), Compressor and Vacuum Pump Manufacturers' Group within VDMA, European Association of Pump Manufacturers Association (EUROPUMP), Federation of Finnish Metal, Engineering and Electromechanical Industries (FIMET), Gesellschaft für angewandte Ölhydraulik and Pneumatik (GOP), Hong Kong Government Environmental Protection Department, Hydraulic Institute (USA), Ministry of Environment (Singapore), National Fluid Power Association (NFPA), Pump Manufacturers' Group within VDMA, Regional Institute of Environmental Technology (RIET), Singapore Association for Environmental Companies (SAFECO), Australian Environment Management Export Corporation Limited (AUSTEMEX), United States-Asia Environmental Partnership (US-AEP) and Valve Manufacturers' Group within VDMA.

The organisers

Launched in 1992, the biennial Asia series show is organised by HQ Link Pte Ltd, one of the leading exhibition organisers in the Asia Pacific region. With three subsidiaries in Malaysia, Thailand and the Philippines, HQ Link also has a global network spanning 30 countries. Backed by a track record of having successfully organised more than 100 events for numerous industries, HQ Link is most recognised for its well-established series of, for example, pumps, valves, piping, compressors, HVAC, telecommunications, and career and educational opportunities.

Economic situation

Despite the recent economic crisis in Asia, leaders in the region remain optimistic about the future of the market. In fact, the Singapore economy surprised economists by registering a surging 10. I per cent growth for the third quarter of 1997. With a healthy forecast of 5 to 7 per cent growth

There were about 1000 exhibitions in 1996

The '98 event is expected to be even bigger than that of 1996

for 1998, it is undeniable that Singapore is definitely the ideal place to showcase an event of such magnitude.

In addition to this, the World Bank has estimated that the Asian infrastructural projects will create an average annual expenditure of US$150 million in the next 10 years. With more new infrastructural projects in the pipeline, HQ Link's First Asia-Pacific Business Opportunity Forum will be making a timely debut with the Asia '98 show series, to provide vital information for tapping into this lucrative market. The forum will focus on business and infrastructural investments available in the region for the next few years. Government officials and representatives from various Asian countries will present and expound on the upcoming projects in the Asia Pacific region.

Inaugural Asia '98 Conference

The Asia '98 Conference aims to be the meeting place for the pump industry and related industries in Asia. This international conference will see industry professionals discussing trends, issues, innovative technologies, forecasts, breakthroughs and related systems in various industries featured in the show.

Complementing the Pumps & Systems Asia '98 exhibition, the conference has a two-fold strategy to meet the business and technical aspects of the pumping industry in Asia. The conference will feature invited speakers from pump manufacturers and related bodies such as industry associations and government organisations who will identify and highlight business opportunities for the pump industry in the Asian region. Also featuring speakers expounding on cutting-edge pumping technologies, the conference aims to be a one-stop location where all professionals can obtain up-to-date information and keep abreast of the latest breakthroughs in the pumping industry in Asia-Pacific.

Environmental issues will be addressed at a separate conference on Pollution Control Equipment, Systems and Technology. This debut event aims to be the focal point of interaction between the industry professionals concerning the latest environmental protection and systems. Issues such as industrial wastewater treatment and water reuse, coastal pollution prevention and control and environmental restoration will be presented and analysed. This conference is co-organised with Regional Institute of Environmental Technology (RIET).

In summary, the Asia series has established itself as the largest gathering of manufacturers and suppliers in their respective industries of its kind. The 1998 event is an ideal marketing platform for entrepreneurial companies eager to tap the world's fastest and potentially largest market of all — the Asia-Pacific region. ●

A vast range of nations are represented

Further information please contact:
Mr Simon Ng
Marketing Manager and Deputy Project Manager
HQ Link Pte Limited
150 South Bridge Road
#13-01, Fook Hai Building
Singapore 058727
Tel: (65) 534 3588
Fax: (65) 534 2330
E-mail: hqlink@singnet.com.sg

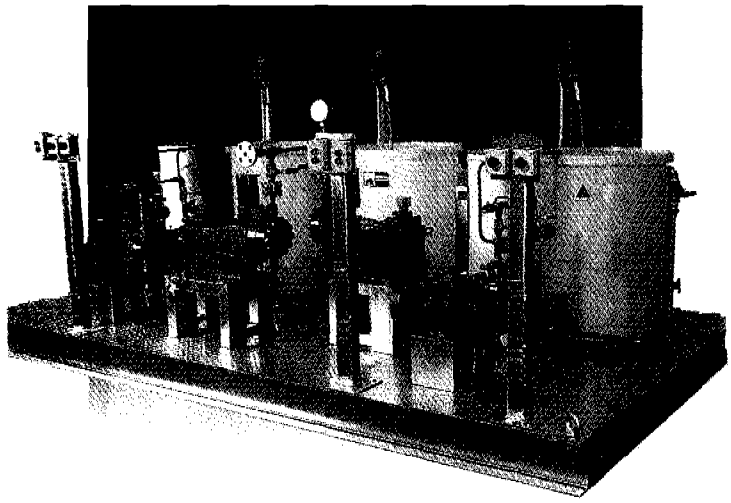
Accuracy, reliability and control.
The vital ingredients for any gas, liquid or dry metering application in the Water Treatment Industry.

Make sure you're operating with the right liquid or dry metering system for the application... at the right price by talking to Acromet today.

Acromet metering pump, chlorine gas or dry material feeder systems deliver world class performance to ISO 9002 quality standards.

To find out more simply call
Acromet Aust Pty. Ltd.
14 Winterton Road, Clayton
Victoria 3168 Australia
Ph: +61 3 9544 7333,
or fax: +61 3 9543 6706.

You want the best water quality, but are you choosing the best metering system?



LL B 6408

ACROMET 1982 ... the better way

Quality Endorsed Company

For further information circle (64)

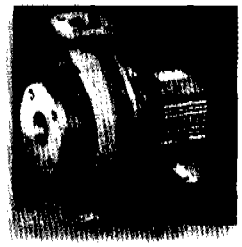
POWER SAVER

Mather+Platt

RELIABILITY

Centrifugal Pumps for all Applications

Each Mather & Platt pump represents a fusion of the latest Computer-Aided Design and manufacturing techniques with the cumulative experience of over 100 years of craftsmanship, metal-working and engineering skills.
Custom-engineered Mather & Platt pumps bring to your project the 'state-of-the-art' in other words the best performance and total reliability. Nothing less. So, when you select Mather & Platt, you select confidence. Take a look at the features some of our range offers.



ET-ISO Water Pumps
- Back pull-out design
- As per ISO 2858
- 32 models: upto 700m³/hr; 175m

PN-ISO Process Pumps
- As per ISO 5199 / DIN 24256
- 32 models: upto 700m³/hr; 175m
- Available with a wide range of optional features and materials of construction for various duties and working conditions

ST / TN / LE / ME
Split casing pumps
- Single stage
- 82 models: from 30m³/hr to 18000m³/hr; 10m to 150m
- Two-stage
- 18 models: from 30m³/hr to 1200m³/hr; 35m to 200m

Now available off-the-shelf or on short delivery basis

MATHER AND PLATT PUMPS - Leading Edge in Technology

For further information please contact:
MATHER AND PLATT (INDIA) LIMITED
Fluid Engineering Group
Pune - Mumbai Highway, Chinchwad, Pune 411 019, India.
Tel: +91 212 7761 96/97/98 Fax: +91 212 762519
e-mail: fegpnq@mappnqfeg.gpnq.xeemail.ems.vsnn.net.in.

For further information circle (65)

Trends and challenges in water supply technology

International co-operation is the key to the world's water problems. This is why networks are so important, such as the European Commission's Environment–Water Task Force, and the new Europump Enersave Programme, which sets up and implements guidelines on the procurement of energy-intensive equipment.

Dr Erich Holzhüter, European Association of Pump Manufacturers

In 1996, the European Commission established an 'Environment–Water' Task Force in order to set up an agenda for water research in Europe. This task force will address the development of methods and technologies for water supply treatment, waste water treatment and remediation of contaminated sites. The programme includes environment and climate; standards; measurement and testing; telematics applications; industrial and material technologies; information technology; agriculture and fisheries; non-nuclear energy; and international co-operation.

The Environment–Water Task Force can be visualised as an open network of Commission Directorate Generals (DGs) and a wide range of participants. Water utilities, water users (such as residential consumers, industry and commerce, farmers and energy producers), technology and service suppliers, government regulators and water research organisations are the partners within this network. These may be involved in the task force individually or through their professional associations. For example, Europump represents the European pump industry and provides expertise on pump-related matters. The organisation of Europump is based on 17 national associations inside and outside the European Union (EU). Each of these national organisations represents a large number of local pump companies, and the majority of them also act globally. Europump's organisation comprises the General Assembly, General Secretary, President and Council, and four Committees: public relations, marketing, technical and standards.

Guidelines and other tasks

Europump sets technical guidelines on pump applications giving technical information about the properties and the behaviour of various pumps involved in the standardisation programmes (for example, ISO- or CEN-Standards). In 1997, the organisation established a Common Research Fund. 'Common research' means research on basic methods as a prerequisite for product development; that is, it takes place in the pre-competition era. The Europump Research Fund, with the legal standing of a European Economic Interest Group, will then be another partner in the network of the Environment–Water Task Force focusing on research items. Its main tasks will be close co-operation with the Commission to define research priorities, and the co-ordination of private and governmental research activities favourable to innovation in the area of water supply.

Two more objectives of the Environment–Water Task Force are worth mentioning in this context. One is to refocus scientific and technological co-operation on priority projects in the EU's relations with Central and Eastern European and Mediterranean countries. Another is to make a particular effort in research, the adaptation of technologies and innovation by financing and organising international co-operation in order to meet the opportunities of the growing markets in South-East Asia and Latin America. Europump can possibly also make a contribution in this respect. The plan is to hold an EU-Asia Business Forum during the exhibition *Pumps & Systems Asia 1998* in Singapore, where the European Commission could present the EU's foreign trade and investment policy, and Europump provide information on relevant aspects on common research, technical guidelines and standardisation programmes. Representatives of EU pump manufacturers could eventually show highlights of pump and systems applications for water supply.

It would also be a good opportunity to discuss possible improvements in the area of co-operation by founding an Asian pump industry association as a partner organisation to Europump.

Problems and possible solutions

Pumps are still at the heart of a water supply system and, for several reasons, the required number will increase. Reliability, energy consumption maintenance requirements and life cycle are the key issues. Water transport over long distances or water extraction out of deeper and deeper boreholes requires a larger number of pumps and pumps with higher performance.

Reliability is a 'must' for all main supply pumps, for instance for those which feed a supply network. Improvements to their reliability will be achieved by using appropriate materials for the hydraulic parts, by internal pumpage lubricated bearings or even magnetic bearings and an advanced design of mechanical seals or even sealless drives. If the pump is built in an intelligent way, it will be possible to detect minor failures at an early stage and to adapt the performance of the pump to the actual and current demands of the system. In the future, the sensors and the electric material needed for such an intelligent pump will cost a fraction of what they cost today. Parallel with these achievements, the maintenance requirements will be drastically decreased as well as the energy consumption.

One simple equation reflects all the benefits arising from

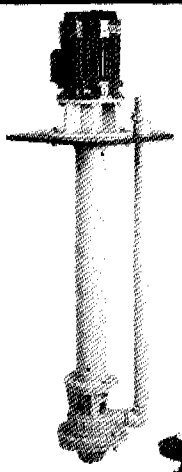
VERTICAL AND HORIZONTAL PUMPS

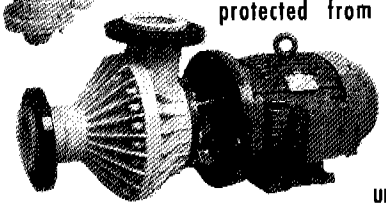
AS/NT

Centrifugal pump, vertical axis, single stage support plate, column pipe, overhung impeller, coupled to electric flanged motor.
Four construction versions, eight sizes, twenty types. Delivery heads up to 40 meters and capacity up to 90 m3/hr. Height of suction from 300 to 3000 mm, without intermediate bearings or passing cone. PTFE- lined bushings fixed by the pumped liquid.

OMA/ANTS

Centrifugal pump, horizontal axis close coupled, single stage, end suction, overhung impeller, coupled to electric flanged motor and food mounted. Four construction versions, 7 sizes, 20 types. Delivery head up to 40 meters and capacity up to 90 m3/hr. Its mechanical seal, of exclusive design, insures a higt safety degree and a remarkable chemical and mechanical strenght. The internal assembly optimizes the flushing action and the loss of heat and reduces the load on faces a to minimum.





MAIN CONSTRUCTION FEATURES

The centrifugal pumps Barbera, in plastic materials, heavy-duty designed, have been manufactured to operate in particular with corrosive and dangerous fluids, held in tanks, reservoirs or wells. As no metal part comes into contact with the pumping fluid, no corrosion or fluid pollution occurs.
To insure the higest consistency with the widest range of chemicals as possible and the maximun service reliability, the whole pump and not only the fluid-wetted parts, are made in Polypropylene, PVC or PVDF and gaskets, bushings and mechanical seal are in PTFE, CERAMIC, FPM, EPDM materials, interchangeable to each other, if required.
The electric driving motors are direct coupled to the pump shaft, sized according to international standards and protected from acid, alkaline or saline environments.
Even if exposed to vapors or drippings, the SAVINO BARBERA centrifugal pumps are designed to accomplish the most burdensome tasks under the maximum duration of life and reducing the servicing requirements to a minimum.

SAVINO BARBERA
di Barbera & Castiglioni
Via Torino, 12 - 10032 Brandizzo (TO) - ITALY
Tel. (011)913.90.63 - Tlx 22.22.35 SAV BAR I - Fax 39.11.913.73.13

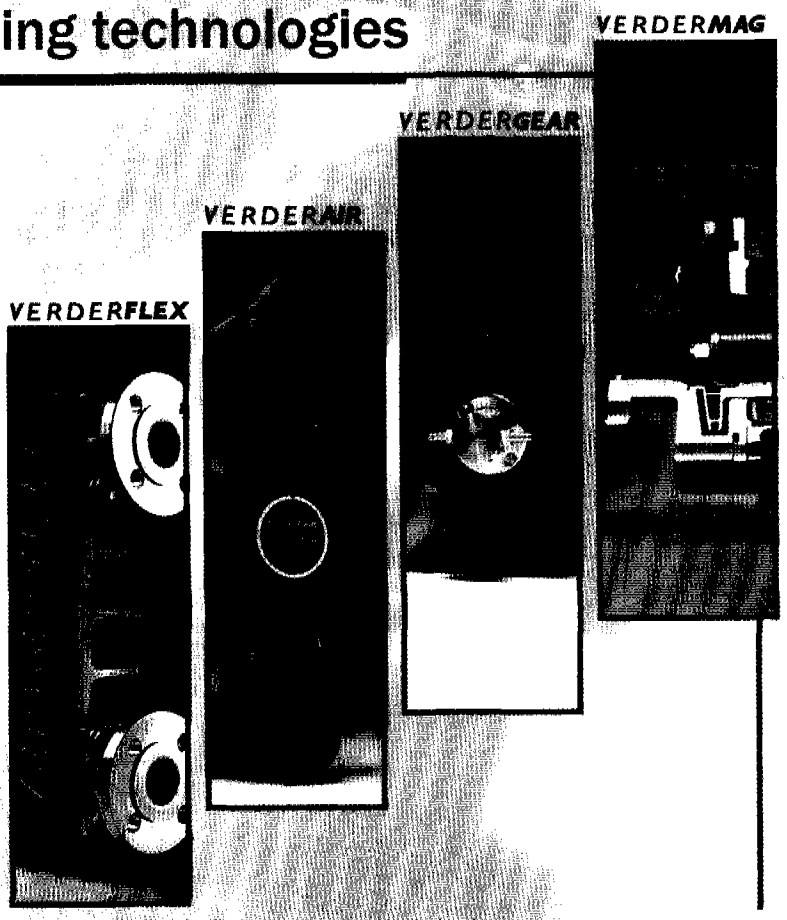
ICS ITALIA

For further information circle 68

The full range of pumping technologies

VERDER's pumping technology specialists deliver a wide variety of solutions for the water industry. VERDER pumps are suitable for every application type and give enhanced productivity with reduced downtime and low maintenance.

- hose pumps
- laboratory tube pumps
- centrifugal, mag drive pumps
- air-operated diaphragm pumps
- gear pumps
- static and dynamic mixers



Solutions Pumping technology

For further information circle 69

VERDER

For more information call VERDER Ltd 0800 132 269

VERDER Ltd, Whitehouse Street, Hunslet, Leeds LS10 1AD Tel: (44) 0113-222 02 50, Fax: (44) 0113-246 56 49, E-mail: verder@legend.co.uk
Affiliated companies: A-Wien • B-Elversele-Temse • CZ-Praha • D-Haan • F-Eragny s/Oise • N-Tistedal • NL-Vleuten • PL-Wroclaw • RO-Bucuresti • USA-West Chester

these developments and can be described as the Total Life Cycle Costs as follows:

LCC	=	$I + LCC_L + LCC_M + LCCE_{NVC}$
where:		
LCC	=	Total Life Cycle Costs
I	=	Investment Costs
LCC_E	=	Life Cycle Energy Costs
LCC_M	=	Life Cycle Maintenance and Repair Costs
LCC_{ENVD}	=	Environmental and Recycling Costs.

It is easy to see that the Life Cycle Energy Costs dominate this equation for pumps of continuous operation.

We have created a new working-group inside the Technical Commission of Europump in order to set up and implement guidelines on the procurement of energy-intensive equipment. The initiative for an industry-embracing programme aiming to focus more on energy-saving measures, both for rotating machines and other energy-consuming equipment, came originally from the Association of the Swedish Mechanical Engineering industries. Europump was unknowingly and simultaneously working on the same idea for the pump industry. Both parties have now joined forces and the pump industry-oriented programme is now fully run by Europump. it has been named the Europump Enersave Programme. Its main goals are to change attitudes towards the use of Life Cycle Costs, to stimulate development of new energy-efficient pumps and systems, and to reduce the total energy consumption (as a positive impact on the environment).

Energy savings

Reducing water consumption and energy consumption are of almost equal importance to the environment. Many proposals have been made for the achievement of significant energy savings. If we prioritise them, we must start with the reduction of friction losses in systems and networks. Some investigations have proved that only between one third and one tenth of energy is needed to pump water through a network when the friction losses in the net are homogenously distributed. Then a lot of throttling can be avoided in many cases and the pump is adjusted to the actual demand.

The next big challenge in energy saving is the adaptation of pump performance to current demand. Savings of 50 per cent have been proven by several case studies. Technically speaking, the adaptation can be managed by applying a variable speed system (frequency converter) or for a given range of centrifugal pumps (with specific speed above nq = 100 in metric units) by using a variable pitch propeller or a variable pitch inlet guide vane.

Next on the list of priorities is the improvement of the hydraulic efficiency of pumps. However, due to the fact that we have already achieved high levels of efficiency, there is not much room left for improvement. By more and more sophisticated flow calculations (for example, CFD-Codes) and new design features for internal leakage control, savings in the order of 5 to 10 per cent will still be achievable. Even on the electrical drives of pumps, improvement of efficiencies in the same order of magnitude as for pumps are attainable. In total about 80 per cent of the potential savings result from process optimisation (system approach) and about 20 per cent from improved efficiencies. A programme of the US Department of Energy called *Motor Challenge* provides interesting information including advice from industry experts on this key issue of energy saving. It is being predicted that in future the Life Cycle Costs of pumps will be dramatically reduced by a more sophisticated design of systems and networks, and by intelligent self-adjustable pumps, which need no maintenance or repairs, offering the highest possible availability by means of early failure detection systems.

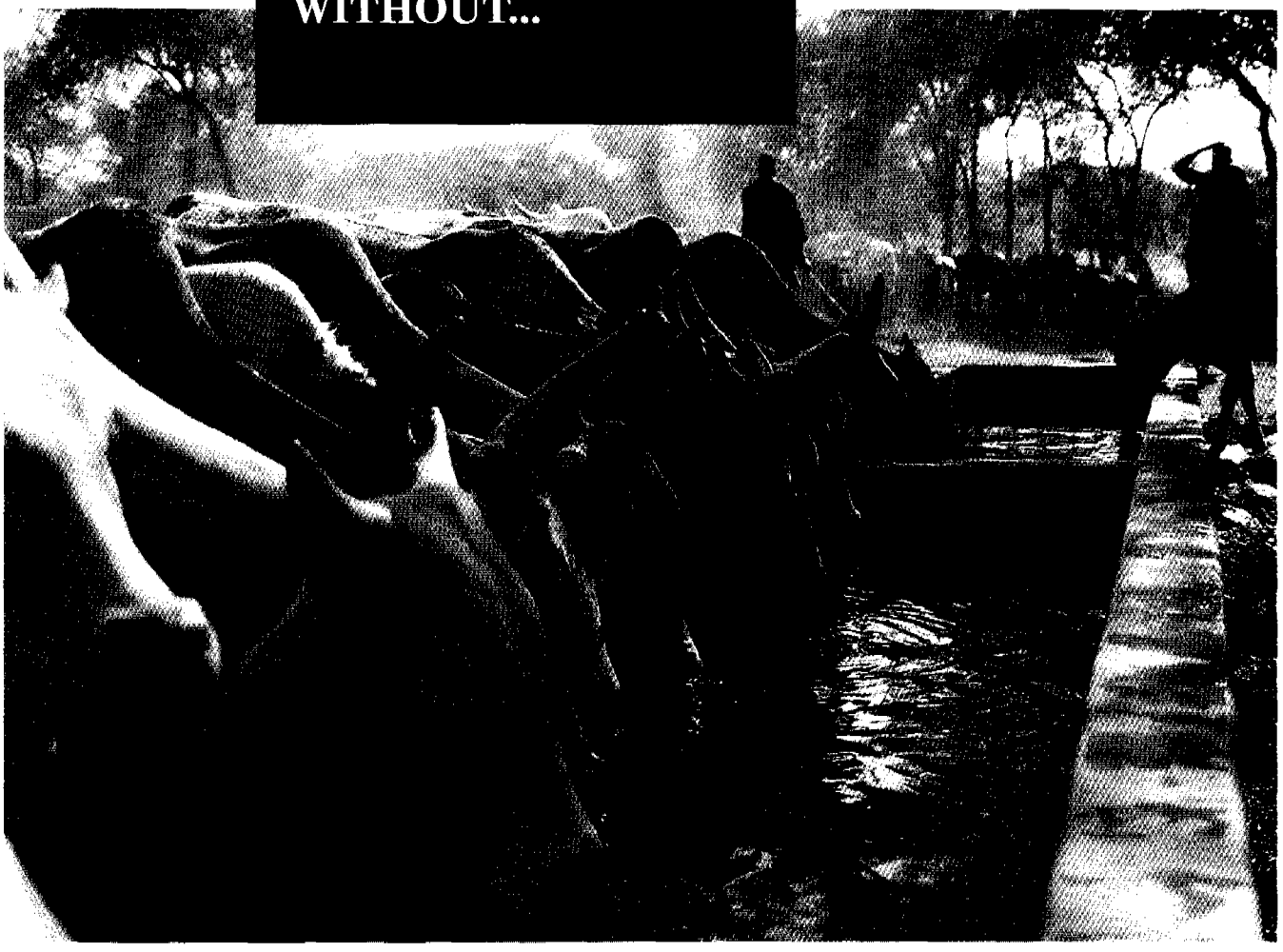
As far as systems are concerned, the technological trend will lead towards adaptation of treatment technologies to specific needs.

Particularly problematic pollutants, multi-pollutants, evaluation of activated sludge, adaptation to the constraints of small suburban and rural units are problems which have to be solved. Key technologies like membranes combined with vacuum systems, adsorption, oxidation and biological processes will be the solutions. Again, suitable sensors and process controls will play an important role in the management of water and environment. The re-use and recycling of water in the various branches of agriculture and industry for irrigation and cooling in particular will be promoted. Irrigation methods through improved irrigation scheduling and an improvement of the irrigation techniques (sprinkler systems), techniques for recuperating rain and run-off water will be advanced. Last but not least, there will be an extension of desalination technology, with improved performance and reduced operating costs.

A great deal of effort will probably pay off by using the possibilities of coupling desalination processes with renewable energy sources. All systems mentioned need more pumps and more sophisticated pumping solutions. Special attention has to be paid to pre-competitive, common industrial research, to an improved and faster exploitation of the results for product and system innovations at both European and international levels. Measures like technology transfer and training will be indispensable. ●

Dr Erich Holzhüter is Director of Technology, Sterling Fluid Systems, Ludwigshafen, Germany, and President of the European Association of Pump Manufacturers (Europump). He was previously a member of the Board of Management of the SIHI Group, and the manager of several departments within KSB.

WATER IS THE ONE THING NO LIVING CAN DO WITHOUT...



AS MARKETING A/S

- GRUNDFOS PUMPS MAKE SURE IT'S THERE!

We all depend on access to fresh water, but not all of us have it flowing right in front of our noses.

Grundfos have developed a whole range of pumps especially for extracting fresh water from wells of any size and any depth. Grundfos pumps are designed for years of troublefree operation in the most difficult circumstances. With our solar powered pump systems we can even provide water where there is no electricity or other sources of power.

Contact us if you want to know more about Grundfos pumps for water supply.

GRUNDFOS®
Leaders in Pump Technology

Europe - Tel. +45 86 68 14 00 · Americas - Tel. +1 209 292 8000 · Middle East - Tel. +971 4 815166 · Asia/Pacific - Tel. +61 834 00200

For further information circle (70)

Where a drop of water **is a piece of gold**

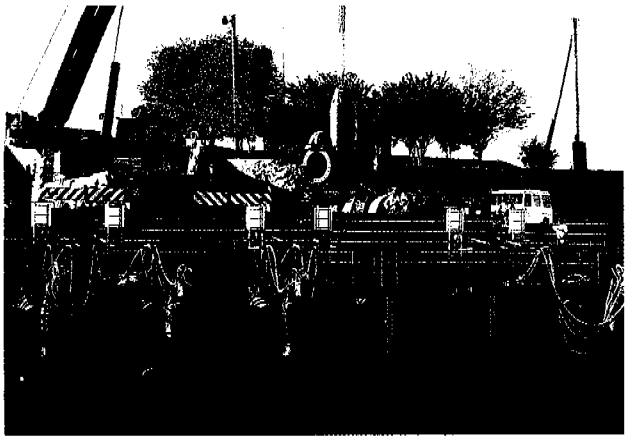
Turkmenistan is rich in oil and natural gas but extremely poor in water. Alexander Farmsworth looks at the water status of the country, in general, and the supply and installation by ITT Flygt of 61 CP 6800 pumps on Yulangyz Canal in Turkmenistan's remote, eastern corner.

Slightly larger than California, Turkmenistan (population 4.2 million) is the most southern and least populated of the former Soviet republics. Wedged between Iran, Afghanistan, Uzbekistan, Kazakhstan and the salty land-locked Caspian Sea, this central Asian desert republic is known for its huge, mostly untapped oil and natural gas reserves. The water situation, however, is best described by the Turkmen maxim that graces the facade of the Ministry of Irrigation and Water Resources in the capital city, Ashgabat: 'Suw damjasy, altyn danesi' ('A drop of water is a piece of gold').

Despite scattered oases, wells and the occasional run-off, Turkmenistan depends on the Amu-Darya and the Murgab rivers for most of its water needs. The swift and muddy Amu-Darya rises in the Hindu Kush, near China, and flows 2580km to the Aral Sea, part of the way through eastern Turkmenistan. The smaller Murgab originates in Afghanistan and flows into several large reservoirs.

The Interstate Economic Water Commission, a group of water ministries from Turkmenistan, Uzbekistan, Kyrgyzstan, Tajikistan and Kazakhstan, jointly decide often-contested water issues. According to Deputy Minister Altiev, Turkmenistan received water entitlements of 22 billion m^3 from the Amu-Darya in 1997. Uzbekistan, which also claims a piece of the river, got the same amount. In Turkmenistan, these waters are pumped through what is, at 39,000km, certainly one of the largest and most complex irrigation and canal networks in the world. The system's centre-piece is the gargantuan 43-year-old Garagum Canal, named for the desert it traverses, which covers 80 per cent of the country. Started by the Russians, the canal diverts water from the Amu-Darya in the east and transports it 1300km inland. In future, Turkmenistan hopes to extend the Garagum all the way to the Caspian Sea.

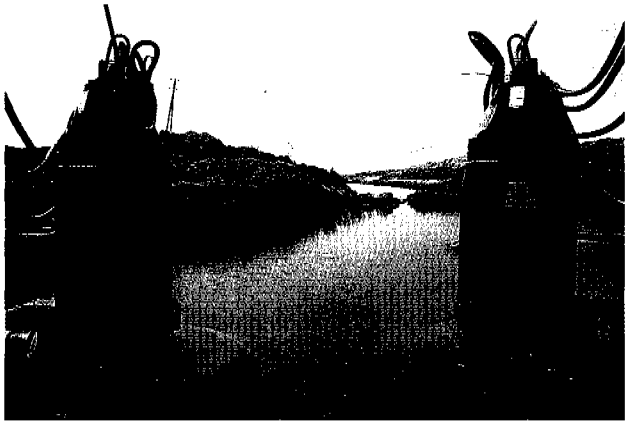
Together with large and small patrimonial canals, pumping stations, reservoirs and dams, the Garagum Canal is crucial to the country's economy and well being. It supplies drinking water to the cities and irrigates almost half of the country's arable land. Like the body's circulatory system of arteries, veins and ever-smaller blood vessels, Turkmenistan's canal system goes from large to small, feeding water down to the smallest sapling. Its operating principle is basic: open the flood gates, let gravity do its job, pump it further along or let it seep. Even the shady parks of Ashgabat are watered by tiny canals whose source lies somewhere upstream. A bird's eye view of Turkmenistan reveals a flat-to-rolling sand desert with dunes rising to mountains in the south along the border with Iran. Occasionally you can catch a glimmer of a river or canal, with a wide swath of cultivated land on either side.



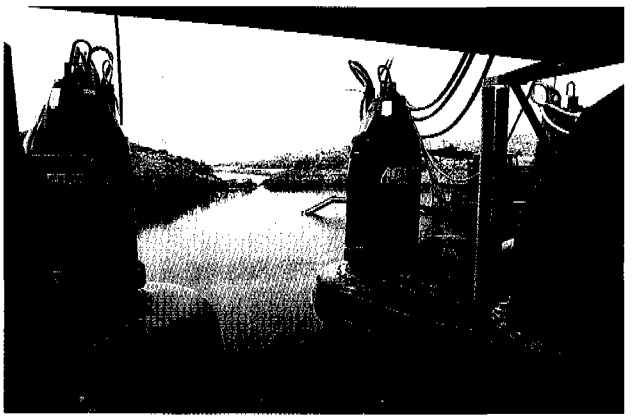
Making better use of existing water resources

The current head of state, President Sapamurad Niyazov, signed a degree outlining major reconstruction and modernisation plans for Turkmenistan's canal and irrigation system. 'We could seed more cotton,' explains Altiev, 'but we have limits on how much water we can get. Today 22 billion m^3 is enough for the crops we have. But by upgrading the technology and adopting better conservation methods, we could double or triple our yields with the same volume of water.'

Making better use of existing water resources is also important for central Asia as a whole. But intensive agriculture in Turkmenistan has taken its toll. Heavy use of agricultural chemicals and pesticides has contributed to soil and groundwater contamination. In addition, some of the water diverted from the Amu-Darya and used for irrigation eventually runs off



Turkmenistan depends on its two main rivers for most of its water needs



Getting the first pumping stations on line was a priority

and seeps into the groundwater. Because most of Turkmenistan used to be a seabed, the salty groundwater has, in places, risen to the surface since the Garagum Canal was built.

'The groundwater used to be 60m down,' says Altiev. 'Now it is only two or three metres below the surface.' In response to this threat — patches of salty groundwater are visible from a helicopter — the Ministry is currently building an extensive drainage system for irrigated lands.

The idea is to pump irrigation run-off hundreds of kilometres away into the deserts. Turkmenistan has come a long way since the days of Soviet isolation. But even with such engineering marvels as the Garagum Canal, the country remains water poor despite its many other riches. 'Our main task is not just to increase agricultural production,' says Altiev. 'We need to industrialise our raw material-based economy and build more processing plants. But first we need to learn to become more economic in our use of water.'

The Yulangyz Canal

In January 1996, ITT Flygt signed a $16.6 million contract with Turkmenistan's Ministry of Irrigation and Water Resources. The contract, to supply and install 61 CP 3800 pumps on Yulangyz Canal in a remote corner of eastern Turkmenistan, is ITT Flygt's biggest single order to date.

The contract also included designs, supply and installation of a whole new electrical power system for the canal. Because it is impossible to work unassisted in countries like Turkmenistan, ITT Flygt hired a local agent, IP Engineering, to handle details such as interpreters, customs formalities and manpower hiring.

Barely a stone's throw from the Afghanistan border, the 35km-long Yulangyz is really five canals linked together by six pumping stations. The first station, with 14 pumps, raises water from the Amu-Darya river. The rest of the stations lift the water 60m into the surrounding highlands, which corresponds to roughly 12m per station. Through a combination of secondary diesel-driven pumps and gravity feed, the five sections of the Yulangyz serve to irrigate 25,000ha of farmland, mostly wheat and cotton. The 20m-wide Yulangyz took four years to build and was completed in 1983.

The six pumping stations were outfitted with massive Russian electrical pumps that used compressed air to seal the motors. Each pump weighed 14t and was attached to a man-sized pipe with a diameter of 1.4m. For maintenance work, each pump was mounted on a track and trolley system which, with the help of mechanical winches, would lift the pump out of the water. According to Kurbanov Kurbanovich, the Ministry of Irrigation and Water Resources' head engineer on site, these pumps were expensive to operate, time-consuming to maintain and inefficient. 'Because spare parts were hard to come by, we often had to take pumps from station five and six to install them in stations two and three,' he explains. 'These pumps had a capacity of five m^3/sec, which was too much. Now with ITT Flygt's pumps we can plan our work much better. Because of the break-up of the Soviet Union, we would have to pay the same price for new Russian pumps, but Flygt pumps are better.' After some design 'to-and-fros' with Turkmenistan's Ministry of Irrigation and Water Resources, ITT Flygt's engineers suggested a CP 3800 installation.

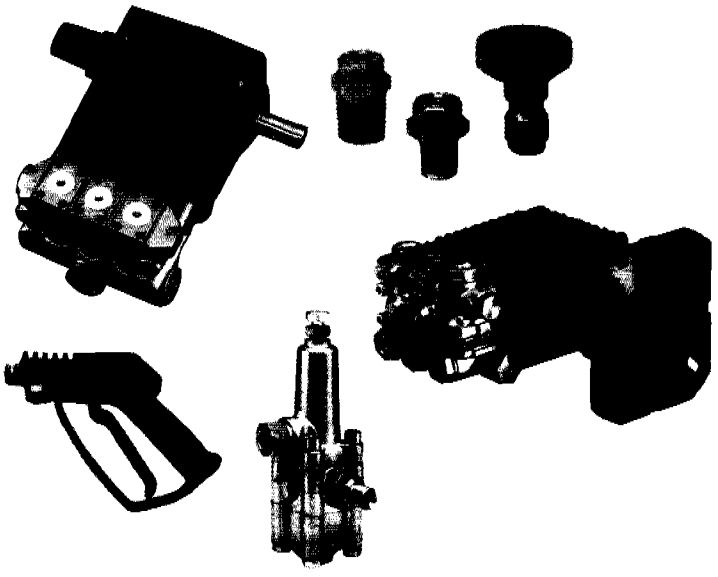
The 'CP' means that the upright pumps are outfitted with a sliding bracket. Then they are lowered down guide bars locking automatically to the discharge connection. The '3800' refers to the physical size of the discharge outlet, in this case 800mm. In concrete terms, two ITT Flygt CP 3800 pumps replaced one Russian pump.

Each of ITT Flygt's pumps weighs 9t, as opposed to 14t for the Russian ones, and has a smaller pumping capacity — $2.5m^3$ as opposed to $5m^3$. But according to ITT Flygt's project manager, Lars Thorö, the new pumps are more reliable and have a longer lifetime. 'Our job was simply to replace the old Russian pumps, not to increase or diminish the capacity of the canal,' he says. But there was a lot more to the project than fitting in the pumps and flipping the switch. Each of the original discharge pipes (diameter 1.4m) had to be bifurcated to fit two CP 3800 pumps.

In addition, each fixture had to have a check valve installed to prevent the water flowing back through the pump. 'It was

Getting material to Turkmenistan was not easy

Experience The Quality That Is General Pump



General Pump serves the high pressure cleaning, carwash, sewer and water jetting, and industrial markets with the finest selection of:

- **Industrial Pumps**
- **High Pressure Plunger Pumps**
- **Thermal Pump Protectors**
- **Unloaders and Regulators**
- **Spray Tips**
- **Guns and Lances**

General Pump backs each of its products with the strongest warranty in the industry and unmatched customer service support.

GENERAL PUMP INCORPORATED
1174 Northland Drive • Mendota Heights, MN 55120, USA. • Tel: +1 612 454 6500 • Fax: +1 612 454 8015
intl@generalpump.com • http://wwww.generalpump.com

For further information circle 71

HYDRO® *International*

Hydro International Ltd.
Your Environmental Solution Company

- SCAF Air Flotation Systems
- Belt Press - Stainless Steel, Fibreglass
- Oil and Scum Removal Pumps
- Compactors
- Submersible Air Mixers
- Screens-Rotary, Sidehill, Internal
- pH Control Stations
- Dry and Emulsion Polymer Feed Systems
- Industrial Biological Treatment Plants
- Sludge De-Watering Carts

Hydro International can provide customers and engineers with turn-key designs and solutions for all types of Industrial and Municipal applications. We specialise in the removal of Fats, Oils, Greases, BOD, COD and Suspended solids and comply with Local, National and International EPA regulations. Additionally, we can offer our customers Telemetry Systems, Scada Systems, Commissioning, Training, Maintenance and Service Contracts.

For more information on our company, products and services contact:

Hydro International Ltd.
Balreask, Trim Road, Navan, County Meath, Ireland.
Tel: 353-46-72658 Fax: 353-46-72659 Email: pjfinn@ibm.net

For further information circle 72

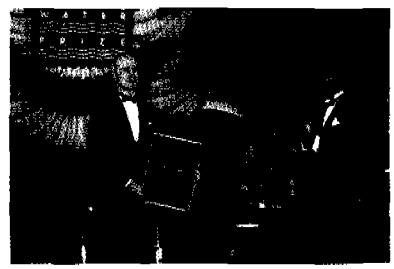
quite complicated geometry to get this to work,' according to one of the Swedish contracted electricians. The supervisor's job was not only to oversee the pump installations, but to lead a team of 15 or so locally hired people who did everything from installing new transformers and control panels to laying 20,000m of cable. 'One of the biggest jobs with this project was getting all the material to Turkmenistan,' says Thorö. Because Yulangyz is the most remote place ITT Flygt has ever worked, every spare part, tool, bolt and pump was shipped in by container from Sweden. In addition, to ward off any possible health problems, 1,600l of water and 1.5t of conserved Swedish food was transported down to Yulangyz for the Swedish engineers.

According to Turkmenistan's Ministry of Irrigation and Water Resources, getting pumping stations two, three and four online by the summer of 1997 was a priority, as the local farmers needed water for their crops. Summer temperatures around Yulangyz can reach 50°C and precipitation is non-existent. Barring unforeseen difficulties, all six of Yulangyz's pumping stations were due to be operational by the end of 1997. ●

ITT Flygt AB, which employs 4000 people worldwide, is a division of ITT Fluid Technology Corporation (ITT FTC), which is a business unit of ITT Industries, a leading diversified manufacturing company. ITT Flygt AB is one of the founders of the prestigious Stockholm Water Prize (see below).

The Stockholm Water Prize and Water Symposium

An important prize of US$150,000 has been awarded annually since 1991 to an individual or an organisation for



outstanding contributions in the field of water conservation. The following awards have been made to date:

1991 Dr David W Schindler, University of Alberta, Edmonton, Canada.
'For research into excess nutrification and acidification of freshwater lakes.'

1992 Department of Environmental Engineering at the Technical University of Denmark under the leadership of Professor Poul Harremoës.
'For research within water purification, contaminated groundwater and tools and techniques to protect it.'

1993 Dr Madhav Atmaram Chitale, New Delhi, India.
'For his achievements in the fields of water conservation and public education programmes in Southeast Asia.'

1994 Dr Takeshi Kubo, Tokyo, Japan.
'For his bridge building work between nations in Asia and Europe.'

1995 WaterAid, London, UK, under the leadership of Jon Lane.
'For bringing water and sanitation facilities to more than three million people in the world's poorest countries.'

1996 Dr Jörg Imberger, University of Western Australia.
'For his pioneering work with interdisciplinary models for water quality management in lakes and coastal waters.'

1997 Professor Peter S Eagleson, Massachusetts Institute of Technology, USA.
'For his role in elucidating and quantifying the dynamic hydrological linkages among vegetation, soil and atmosphere.'

The prize is awarded by its patron, His Majesty King Carl XVI Gustaf of Sweden, during the Stockholm Water Festival, in connection with the Stockholm Water Symposium. The next such symposium will take place as follows:

8th STOCKHOLM WATER SYMPOSIUM
10-13 AUGUST 1998

with the theme: WATER — the key to socio-economic development and quality of life.

For further information, please contact:

Stockholm International Water Institute (SIWI), SE–106 36 Stockholm, Sweden, Fax: +46 8 736 20 22.

Wetterauer Pumpenbau GmbH

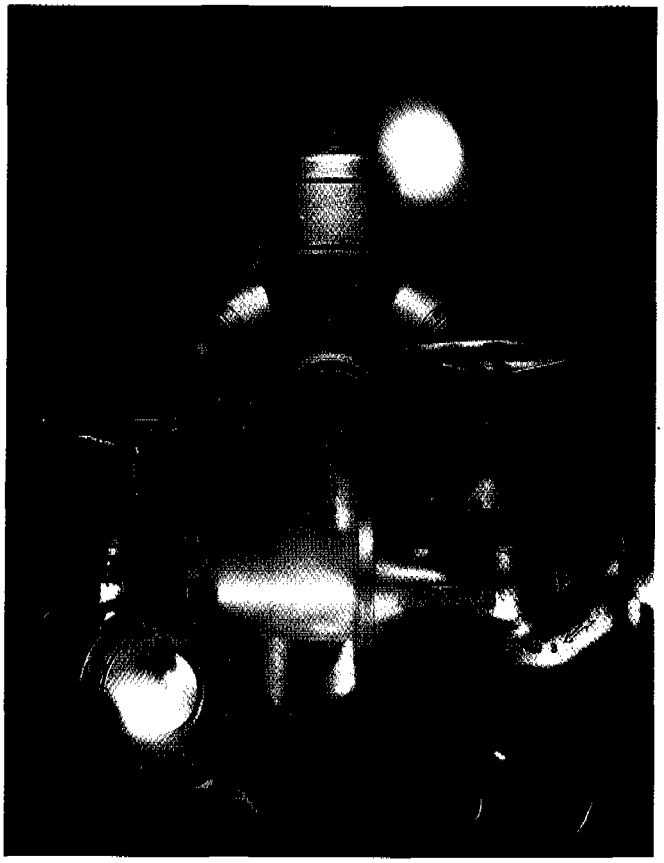
Am Sandberg 1, • D-35519 Rockenberg, • Germany • Tel: +49 6033 67477 • Fax: +49 6033 71461

Do you need to pump water at sites without electrical energy?
Do you need to lift water manually from boreholes and wells?
Do you need to transfer waste water by hand-driven pumps?
Do you need to pump oil from tanks to drums, or by hand?

If so, then send your enquiries to our factory!

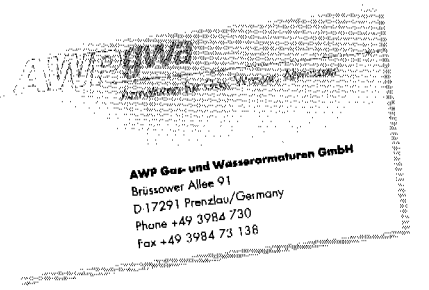
With 50 years of experience in the manufacture and application of hand-driven pumps and pumping systems, we can solve any problem you have. Our engineers and skilled personnel are always available for consultation, and our reputation ensures that you have simple, reliable pumping equipment for manual use wherever electricity is not available.

For further information circle (73)



Von Roll valves and hydrants: Quality with a profile

After focusing its attention on the needs and requirements of the home market for many years, Von Roll, Switzerland's leading manufacturer of superior quality valves and hydrants, is now moving up a gear on the export front. The acquisition of AWP Gas- und Wasserarmaturen GmbH (AWP gwa), a new subsidiary in eastern Germany, firmly underlines the seriousness of its long-term objective to establish a much broader geographical base – from Europe up to Asia.



vonRoll *INFRATEC*

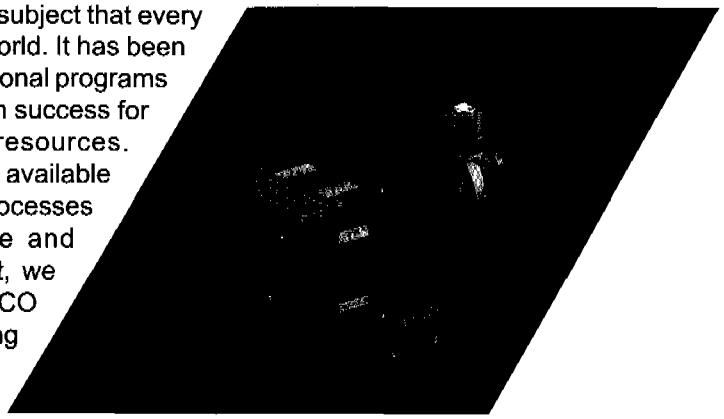
Von Roll Valves Ltd, CH-4702 Oensingen/Switzerland
Phone +41 62 388 11 11, Fax +41 62 388 11 88
E-mail: valve@vonroll.ch

For further information circle (74)

JESCO®
DOSIERTECHNIK

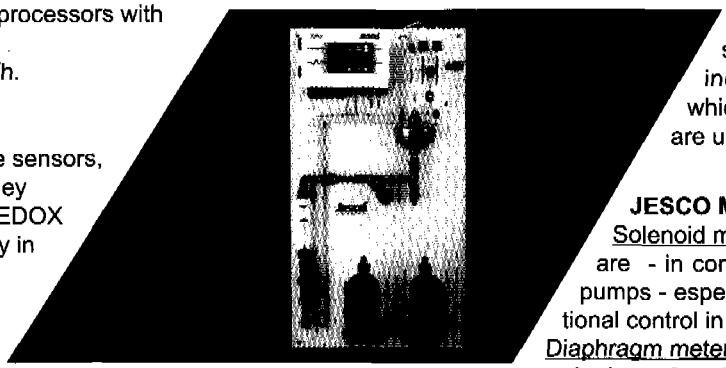
JESCO METERING EQUIPMENT TREATS WATER RIGHT. WORLDWIDE.

Industrial technology and environmental protection - a subject that every year becomes more and more important all over the world. It has been clear for a long time that home-made solutions and national programs are just a small step forward but do not bring long-term success for the conservation of the most important natural resources. Progressive environmental technology must be made available internationally. Nationally successful concepts and processes must be used worldwide wherever it is possible and appropriate. In more than 70 countries of this planet, we have partners who sell reliable and experienced JESCO Metering Technology. This is our contribution to solving environmental problems.

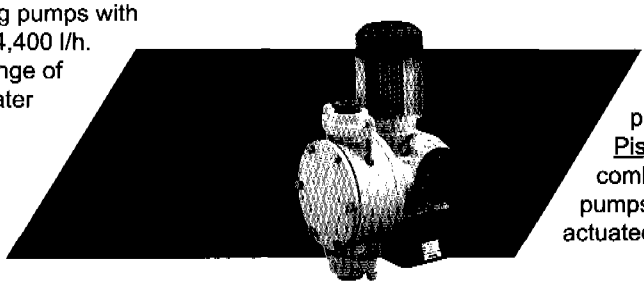


1.The new generation of solenoid metering pumps
The MAGDOS DE/DX range combines the digital technology of state-of-the-art microprocessors with high-quality mechanics.
Metering capacity is 0.1 l/h to 100 l/h.

2. Water Sampling stations
The water sampling stations include sensors, controllers and metering pumps. They measure free chlorine, pH value, REDOX potential and temperature especially in drinking water and swimming pool applications.



3. MEMDOS
Diaphragm metering pumps with capacities of up to 4,400 l/h. Ideal for a broad range of water and waste water applications.



4. Chemical feed systems
The fully equipped systems are ready for use on delivery. All chemicals are possible.

The JESCO product program is as specialized as the individual applications in which the metering devices are used:

JESCO Metering Pumps
Solenoid metering pumps
are - in comparison to motor-driven pumps - especially suitable for proportional control in dependence of pulses.
Diaphragm metering pumps
are leakproof and can therefore be used particularly for aggressive and toxic materials.
Piston metering pumps
work very precisely and mostly independent of pressure.
Piston-diaphragm metering pumps
combine the advantages of the leakfree diaphragm pumps and the very precise piston pumps. Hydraulically actuated diaphragm pumps are also available.

JESCO Chlorinators
Chlorination installations for the disinfection of drinking, swimming pool, industrial, cooling and waste water.

JESCO Dry Feeders
The volumetrically precise dry feeders are used for metering bulk material (e.g. powders and granules).

JESCO Controllers
For all JESCO metering equipment we supply the appropriate monitoring and control periphery.

Wedemark - New York - São Paulo - Casablanca - Sidney - Beijing - Kuala Lumpur - Kuwait - Bangkok - Hong Kong

JESCO Dosiertechnik GmbH & Co. KG
Am Bostelberg 19
D-30900 Wedemark
Postfach 10 01 64
D-30891 Wedemark
Tel.: +49 5130 / 5802-0
Fax: +49 5130 / 580268
E-mail:jesco@t-online.de

DIN EN ISO 9001 BGB

Metering & Control Technology
for Liquids, Gases and Solids

Taking a closer look **at penstocks**

Today's modern penstocks benefit from the most modern CAD technology and construction materials enabling ever more sophisticated designs and demanding applications. This is a far cry from the centuries old traditional hand-lift timber gates from which the name 'penstock' originates.

David Lewis, Biwater Industries Limited

Known generically worldwide as sluice gates, the name 'penstock' derives from the early days of water mills when a pond or 'pen' (stored or penned up water) was used to drive the mill race or water wheel. The timber stop logs used to control the flow on to the driving wheel were called the 'stock'. With the increasing need to more accurately control the speed of flow over the wheel, stop logs were replaced by a sliding gate operated by a screwed spindle or stem — the forerunner to today's modern gates.

Over time, the favoured build materials of penstocks have evolved from the original English oak gates to the modern gates of today made from cast iron, stainless steel, aluminium, mild steel and most recently, plastics.

In addition to the changes in materials, penstocks have also developed considerably in both size and application. Operating duties of heads between 30 and 40m are common place, and gates up to 5m^2 are not unusual.

Penstock operation

Installed to control the flow of liquid through a channel, opening in a wall or, less commonly, at the end of a pipe, penstocks are vertically acting single faced control valves.

The main methods of raising and lowering penstocks include handwheel operation via translation screwed stem; electric actuator via translation screwed stem; and hydraulic and pneumatic linear lift cylinders. Fixing designs include cast rebates in thin channel walls, wall mounting for bolting to flat concrete, flange mounting for attaching to a pipeline, wall casting or thimble embedded in concrete.

Sealing and gate materials

The most common type of penstock is a grey cast iron gate with copper alloy seating faces around the four sides of the aperture. Alternatively a resilient seal can be attached to the bottom of the door to deliver a flush invert and ensure laminar flow characteristics.

Cast iron gates can also be supplied with resilient seals throughout, in lieu of copper alloy. Fabricated penstocks provide a greater material choice. Frames can be manufactured in stainless steel, mild steel and aluminium alloy. Doors, including sandwich construction steel reinforced plastic, all have resilient sealing arrangements.

For applications requiring a higher level of watertight sealing, resilient seals as applied to Biwater's Plastigate, Fabrigate 100 and Glydaseal penstock units offer greater efficiency, when compared with the performance of metal to metal sealing faces. Biwater's Glydaseal Series 70/50 resilient seat penstock achieved a tolerance of 100th of that required by the AWWA C501-87 & BS7775 for leakage.

Biwater Plastigate penstocks in use at a privately financed sewage treatment plant in Puerto Valoarta, Mexico

Special materials

Marine applications, including docks and sea water treatment plants, demand special performance characteristics from penstock materials. Zinc-free bronze, such as phosphor bronze which contains virtually no zinc, is highly recommended for marine installations where de-zincification of bronze can occur, leading to inefficient penstock performance. De-graphitisation of grey cast iron may also occur in sea water, and it is recommended that Ni-Resist iron is specified.

Rising and non-rising stem

Rising stems are preferable wherever possible as the threaded section of the stem is invariably clear of the fluid and therefore less susceptible to corrosion. The threaded section of a non-rising stem is normally submerged which makes effective lubrication difficult, limiting the operational effectiveness of the gate.

Flush invert seals

Where a chamber needs to be completely drained, flush invert seals provide excellent flow characteristics across the gate. Flush invert seals are also suited to channel applications.

Wedges

Wedges are used on virtually all Biwater penstocks to enhance sealing characteristics and ensure full contact between sealing faces. Wedges fitted to conventional cast iron gates are cast iron or cast iron bronze faced, machined on contact surfaces. Adjustable at site, wedges are positively locked in to position in the optimum setting at Biwater's manufacturing facilities.

Side wedges are fitted as standard on all gates. Where gates are subjected to off-seating heads, top and bottom wedges are also added to further reinforce the sealing performance of the gate.

Size

Constraints on gate size depend on the specified material and operating head. The largest Biwater grey cast iron gate is 5000mm^2, and is considered to be approaching the outer limits for gates of this specification. Steel-fabricated gates can be manufactured for larger apertures and a large variety of designs is available for individual circumstances.

The maximum size for fabricated penstocks with plastic sandwich construction steel-reinforced doors is 2500mm^2. Larger gates can be supplied, but a number of manufacturing constraints have to be considered.

Maximum head

The maximum head under which a penstock can operate is a function of individual size and the operating pressure. Penstocks can be designed for operating pressures up to a 40m-head.

Where penstocks are installed under high off-seating heads, consideration must be given to the way the penstock is attached to the structure. The most reliable method in these circumstances is using an iron wall thimble, cast in position during the construction of the concrete structure.

Installations where the operating thrust cannot be taken on the penstock frame and has to be taken at an independent floor level require that the concrete corbel or similar structure to which the floor pedestal is attached must be designed to withstand the maximum forces transmitted to it by the operating gear.

Wear on throttle/modulating penstocks

In installations where the stem length is many times longer than the actuator drive sleeve, wear is normally associated with the drive sleeve and not the stem.

Biwater recommends the use of carefully proportioned drive sleeves and stems operating at low actuator speeds to give a maximum gate rise of 80mm per minute, helping to reduce premature wear.

Maximum leakage

Leak tightness is dependent on a variety of factors, most significantly the installation practices of the contractor. Modern penstock designs and manufacturing processes provide virtually drop tight performance at on-seating working pressures where installed correctly.

Units subject to on-seating pressure seal more effectively than those under off-seat pressure, as the direction of force on off-seat installations works against the gate, while on-seat pressure pushes against the gate reinforcing the seal.

An average criterion for leakage based on rates indicated in the AWWA C501 & BS7775 standard for metal to metal faced penstocks is 1.25 l/min/seal perimeter (metres) for on-seating duty. For off-seating duty, it is as follows (in metres):

- Up to 6m head — 2.5 l/min/seal perimeter
- Up to 9m head - 3.0 l/min/seal perimeter
- Up to 12m head - 3.75 l/min/seal perimeter, and
- Up to 15m head - 4.5 l/min/seal perimeter.

Maintenance

Penstocks require regular maintenance to ensure optimum performance. It is recommended this should be carried out every six months and include lubrication of all moving parts, cleaning all guides and wedges and inspection of sealing faces.

The Biwater range of high performance penstocks includes:

- Ham Baker penstocks: cast iron, metal to metal penstocks
- Ham Baker Glydaseal Series: cast iron resilient seated pen stocks
- Plastigate Series: uses the latest syntchtic materials com bined with the use of either mild steel or stainless steel, and
- Fabrigate 100 Series: fabricated stainless steel, mild steel frames and doors.

Biwater Industries is one of the leading UK manufacturers and suppliers of high-performance penstocks for use in fluid control applications by the water and construction industry around the globe. Formerly known as Ham Baker and Company Limited, Biwater Industries is based at Oldbury West Midlands, UK, and has been manufacturing penstocks/sluice gates for more than 100 years. The company commands a substantial share of the worldwide penstock market. ●

David Lewis is Major Projects Manager, Biwater Industries Limited, Chesterfield, UK. He joined Ham Baker and Company Limited in 1967 (now Biwater Industries Penstocks Division), where he has held several senior positions.

Uniquely-designed **strainers and valves**

The Fluid Control Division (FCD) is a United Dominion company comprising seven business units, each with its own specialty in strainers and valves or role within the company, and including companies in Singapore and England.

● Fluid Control Division, a United Dominion company

Within the past three years Mueller Steam Specialty has successfully launched worldwide the uniquely designed Ball Plex® duplex strainer which is unique in its design; its features include Bubble tight sealing in basically all services, in-line maintainability, easy seat replacement and long, trouble-free service life. The Mueller Duplex strainer is able to accomplish these features while using the proven ball valve concept. Instead of metal seated plugs in the strainer, Mueller uses three-way ball valves with PTFE seats. This concept allows the Bubble-Tight Shut-off. The units are rated to the full ANSI class rating from class 125 to class 300 with sizes of 2in to 6in inclusive. The Ball Plex is also very easy to automate. With the floating ball valve design and the resulting low torque, pressure equalising valves and piping are not required. This allows the use of simple, low-cost actuators, which can be combined with direct-mount differential switches to produce a unit that is completely automated. A transmitter can also be included to allow for remote operation of the unit.

The High Performance Butterfly valve is another new product that Mueller Steam is including in its broad line of products. The valve is bi-directional , drop tight shut off with a blow out proof stem and adjustable seals. The valve is fully rated to ANSI class 150 and 300 with disc taper pins welded in place and integrally cast disc position stop. Sizes range from 3ins to 24ins.

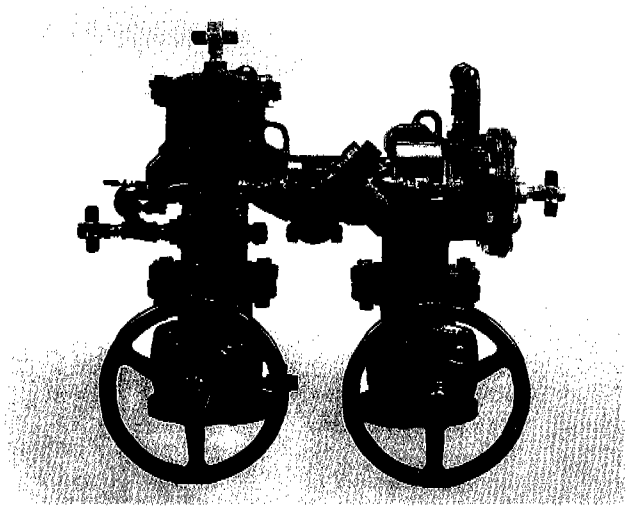
Another unit, Mueller Flow Technologies, is introducing to the market its Dual Chamber Orifice Fitting, the SureShot™, another innovation in the gas measurement applications. This uses a bonded elastomer eccentric plug valve for isolating the lower and upper chambers during operations. The use of this eccentric plug valve offers a bubble tight seal between the lower to upper chamber, fewer parts and no more grease. The orifice fitting also features a pressurized 'V' ring shaft seal, in-line field repairable plug, telemetry taps and a unique locking device to safely lock the plug valve in the closed position when the orifice plate needs to be changed. This fitting therefore provides safe uninterrupted service, and conforms to the latest ANSI /API 2530 , API MPMS 14.3 and AGA # 3, with 'No Restrictions' and is available in sizes 2ins to 8ins Class 150 to Class 600 inclusive.

Fluid control valves

In the world of fluid control valves, CMB Industries offers the most innovative products in the water control industry: the FEBCO Backflow Preventers, the Polyjet Control Valves and the K-Flo AWWA butterfly valve.

The FEBCO backflow prevention valves are a broad line of bronze and ductile iron which range in size from 1/2in to 10ins. In a cross-connection control programme the importance of the backflow prevention is to protect the potable water supply from contaminants introduced into the system by back siphonage or back pressure.

The Polyjet® valves provide precise control of flow and pressure in very severe service applications. The Polyjet is designed for high head-breaking applications in municipal distribution systems to hydroelectric turbine bypass installations. It delivers exacting performance while controlling cavitation through its patented port design, and also provides quieter and lower vibration operation. All of these valves are individually engineered for optimum performance. High pressure drops and precise flow control, over a wide range, are provided with both valve and pipeline free from cavitation damage. The Polyjet is currently in service breaking more than 1500ft (457m) of head and controlling flows from 1 to 590 CFS (16.5 CMS). Additionally, it can be designed with a high valve flow coefficient (Cv) to optimise permanent pressure drop at maximum designed flow rates . The sizes range from 3ins to 64ins. The valves can be actuated manually, electrically, hydraulically, pnuematically or with pilot systems. The K-Flo valve is the former Keystone AWWA valve and is now manufactured by CMB Industries. This line of products include the model 504 and 506 valves in sizes 3ins to 24ins. The figure 47 valve offers AWWA service in sizes 30ins to 96ins. The butterfly valves have the same actuation options as the Polyjet. ●



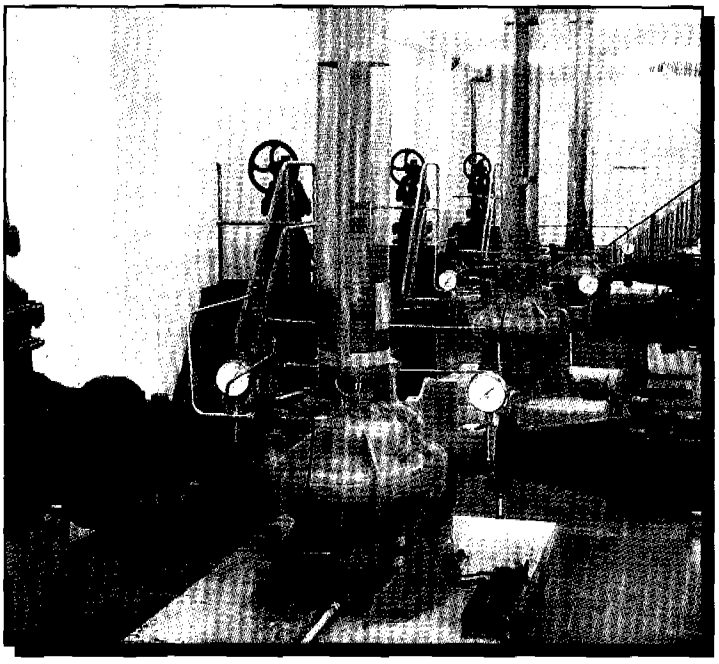
The FEBCO 876 N-shape (Masler series) valve

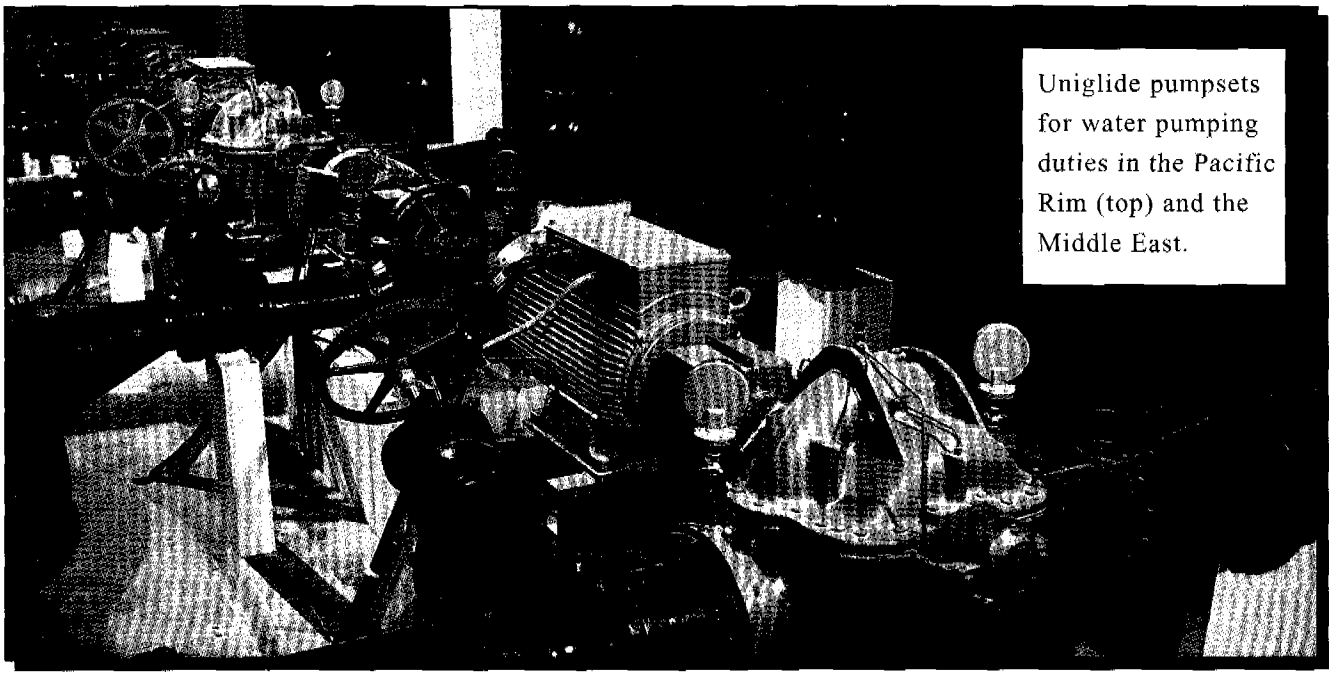
WATER FOR A NEW WORLD

Weir Pumps is recognised as an international leader in the design and supply of pumps and systems for the water and sewage industry.

The Weir range includes the varying sizes and styles of pumps essential for water and wastewater applications, augmented by an ability to project manage pump-related mechanical and electrical installations throughout the world.

The company also has facilities for sump model testing and can offer advice to optimise sump design.





Uniglide pumpsets for water pumping duties in the Pacific Rim (top) and the Middle East.

WEIR

WEIR PUMPS LTD

149 Newlands Road, Cathcart, Glasgow G44 4EX Scotland
Tel: +44 141 637 7141 *Fax:* +44 141 637 7358
E-mail: sales@wpl.weir.co.uk *Web Site:* http://www.weir.co.uk

For further information circle (80)

Centrifugal pumps for a **host of applications**

Weir Pumps Limited, one of the leading pump makers in the world, has a history dating back to 1871. Pumps are sold under the well-known trade names of Weir Pumps, Mather & Platt Machinery, W H Allen and Gwynnes Large Pumps, Ash, Galigher, WEMCO, Rot-Jet, GEHO, Begemann and Floway Pumps.

Weir Pumps Limited

Weir Pumps, the flagship company of the Weir Group, has its main manufacturing plant in Glasgow as well as a network of sales offices, manufacturing facilities and service depots throughout the world, offering global sales and service. This network enables Weir Pumps to reach its target markets quickly and efficiently, and explains why more than 50 per cent of its business comes from outside the UK. The company has supplied pumps for major installations overseas including large sewage pumps for the Baltalimani pretreatment works at Istanbul, the Lahore Development Authority in Pakistan and clean water pumps for Warren pumping station in Zimbabwe. Other major contracts include projects in Hong Kong, Thailand, Egypt, Nigeria, Venezuela, Sir Lanka, Syria, Ghana, Azerbaijan and many other countries around the world.

As well as the supply of pumps, the company offers the complete design and installation of mechanical and electrical pump system packages, specialising in providing minimum, whole-life cost and optimised pumping solutions

With continuous investment in modern manufacturing and testing facilities, combined with in-house foundries and extensive research and development, Weir Pumps produces centrifugal pumps for a wide range of applications and industries including power, oil, general industrial, fire-fighting, water and sewage. It is renowned worldwide for its quality, high efficiency, excellent reliability and long life. A large range of pump materials and arrangements to suit almost any application can be offered. Pumps range in size from 80mm branch size to over 1500mm with powers from a few kW up to 2000kW and more. Pump materials range from cast iron and bronzes through to super duplex stainless steels, such as Zeron (a Weir product). All pumps are manufactured to high-quality standards, including ISO 9001 and other international standards appropriate to specific industries, such as power generation.

Weir Pumps has some of the largest and most modern testing facilities available and with capacities up to 60,000m^3/h and a 15,000kVA electrical supply with various voltages available, almost all the pumps manufactured can be works tested at their design duty.

Within the research and development facility there is the capability and expertise to conduct hydraulic scale model testing of sumps and intake structures. These models are used to ensure that the pumping station design will afford optimum conditions to allow the pump to operate satisfactorily without any of the common problems such as swirl and air entrainment.

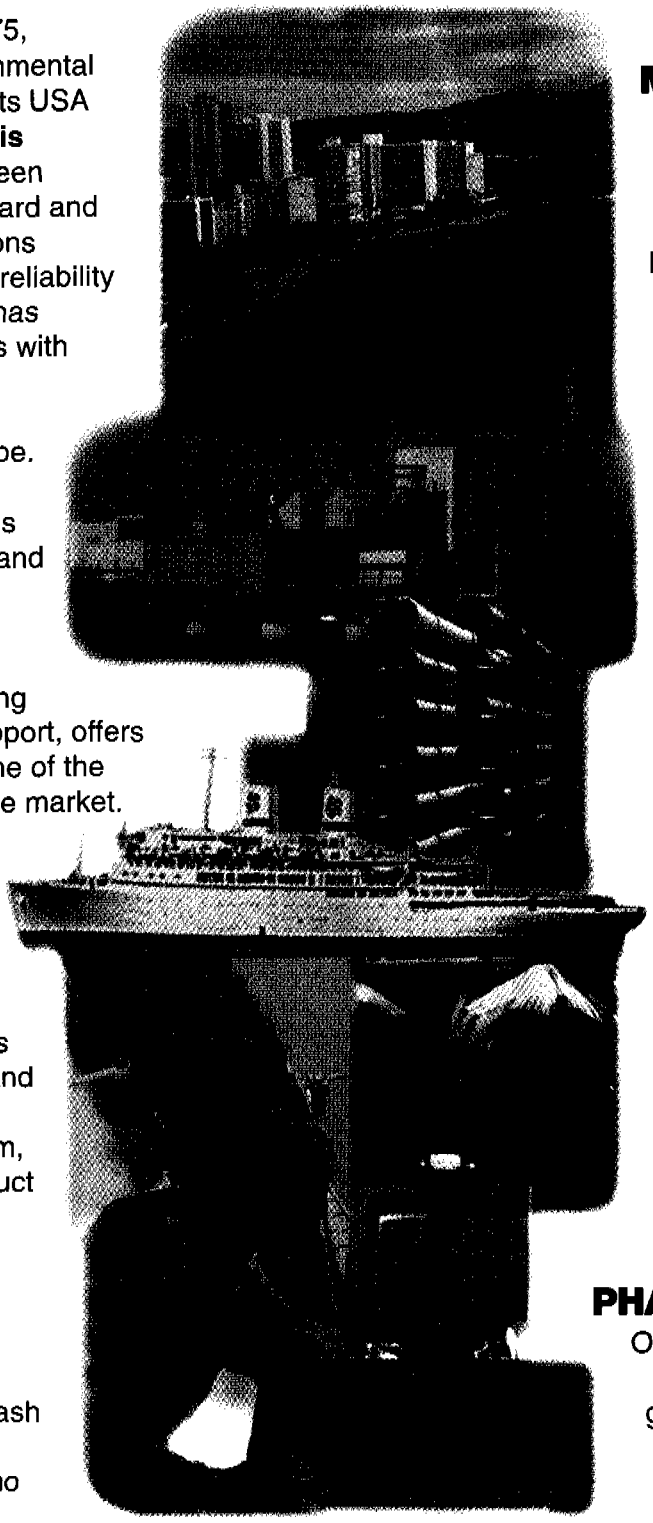
As well as the supply of pumps, the company offers the complete design and installation of mechanical and electrical pump system packages, specialising in providing minimum, whole-life cost and optimised pumping solutions. With support expertise in pump system hydraulics, water hammer, model sump analysis, operation and maintenance, equipment design and layout, it has the total capacity to solve your pumping needs.

For the water industry the Weir range includes the following pump models:

- Uniglide and Duoglide: split casing single/two-stage clean water pumps
- *Isloglide: end suction, single-stage water pumps*
- Swallowglide: end suction, single-stage sewage pumps
- Ulectriglide: submersible multi-stage borehole pumps (wet type)
- Shaft-driven bowl: vertical axial/mixed flow bowl type, single- or multi-stage clean water pumps
- Submersiglide: sewage and clean water submersible pumps
- Spiroglide: multi-stage, ring-section type pumps, and
- Envirotech: pumps for grit and slurries, including peristaltic pumps.

Specific product brochures are available describing the above ranges, including pump arrangements, standard material options, duty ranges and frame sizes, and these can be provided on request. ●

Since 1975, Environmental Products USA **Reverse Osmosis** equipment has been favored for standard and custom applications worldwide. Their reliability and high quality has served our clients with large numbers of fielded systems spanning the globe. Our technical expertise expands into many areas and coupled with our manufacturing flexibility, quick delivery and strong warranty and support, offers our customers one of the best values on the market.



ELECTRONICS MANUFACTURING

We provide high purity process water for semiconductor and hard drive OEM's. R.O. water significantly reduces the cost of deionization in these applications.

DESALINATION

EP Reverse Osmosis systems are used in resorts, hotels and cruise ships to provide a secure supply of potable water that is less expensive than most alternatives.

INDUSTRIAL

EP equipment is favored for production of water for boiler feed, processing, agriculture, and other industrial applications. Due to its proven reliability, ruggedness, and quality it is the equipment of choice worldwide.

PHARMACEUTICAL

Our sanitary, double-pass systems make USP grade water for a range of pharmaceutical processes and is currently distributed worldwide.

BEVERAGE BOTTLING

Our Reverse Osmosis systems allow beverage and water bottlers to produce a uniform, high quality product worldwide.

AUTO WASHING

We are a leading supplier to car wash equipment manufacturers who offer "Spot Free Rinse" equipment.

"Your best solution for Pure Water Technology."

Environmental Products USA, Inc.

730 Commerce Drive, Venice, Florida 34292 USA
Tel: 941/480-9101 Fax: 941/480-9201
WWW.envprod.com, e-mail: cleonard@envprod.com

Desalination for the **twenty-first century**

It is generally agreed that desalination will enable many nations to realise their full economic potential. Problems of inadequate clean water supply are increasingly calling for converting ocean water and brackish or highly mineralised waters found in lakes and rivers into fresh water supplies.

Wayne McRae

While it is not possible here to review the histories of all the principal players in desalination, I have chosen to focus on one pioneering company, Ionics Incorporated (Watertown, Massachusetts, USA), with which I have been closely associated for half a century. While history is not always a predictor of the future, Ionics' history of continuing innovation can be extrapolated well into the twenty-first century as we continue to grapple with desalination and water reuse challenges.

Ionics' history begins before it was officially incorporated. At the end of World War II, perceiving a need for an economical brackish water desalination process for developing nations, a team of researchers in the Chemistry Department at Harvard University developed an ion exchange process based on the lowest cost available chemicals for regeneration, namely lime and sulphuric acid. A successful field test plant was built. Toward the end of the project, during fundamental research on ion exchange, ion exchange membranes were discovered and the world's first membrane desalting process invented. At the same time, caustic and chlorine production was invented using such membranes.

In 1948, some of the Harvard scientists together with engineers from the Massachusetts Institute of Technology (MIT) founded Ionics to continue the development of ion exchange processes, membranes and their applications. Funding was provided by the foremost venture capital company at the time, American Research & Development Corporation (ARD), the driving force of which was General Georges Doriot, whose other 'children' have included Digital Equipment Corporation and Teredyne.

History is made

A revolutionary demonstration of membrane desalting of seawater in February 1952 at an annual meeting of ARD created a sensation in the press and around the world, with reports appearing on the front page of *The New York Times*. Thousands of letters were received by Ionics from people around the world desperate to obtain fresh water using the first commercial desalination process using neither heat nor chemicals. A year later, at another annual meeting of the venture capital firm, a full-scale, commercial version membrane desalting plant was demonstrated. The same year, Ionics received the first of its worldwide basic patents on ion exchange membranes, membrane desalting using such membranes (electrodialysis or ED) as well as on caustic and chlorine production using such membranes. Advanced, rugged membranes based on cross-linked polystyrene were put into production.

In 1954, Ionics installed the world's first commercial membrane desalting plant at a large petroleum company in Saudi Arabia, Aramco. Even in the pioneering days, Ionics realised that a reliable source of fresh water was critical and, prompt service and spare parts were necessary. Therefore, manufacturing, sales and field service offices were set up conveniently near the various 'own and operate' membrane desalting plants.

By 1958, Ionics had patented reversing type electrodialysis (EDR), in which periodic reversal of the direct current (DC) power provides a unique self-cleaning capability that allows for desalting of scaling or fouling waters. EDR has been a mainstay process in the desalination industry for the past 30 years.

Since the very first commercial ED system in 1954, Ionics has installed more than 3000 membrane desalination systems around the world, including plants to supply water to major portions of communities in the Caribbean and the Canary Islands, as well as for desalting municipal and industrial wastewater for reuse.

Progress on membrane-based desalination

What follows is a brief cross-section of desalination projects around the world, demonstrating the kind of progress being made in membrane-based desalination in the late twentieth century.

At Maspalomas, island of Gran Canaria, Spain, both brackish well water and seawater are treated using EDR and reverse osmosis (RO) respectively, as part of a nine million gallons-per-day (gpd) facility which sells potable water to the local utility, Eléctrica Maspalomas SA, on 20- and 25-year contracts. In this 'privatised' water supply project, Ionics designed, constructed, owns, operates and maintains the desalination plant, a so-called BOO arrangement, which is a growing trend in desalination. On the

neighbouring island of Tenerife, the Island Water Authority purchased two high-recovery EDR units to desalt 820,000 gpd of brackish groundwater as part of a drinking and irrigation water improvement programme. The precious groundwater in these volcanic islands is highly mineralised and in some regions contains excessive concentrations of fluoride which causes teeth staining.

In the Czech Republic, an EDR system is used as part of a complex process involving evaporators and crystallisers to reduce the volume of acid waste at Diamo, a Czech uranium mine. In this instance, a combination of membrane and thermal processes are used to provide solutions to complex wastewater treatment problems which threaten the local drinking water supply.

In Egypt, two turnkey EDR systems of about 500,000 gpd each were installed in 1996 and 1997 at a petrochemical plant and a paper-mill plant, both for desalting brackish river water for process use.

A perfect instance of a water conservation/reuse project employing desalination technology is at Moody Gardens (Galveston, Texas, USA), a $200 million world-class therapeutic, educational and recreational complex dedicated to life-building rehabilitation and training programmes for disabled and mentally-challenged individuals (see Figure 1). The 142-acre site, featuring 20,000 species of tropical plants and trees and some exotic fish, uses an Ionics EDR system to desalt difficult-to-treat sewage treatment plant effluent for watering the landscaped grounds, fountains, plants and enclosed rain-forest pyramid in order to conserve the City of Galveston's limited water resources.

Building upon the successful history of ED and EDR, a next-generation system called the Ionics EDR 2020™ has recently been brought to market to address drinking water purification from brackish sources more cost effectively, demineralisation of industrial process waters and reuse of tertiary treated effluent.

In Ghana today, Ionics will provide a 300,000 gpd desalination system using both sea water reverse osmosis (SWRO) and brackish water reverse osmosis (BWRO) to Stone and Webster Engineering Corporation, to enable the Takoradi Power Station to produce high quality process water. SWRO is a proven and reliable membrane-based process for producing fresh drinking water from the sea, the technology employed in one of the world's most renowned drought-proofing desalination projects, the City of Santa Barbara, California, situated on the Pacific Coast, about 100 miles north of Los Angeles.

Moody Gardens in Texas is a therapeutic, educational and recreational complex using desalination technology

Summary

In 1998, 50 years after the founding of Ionics, and 46 years after the legendary demonstration of the first membrane-based desalting process, the hope articulated in *The New York Times* of being able 'to open vast new reservoirs of fresh water for use in agriculture, industry and the home wherever water is now scarce...' is now a reality.

One may extrapolate from its first half century of history that Ionics and other companies with similar histories of technological ingenuity and continuing innovation will play critical roles in the twenty-first century, providing the desalination capabilities which will enable many nations in the Middle East, Africa, Eastern Europe and Latin America to address critical drinking water supply concerns, as well as industrial and municipal water and wastewater reuse challenges.

In many parts of the world, survival depends on how cost-effectively we can apply our technological innovations to desalting the world's brackish and sea waters. The next century will witness rapid change, but one thing will be certain: water will be of paramount importance. ●

Wayne McRae discovered Ion exchange membranes while at Harvard University and invented electrodialysis, reversing type electrodialysis and membrane type caustic and chlorine plants. For many years, he was in charge of R&D at Ionics. He is the inventor or co-inventor of 39 US patents and numerous foreign patents. He retired in 1986 and now lives in Switzerland, where he works as an independent consultant.

Working together for safe **drinking water**

The USA is moving into a new era in the protection of drinking water supplies. Laws have been updated and more than a billion dollars appropriated to new programmes. A combination of creative management, dependable treatment methods and new technologies must now ensure even safer drinking water.

Bevin A Beaudet, American Water Works Association

More communities are getting safer, cleaner water than ever before. In 1995, nearly 93 per cent of the nation's 58,000 (approximately) public water systems met the Maximum Contaminant Level (MCL) of the US Environmental Protection Agency (USEPA) standards. The number of systems violating the standards fell by almost 20 per cent in just four years. Infectious water-borne diseases such as typhoid and cholera have been eradicated in public water systems for decades. The problem posed by parasites such as giardia, which has existed since time immemorial in some water supplies, is quickly being eliminated. Industrial contamination of rivers and lakes has greatly decreased. Yet, given its value to our society, clean drinking water remains very cheap.

There is more good news. Thanks to the joint efforts of regulators and water suppliers, America's drinking water meets some of the strictest standards on earth, and it is improving all the time.

Legislation

In 1995, the Partnership for Safe Water was formed by a water community coalition including the American Water Works Association, the USEPA, other national organisations and hundreds of local water utilities. Its purpose is to help water suppliers assess and improve their treatment operations, to optimise drinking water quality and protect the public from cryptosporidium and other harmful organisms.

The Safe Drinking Water Act (SDWA) of 1996 authorises the USEPA to respond to urgent public health threats by focusing on true health issues and using sound science in standard setting. SDWA also, for the first time, provides $9.6 billion in revolving loans to assist water systems that have difficulty financing costly water improvements. The loans will help local water suppliers upgrade storage and treatment facilities, repair or replace leaky or broken pipes, and clean up contaminated water sources or develop new sources that meet government standards.

Anyone can obtain information about their drinking water by contacting their local water utility. Although many water utilities already publish annual reports explaining what is in the water, the SDWA requires that by 1998, all public water utilities will provide their customers with yearly, easy-to-understand 'Consumer Confidence Reports'. These reports will explain the quality of their water and list contaminant levels compared to the federal standards. If a violation of federal standards occurs, the water utility will explain publicly any related health concerns in plain language. Short-term serious risks must be reported within 24 hours.

Detecting contaminants

Huge advances have been made in contaminant detection and treatment. And all water — even distilled water — can contain contaminants. Determining the level at which the contaminants pose a health risk is the central question. A generation ago we measured contaminants in parts per thousand; today, we measure them in parts per trillion. Existing technology can virtually purify water through treatment processes, but it is very, very expensive — and largely unnecessary — to protect public health.

Perhaps the biggest challenge water systems have faced and will continue to face is that of strategic planning for capital improvements in the light of changing water quality regulations. The 1996 amendments retained the requirement added in 1986 that USEPA regulate 83 specific contaminants. Regulations have been set for most of these contaminants, but not yet for arsenic, radon, and uranium. In addition, the 1996 amendments require USEPA to proceed with a Stage 1 and Stage 2 rule for disinfectants and disinfection byproducts, an enhanced surface water treatment rule, and a rule for disinfection of groundwater. New contaminants will be regulated every five years through a new listing, evaluation, and regulatory process, with the first set of new contaminant regulations in effect in 2005.

Occasionally a water system has a serious problem such as Milwaukee's 1993 outbreak of cryptosporidium that sickened hundreds of thousands. And there are certainly water systems that need improvement. In addition, the estimated 17 per cent of Americans who get their water from their own private systems need carefully and consistently to test their water quality.

But the drinking water community, environmentalists and regulators alike have identified and are already working on solving the next set of issues in their constant pursuit of better quality. Increasing watershed and source protection, combating microbial and organic contaminants that new detection techniques have enabled us to identify, controlling pesticide runoff, reducing chlorine by-products, and upgrading aging infrastructure are all receiving unprecedented attention.

In the next century, surface water systems will continue to rely on 'conventional' treatment (coagulation, flocculation, sedimentation, filtration, and disinfection) for particulate removal, but will need to find other treatment processes to address site-specific water quality problems. Technology such as ozone, granular activated carbon, and membranes will see increased use, while new disinfection strategies will be needed to minimise both microbial risks and unwanted by-products from disinfection.

Utilities will look increasingly at management alternatives, such as public-private partnerships, total privatisation, and customised design-build-operate agreements. For many small systems, that will lead to restructuring or consolidation.

Improving customer relations

Water utilities will also need to listen better to their customers, and management decisions increasingly will be influenced by customer concerns.

Consumer confidence reports will be produced regularly to brief customers on water quality and operations, including any violations. New developments in electronic technology will enable utilities to communicate more information to their customers more cost effectively. Already a growing number of utilities have a presence on the Internet; by the end of the century, electronic billing, water quality updates, and other useful consumer data will be standard.

Upgrading the water supply infrastructure will require a massive investment of public and private money over the next several decades. And many communities may wish to further upgrade their treatment capabilities, too. These decisions will be shaped, to a large extent, by a series of tough community choices such as: how pure do we want our drinking water to be? And how much are we willing to pay for it? Communities must weigh the relative risks and trade-offs in determining how limited local resources should be spent.

Even though most communities already benefit from a safe water supply, complacency is dangerous. To continue to safeguard our water resources and improve our drinking water will require the active involvement of the American people in local community decision-making.

In the future, the quality of American drinking water will directly reflect communities' values and actions. The continued availability of an improved abundant and safe water supply will depend in large part on our willingness to make it a priority and pay for it. In the end, it is our water, our money, and our health. ●

Safe, clean, drinking water for all

Bevin A Beaudet is President of the American Water Works Association (AWWA). Founded in 1881, AWWA is the world's leading authority on drinking water. With headquarters in Denver, Colorado, its members include scientists, engineers, environmentalists, public health experts, educators, and water utility managers throughout the USA, Canada, and Mexico.

Drinking water supply and **sanitation in Asia Pacific**

Outbreaks of cholera serve as a reminder of how quickly the adverse effects of unsatisfactory drinking water supply and basic santitation appear and accelerate. It is not enough to provide facilities; they must be sustained through adequate provision for operation and maintenance of systems, and their proper usage ensured through adequate health and hygiene education.

Dr Ali Basaran, World Health Organization Western Pacific Regional Office

Following the International Drinking Water Supply and Sanitation Decade (IDWSSD), a new programme was established entitled the WHO/UNICEF Joint Water Supply and Sanitation Monitoring Programme (JMP). This programme has assembled data to determine the status of the sector in 1990 (1), 1992 (2), 1994 (3) and 1996. The information from 1996 is still being processed, and therefore the following assessment of the sector status is based on 1994 data. Any analysis of trends however, needs to be treated with some caution since the data gathered, the form of reporting, responding countries, and definitions for 'access', 'adequacy', 'acceptable water quantity' have varied in the different exercises and from country to country. (See Tables 1 and 2). Nevertheless, in all cases, the information is valuable as a way of targeting resources and setting priorities.

Global situation

The following is based on information provided by 84 countries.

Water supply. The population of the developing countries rose by 312 million to 4383 million. In that same period, based on the data reported through the JMP and extrapolated for non-reporting countries, a total of 781 million people gained access to safe water. The total number of people still lacking access therefore reduced by 469 million. That still left a total of 1115 million people unserved in 1994 (25 per cent of the population of the developing countries).

With an average of 195 million people gaining access to safe water every year (more than half a million people every day!), the number of people served was growing at nearly 8 per cent a year — a marked acceleration over the rate of progress achieved during the 1980s. However, there have been substantial differences in the coverage increase in different regions and between urban progress and that in rural areas.

Despite the apparent overall achievements, the available data indicate some alarming trends. The improvement in water supply coverage occurred overwhelmingly in Asia and the Pacific, where about 700 million people have been served in the four years. Indeed, the Asia and Pacific countries account for nearly 90 per cent of the progress achieved in water supply and for 95 per cent of rural water supply increases. Increases achieved in other regions are far more modest. In Africa, 38 million people gained access, while in Latin America and the Caribbean, an extra 30 million people were served, representing respectively 5 and 4 per cent of the total number who gained access to safe water during the period.

The figures show that the greatest water supply progress from 1990 to 1994 was in rural areas. The 611 million extra rural people served during the four years raised rural water supply coverage from 50 to 70 per cent. In urban areas, the extra 170 million people served was offset by a 205 million increase in the urban population, leaving the percentage coverage unchanged at 82 per cent. Clearly, the effects of high population growth

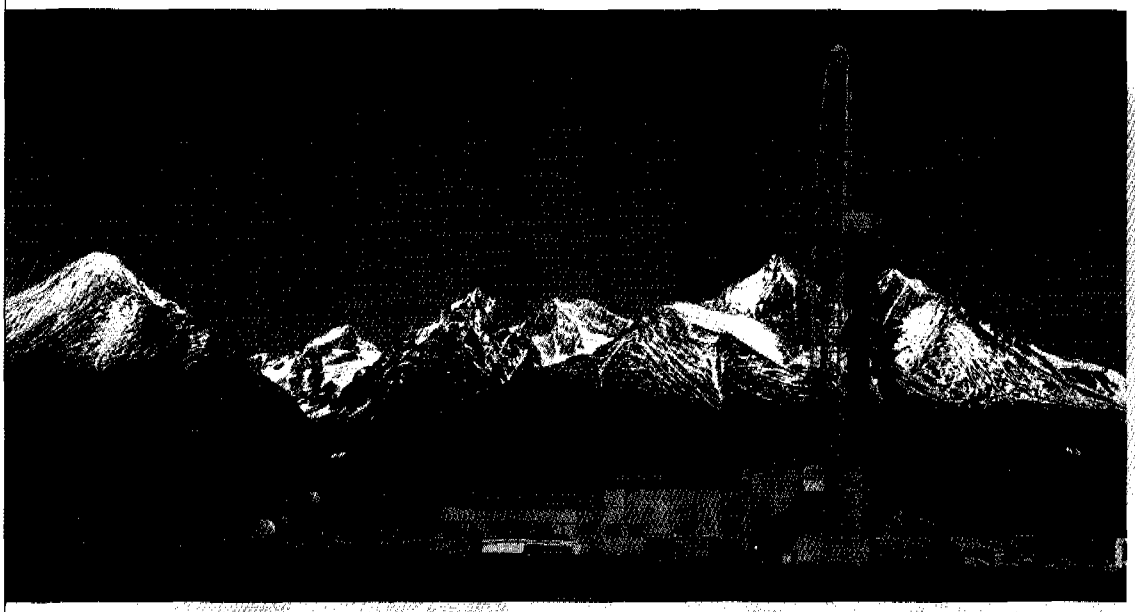
Number of countries defining access as 'Water source at a distance of less than..'									
	50m	100m	250m	500m	1000m	2000m	5min	5min	30min
Urban	20	6	3	8	1	–	1	–	1
Rural	10	1	6	17	4	4	–	1	1

Table 1. Definitions of access to safe drinking water source.

Number of countries defining the minimum quantity per person per day as					
Litres	15–20	20	20–30	30–50	> 50
Countries	1	19	5	10	3

Table 2. Definitions of acceptable water quantities for rural areas.

NAFTA a.s. Gbely is a Slovak joint stock company. Established in 1914, the year when the petroleum industry in Slovakia was founded, since NAFTA a.s. has consolidated its role in the domestic market as an important player.



Business activities can be divided into the following five areas:

1. Exploration in prospect areas of Slovakia performed by own drilling rigs, work over jobs, drilling services for domestic as well as foreign customers.

2. Gas and crude oil production, including geological reservior engineering service.

3. Storing of imported gas in underground gas storage which are designed, constructed and operated by NAFTA.

4. Building oil related machinery, engineering, maintenance and repairing all oil and gas equipment.

5. Construction of gas and oil gathering centres, pipelines, cable networks, gas regulation stations and gas storage facilities.

Today, NAFTA's business activities focus on the development of the underground gas-storing facilities, the construction of the fourth and fifth stage of the UGS complex Láb and the stabilisation of gas production. Well-known in the European gas market, NAFTA a.s. makes a significant contribution to the developmental activities in prospective oil field regions.

nafta GBELY

NAFTA a.s. Gbely, 908 45 Gbely, Slovak Republic
Tel.: + 421 801 921 500-5, Fax: + 421 801 921 103

and accelerating urbanisation are proving a formidable challenge.

Sanitation. Analysis of the figures leaves the unavoidable impression that sanitation has been almost totally neglected in the four years from 1990 to 1994. While the application of tighter definitions as to what constitutes 'adequate' sanitation has evidently had some impact (the number of rural people deemed to be adequately served actually fell by 31 million), the comparison with water supply progress makes it all too clear that investment in sanitation improvements remains a low priority for many governments and communities.

Overall, the number of people deemed to be lacking adequate sanitation rose by 274 million in the four years, with percentage coverage falling in both urban and rural areas. At the end of 1994, a mere 18 per cent of rural people could be said to have access to adequate sanitation services, leaving some 2284 million rural dwellers unserved. A further 589 million urban residents also lack proper sanitation, 146 million more than in 1990. Only Western Asia bucked the trend of decreasing coverage, and even there the population unserved rose by a million in the four years.

Asia and the Pacific

The following is based on information provided by 23 countries.

In Asia and the Pacific region 13 countries (56 per cent) reported a level of water supply service coverage of more than 75 per cent, and 2 countries (9 per cent) a level of less than 25 per cent. As for sanitation coverage, only 8 countries (35 per cent) have reported a level higher than 75 per cent while 7 (30 per cent) reported coverage levels of less than 25 per cent.

On the basis of the reported data, considerable achievements took place during the 1990-1994 period, in relation to the provision of water supply. Overall (urban/rural) water supply service coverage increased from 61 per cent to 80 per cent through the expansion of services to an additional 698 million people — an average increase of 175 million per year, 90 per cent of the average global population served per year during that period. The major achievements have been in rural areas, where the level of water supply service coverage has risen from an estimated 53 per cent to 78 per cent. To attain this level, a total of 582 million rural people were served, representing 83 per cent of the extra people served in the region.

In comparison, in the urban setting, water supply coverage rose by only 1 per cent (from 83 per cent to 84 per cent) following provision of water supply to an additional 116 million people. As a result, the number of unserved people grew by 10 million bringing to 150 million the number unserved in 1994.

Overall, the level of sanitation service coverage decreased from 30 per cent to 29 per cent, with nearly 2206 million people without adequate services in 1994, 172 million more than in 1990. But this apparent decrease in coverage for Asia and the Pacific is mostly due to the adoption of a more stringent criteria of what constitutes an adequate means of excreta disposal by some of the larger countries in the region, particularly China. The sharpest decline appears to have occurred in the rural settings where in absolute terms the number of people with sanitation service decreased by 47 million due to a drastic change in criteria. In the urban settings, although an additional 71 million people gained access since 1990, because the population grew by 126 million during the same period, in terms of coverage the level slipped from 62 per cent in 1990 to 61 per cent in 1994, leaving some 371 million people without access to sanitation services as of 1994.

Child Summit goals

The overall Child Summit goal for water supply and sanitation is universal coverage by the end of the year 2000. To come close to that goal, many developing countries would require an unprecedented acceleration in the level of investment in improved water supply and sanitation facilities in the remainder of the 1990s.

If the 1990–1994 trends remain unchanged, by the year 2000 some 755 million people will remain without access to safe drinking water supply. Of these unserved, 51 per cent will be in urban areas, mostly in Latin America and the Caribbean, Asia and the Pacific and Western Asia regions. Nearly 86 per cent of the unserved rural population will be in Africa, where 59 per cent of the total unserved will be living. Some 3.3 billion people will be without access to appropriate sanitation by the year 2000, with 74 per cent in the rural areas. With almost 60 per cent of the rural unserved and three-quarters of the total unserved population, Asia and the Pacific region faces the greatest challenge.

Prospects to the end of the century

Urban water supply. Except for Western Asia, where the current rate of increase in coverage, if continued, would provide water supply to all urban dwellers by the year 2000, a continuation of the trend in the provision of services witnessed between 1990 and 1994 would not be enough to prevent an increase in the number of people without access to safe water.

In the case of Africa, the rate of service provision would need to be more than twice the current rate in order to keep pace with urban growth. More than a fivefold increase would be required to achieve full coverage. In Latin America, the rate of progress would need to be as much as 2.6 times higher in order to achieve full coverage

by 2000, and a 2.12 times accceleration is needed in Asia and the Pacific.

Within a longer time-frame, the continuation of the current rate of progress in Latin America and the Caribbean would yield full urban water supply coverage by the year 2020. However, Africa would need to treble its current rate and Asia and the Pacific would require a twofold increase to reach that target.

Urban sanitation. The situation in urban sanitation gives serious cause for concern in all regions and, in the case of Africa, for outright alarm. In all regions, the current rate of service provision is insufficient to prevent an increase in the number of dwellers without access to at least minimum standards of sanitation. Both Asia and the Pacific and Western Asia need to more than double their current progress rate to maintain the current levels of unserved. A rate of increase nearly 33 times higher will be required in the African region to achieve this objective.

In Asia and the Pacific, service coverage would need to be provided to an additional 99 million people a year in order to achieve full coverage by the year 2000, representing an increase as much as 5.6 times the current rate. A fourfold increase would be needed to achieve the same objective by 2020. Latin America and the Caribbean would need to add some 24.5 million people a year, and a fourfold increase would be required for Western Asia to achieve full coverage. In Africa, the rate of expansion would need to be 80.6 times higher to the end of the century. The region would need to provide services to an additional 29.8 million people a year — a patently impossible task.

To achieve full coverage by 2020, Asia and the Pacific would require a rate of progress more than three times higher than the current rate, and Africa 46 times higher. The Latin American and Caribbean region would need to add some 9.9 million people a year to those served in order to achieve full coverage.

Rural water supply. Under the current criteria regarding suitability in terms of quality and distance to water supply sources, a continuation of the rate of progress that has been reported to have taken place in the provision of safe water to the rural populations of Asia and the Pacific would yield full coverage in the region before the end of the century. This is not the case for any of the other regions. In Africa, a continuation of the current pace of providing safe water to rural dwellers would be insufficient to maintain the number of unserved people at the 1994 level. An increase of 58 million people a year would be required in order to supply every person with safe water. This would require a nearly 12–fold increase in the current rate of progress.

With a longer-term objective of providing full service coverage by the year 2020, the region would need to provide safe water to an additional 19 million people a year. The rate of increase would need to be 6.5 times higher in Latin America and the Caribbean, where nearly 9 million people a year would need to be added to those having access to safe water. In spite of the projected decrease in rural population, the current rate of expansion in services would be insufficient to achieve full coverage by 2020. The rate of progress in Western Asia would need to be 2.6 times the current rate in order to achieve full service coverage by the end of this decade.

Rural sanitation. In view of the stagnation in providing sanitation services to the rural population, a solution to the problem is unlikely to be at hand in the near future. In Africa, a rate of progress nearly three times higher than the current trend would be required simply to keep pace with increase in the rural population. A rate of progress nearly 21 times higher than the current one would be required to achieve full service coverage by the end of the century. Given the projected rate of growth in population, an expansion in the time-horizon to the year 2020 would not make the solution any easier.

Nearly a fourfold increase in the current rate would be needed in Western Asia. The Latin American and Caribbean region would need to provide sanitation to 13.4 million rural dwellers each year to the end of this century. Asia and the Pacific would have to provide sanitation to an additional 320 million rural dwellers per year to achieve full coverage by the year 2000. An increase of 75.5 million per year would achieve this objective by 2020. ●

Dr Ali Basaran is Regional Adviser in Environmental Health, World Health Organization Western Pacific Regional Office, Manila, Philippines.

1. *Water Supply and Sanitation Sector Monitoring Report 1990 (Baseline Year), WHO/UNICEF/Water and Sanitation Collaborative Council, November 1992.*
2. *Water Supply and Sanitation Sector Monitoring Report 1993 (Sector Status as of 31 December 1991), WHO/UNICEF/Water and Sanitation Collaborative Council, August 1993.*
3. *Water Supply and Sanitation Sector Monitoring Report 1996 (Sector Status as of 31 December 1994), WHO/UNICEF/Water and Sanitation Collaborative Council, 1996.*

Turf reinforcement mats for **culvert and bank protection**

Turf reinforcement mats have demonstrated their performance both in unilateral hydraulic systems such as storm water channels and also in civil engineering systems with more challenging water environments. They are replacing hard armour systems such as rock riprap because vegetation can be established quicker and be reinforced to sustain stronger hydraulic forces.

● **Synthetic Industries Incorporated**

Rock riprap is widely used for protection around pipe inlets and outlets and on the banks of reservoirs. Limited design procedures to protect these structures against hydraulic forces that can initiate erosion have attracted engineers to what has been used for many years and shown in the standard details on previous projects. At times, rock riprap is used without consideration to cost, previous performance, aesthetics, safety or other key environmental factors. Often this expensive and unattractive technique is not necessary.

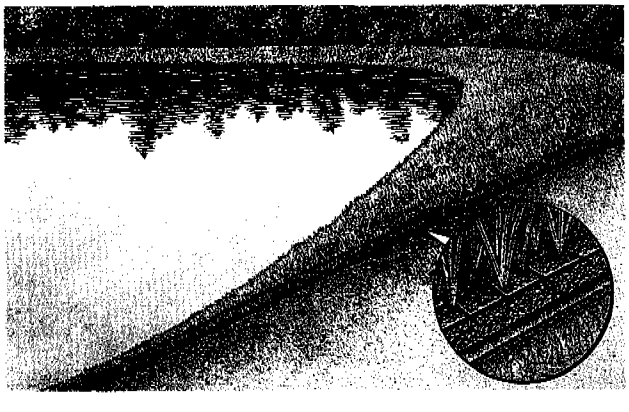
Since their introduction in the 1960s, Rolled Erosion Control Products (RECPs) have been used to protect construction projects with disturbed soil slopes, channels and peripherals that must be immediately protected and revegetated. These products have experienced rapid growth due to increasing awareness by engineers, contractors, owners and agencies. The benefits of using RECPs include cost, ease of installation, promotion of vegetation, increased infiltration, reduced run-off, decreased visibility and excellent long-term performance. Although traditionally used in low-flow drainage channels as lining systems or on bare soil slopes for rapid revegetation, one particular category of RECPs has performed exceptionally well on culvert and bank protection installations.

Turf reinforcement mats (TRMs) consist of a lofty web of polypropylene fibres positioned between two high-strength, biaxially oriented nets and mechanically bound together by parallel stitching with polyolefin thread. The mat possesses strength and elongation properties to limit stretching and is UV-stabilised against degradation. TRMs are constructed of ultraviolet-stabilised synthetic materials which function to protect the seed and inhibit erosion prior to germination. As a result, these products provide permanent reinforcement of vegetation capable of withstanding much higher velocities and shear stresses than vegetation alone.

Culvert and bank protection

The area immediately surrounding a pipe inlet or outlet (the collar) is often protected with a geotextile overlain by rock riprap simply designed to withstand entrance and exit velocities or shear stresses that are typically within the performance window of TRMs. Synthetic Industries' patented PYRAMAT® permanent erosion and reinforcement matrix has been independently tested to withstand long-term (50 hours) vegetated velocities of up to 14 ft/sec. As an example, this product is used as a protective collar around corrugated metal pipe specified by the State of Nebraska Department of Roads with diameters up to 36ins.

Specially-designed TRMs with a geotextile backing are used for banks and shorelines subjected to little or no wave action when migration of highly erosive soils, that is, silt or sand beneath the surface, is of concern. This is especially true when installing this unique TRM on the banks of canals, reservoirs, surface impoundments, lake shorelines and water treatment ponds. The rise and fall of surface impoundments causes localised erosion. The product, LANDLOK® TRM 1061B, is used when little or no waves are present. If wave heights exceed those caused by distant recreational traffic or wind fetch, Synthetic Industries offers PYRAMAT® 3-D erosion reinforcement matrix. If wave heights are the result of storms on bays, inlets and oceans, Synthetic Industries offers geotextile tubes to be used in conjunction with PYRAMAT® 3-D erosion matrix. Geotex® Tubes, fabricated of high-strength polypropylene or polyester woven fabrics, are ideal for use in wetland reclamation, shoreline protection, offshore breakwaters, and containment/dewatering of contaminated materials. These dredged material-filled tubes are economically priced and environmentally friendly. ●



Advance hydraulic **rotary drilling rig**

The outstanding feature of Advance equipment is the storage of the drill pipes on special racks.

Soilmec Spa

The Soilmec Advance series rigs for water, oil and geothermal drilling present the following main features:

- Fully hydraulic operations
- Telescopic mast provided with a pull up-down cylinder which allows reduced dimensions in transport and drilling operations with Range 3 drill pipes
- Sliding realised by means of a central cylinder which allows the pull up-down operations
- Pull-up load distributed in line with the mast without generating bending or torsional stresses
- The particular design allows the fixed section of the mast to be totally load-free and therefore lighter
- Power swivel with hydraulic motors mounted on an articulated quadrilateral with rigid frame
- 'Load sensing' hydraulic system with automatic load balancing adjustable from the remote control panel
- Fully automatic drilling operations
- Mobilisation and demobilisation operations reduced to a minimum, and
- Quick and easy disassembly and assembly, leading to time savings when moving from one site to another.

Advantages over other systems

The system (covered by international patent) is totally innovative compared with the systems currently used to perform pipe change-over manoeuvres and it offers major advantages, including:

- Drill pipe checks on site, without wasting time at the mouse-hole
- The space occupied is reduced to a minimum
- The system can also be used for tubing during work-over operations
- During operations on drill pipe strings, the pipes are placed individually in a mouse-hole in a pre-set position by means of the remote-operated crane; all the operations that follow are performed in automatic cycle.

Advance drilling rigs are generally mounted on a two or three-axle semitrailer. They are powered by a three-axle tractor, and the total weight and overall dimensions in transport conditions allow easy handling with bureaucratic formalities reduced to a minimum.

Soilmec can supply, on request, the assembly on a three- (or more) axle semitrailer or on a truck.

A height from the working table up to 6m and the free room under the main base allows the assembly of necessary BOP. A platform mounted on the main base for the quick and easy BOP installation at the well centre is possible.

Engines and the fans for the hydraulic oil cooling system are sound-proofed.

The power swivel stroke up to 16m allows the use of API Range 3 drill pipes and casings. The power swivel can be moved out of the well centre of 1200mm to take and put down the string elements in the mouse-hole.

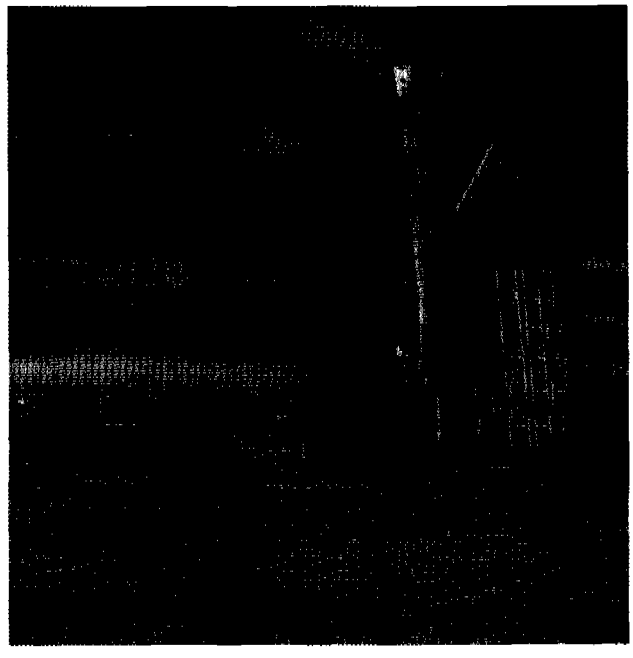
The power swivel can be operated by two, three or four hydraulic motors, depending on which is required, and it develops a real torque up to a maximum of 3600kgm at 50rpm.

A hydraulic device allows for automatic drilling with a constant load on the bit selected by the operator on the control panel. Both controlled pull-up and pull-down operations are possible.

This device, totally reliable and widely experienced on site, makes the operator free to move to control the job site and to prepare the drill pipes for the mouse-hole.

The vertical container system of drill pipes and collars, with a jib crane fitted to the rig, makes the transport, the drilling operations and the extraction of the string from the well quick and easy.

The total storage depends on the size and length of the drill pipes used. With API Range 3 drill pipes the capacity is 3000m with 2⅞ins and 2700m with 3½ins (the vertical container system is covered by international patent). ●



The new g-125 drilling rig

An action-oriented network for water **resources development**

The Global Water Partnership (GWP) was initiated in 1996 by the World Bank, United Nations Development Programme (UNDP) and the Swedish International Development Co-operation Agency (SIDA) as a network of organisations interested in sustainable development of freshwater resources in developing countries.

Johan Holmberg, Global Water Partnership

The Global Water Partnership seeks to consolidate the various watesub-sectors under the umbrella of integrated water resources management, applying the principles enunciated in 1992 at the Dublin conference and later embedded in chapter 18 of Agenda 21.

GWP's role is one of catalysing, linking and networking at global and regional levels, as well as helping to stimulate creation of concrete action plans. GWP describes the global water sector in terms of four sub-sectors:

- Water for household use (supply and sanitation)
- Water for food security (irrigation and drainage)
- Water for ecosystems and the environment, and
- Integrated water resources management.

Other categories that may later be added include water for energy (hydropower), water for industrial uses and water for navigation. Within each sub-sector, operational field programmes (so-called 'associated programmes') are being identified. These may have different functions, including technical assistance, capacity building, dissemination of R&D findings, best practices and so forth.

Structure of GWP

From the outset, it was recognised that GWP could not be created as a conventional intergovernmental institution because the financial resources to sustain such an agency would not be available. GWP was therefore conceived as a 'reinforced network' with an organisation characterised as low-cost, flexible and voluntary, and guided by professional and scientific excellence. The principal elements of the GWP governance structure are the following:

- A small central secretariat of six staff hosted by SIDA in Stockholm and headed by the Executive Secretary; this is not a legal entity of its own, and all formal agreements are concluded by SIDA on behalf of GWP
- The intellectual spearhead of GWP, its Technical Advisory Committee (TAC), chaired by Torkil Jonch-Clausen from Denmark, and consisting of 12 specialists
- The GWP membership assembly, the Consultative Group, which is chaired by Ismail Serageldin, Vice-President of the World Bank, working in a personal capacity; the Group meets semi-annually to make policy decisions and direct the development of GWP
- A Steering Committee which guides the Executive Secretary, consisting of some 15 members, who represent the various constituencies within GWP, and
- Patrons who have been requested to speak in favour of GWP in 'high places'.

Two types of service

GWP has set for itself the task of providing services for water resources development to developing countries. This has two dimensions: the substantive issues, in which developing countries typically require services (the 'what' question); and the type of services required (the 'how' question).

The substantive issues in which key stakeholders, including government agencies and NGOs in developing countries, typically require assistance in relation to water resources management include irrigation management and cropping systems, environment and health, strengthening of institutions, legal frameworks, technologies, indicators, operations, and policy development and planning.

The modes of assistance required by such stakeholders include:

- Financial resources and mechanisms
- Innovations in policy, management and technology
- Transfer of environmentally sound technologies
- Technical assistance
- Capacity building, and
- Information on best practice, expert rosters, and so on.

The assistance described can be divided into two categories. 'Soft' assistance consists of information that comes free if it can be accessed, and 'hard' assistance is provided only at a cost.

Creation of partnerships

GWP will help developing countries address their needs by helping create water partnerships, both within developing countries (especially among government agencies and NGOs, research institutes and the private sector, including farmers) and between them. Regional water partnerships will be fostered in different parts of the world

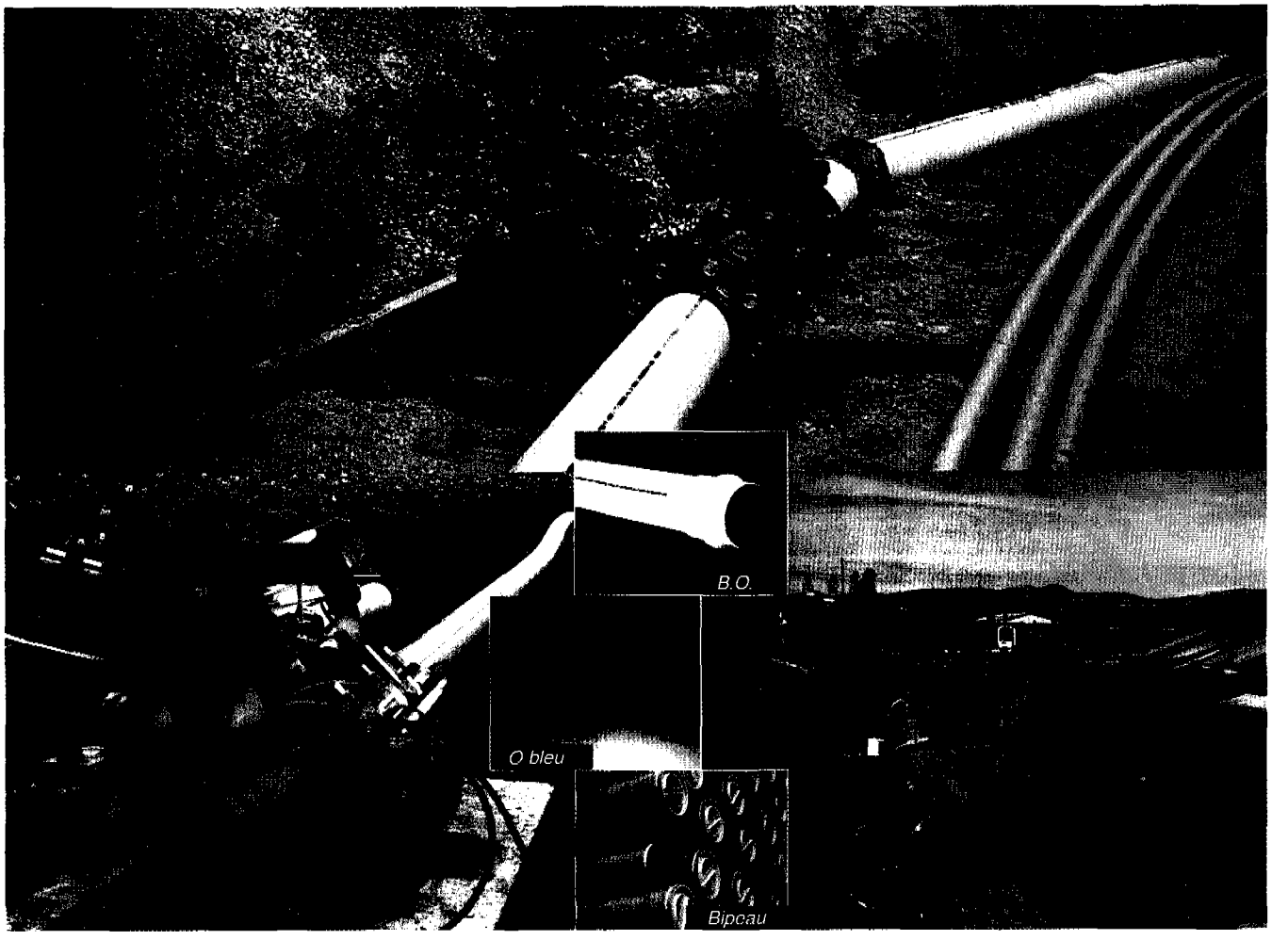
to identify needs better and demand appropriate services to address them.

The centrepiece of the regional water partnership is the regional TAC; constituted in the same way as the central GWP TAC, a regional TAC is a body of eminent experts drawn from within the region working in their personal capacity. Regional TACs are now being created in Southern Africa and in SouthEast Asia, and it is expected that one will soon be created in South America. The next to follow will be South Asia, Eastern Europe, North Africa and China. GWP aims to help create 10 regional TACs within its first five years of operation.

In this manner, co-operation for water resources development would be truly demand led. Water users in developing countries would be able to have a mechanism for demanding services from the GWP 'associated programmes' supported by the aid donors. This mechanism would be guided primarily by professional and scientific considerations and be as non-political as possible. It would also put pressure on the donors to improve their co-ordination and make aid more efficient. This is increasingly important as public aid flows have declined to their lowest level in relative terms since the mid-1970s at 0.3 per cent of GDP of the donor countries.

GWP is still in its infancy. It is an experiment in a new form of international co-operation that builds on the common recognition by water users all over the world that the water shortage will become one of the main impediments to development in the next century unless effective action is taken today. The attention finally given to this issue in the United Nations, manifested at the UN General Assembly Special Session in June 1997 and leading to work in the Commission for Sustainable Development from April 1998 onwards, augurs well for an international consensus on the need for a holistic or integrated approach to water resources development. GWP is well placed to help foster such a consensus and co-operation with UN agencies and other international organisations. ●

Johan Holmberg has worked with development issues since the late 1960s, mostly in the field of agriculture and rural development. He directs SIDA's Department for Natural Resources and the Environment, while working as Executive Secretary of GWP, which is based in Stockholm.



Alphacan Canalisations
Systems to fit every situation

Water supply systems

• Alphacan B.O. high pressure PVC pipe

An up-to-date bioriented PVC pipe operated at a *nominal pressure of 25 bar. B.O. is the best compromise* of lightness, impact resistance and cost optimization.

• Alphacan O'Bleu PE system

A complete range of polyethylene pipes, from Ø 20 mm to Ø 630 mm, up to nominal pressure 16 bar and more.

The security of Alphacan's technical expertise : The right fittings (but-welding or electrofusion joining), training courses attended by our operators, on-site assistance at work's starting.

• Alphacan Lucoflex PVC pipe

A versatile range of PVC pipes, up to Ø 630 mm, adapted to every irrigation and water supply situation.

Sewage disposal systems

• Alphacan Bipeau system

A complete solution of structured PVC pipes up to Ø 710 mm, in various stiffness classes up to 8 KN/m², including a large range of accessories and fittings to simplify any technical issues, **with the best cost effective solution.**

Alphacan is one of the European leaders in the development and manufacturing of plastic piping systems : the solution to any special purposes from drainage to bridge stay cable sheath, including all kinds of protective ducts for optical fibres or electrical wires, gas lines, or specific design for your own request.

Should you have any queries or need any further details, please do not hesitate to contact us :
Alphacan Export Department, tel. : + 33 130 825 845, fax : + 33 130 825 949.

ALPHACAN
COMMITTED TO PROGRESS

ALPHACAN - Export Department - 12/18 Avenue de la Jonchère - 78170 La Celle St Cloud - France

For further information circle (92)

PRODUCT SHOWCASE

Low-cost method of pre-treating discharge effluent — Hydro International Limited

Hydro International Limited is a leading manufacturer of environmental equipment and designs, with extensive experience in a wide range of industrial and municipal applications. In the 15 years that it has been in business internationally, it has earned its reputation as an experienced, organised and efficient company with exceptional products and customer service.

This successful record indicates that your process wastewater treatment does not need to be complicted or expensive. The company's approach is an extremely simple, effective and low-cost method of pre-treating discharge effluent for the removal of suspended solids, fats, oils, greases, BOD, and COD from wastewater effluent streams, and complying with local, national and international EPA standards and regulations.

Hydro International believes that to service effectively customers with pollution concerns, the environmental company must offer some key services. Therefore, for the past 15 years, Hydro International has worked hard on developing, not only its innovative technology, but also a complete service and support package. The company is proud to offer the following services:

- Design and consulting
- Process evaluation with cost-effective alternatives
- Compliance specifications
- Manufacturing of the equipment
- State-of-the-art system controls
- Plant start up
- Operator training
- Installation and field support
- Treatability studies, and
- Follow-up service with plant operators.

For further information please contact:

Hydro International Limited
Balreask
Trim Road, Nvan
County Meath, Ireland
Tel: +353 46 72658
Fax: +353 46 72659
E-mail: pjfinn@ibm,net

Our role in resource restoration — Pentair Pump Group

Wastewater disposal has assumed increasing prominence worldwide. The various processes involved in the collection, treatment and sanitary disposal of water-carried waste from households and industrial waste is of primary concern.

Methods to address waste disposal date back to ancient times, and some storm water sewers that were built by the Romans are still in use today. When interest in construction of storm sewers was renewed, mostly in the form of street gutters and open ditches, this form of waste disposal was initially illegal. However, by the nineteenth century, it was recognised that community health could be improved by discharging human waste into these channels for rapid removal. Despite reservations that these unsanitary systems wasted resources, created health hazards and were expensive, many cities built them and by 1910 there were roughly 25,000 miles of sewer lines in the USA alone.

By the beginning of this century, communities had realised that the direct discharge of sewage created health problems, and this led to the construction of sewage treatment facilities. At about the same time, the septic tank was developed for both urban and rural areas.

Since then governments around the world have encouraged the prevention of pollution by providing funds for the construction of municipal waste treatment plants and implementation of water pollution prevention techniques. New processes have been developed to treat sewage and analyse wastewater. These efforts become increasingly critical as expanding populations, consumption of water resources and industrial and economic growth contribute to pollution and health difficulties.

Pentair Pump Group is at the forefront of development in technologies as applied to the water and wastewater handling industry. The company designs and produces a variety of pumps and pumping systems to deliver clean, safe water supplies and ecologically sound waste management and water reclamation to communities around the world.

Ultimately, we all play a part in the water resource management cycle. Our success is contingent upon our ability to work together to maintain the resource for future generations. With that understanding, it will serve us well to consider that in an industry with so many competitors striving to be 'number one', it is teamwork that is the true measure of leadership. We are proud of our role and commitment to being a leader serving the vast and ever-changing needs of our global population.

For further information please contact:

Pentair Pump Group
800 Airport Road
North Aurora
Illinois 60542, USA
Tel: +1 630 859 7000
Fax: +1 630 859 7060
Website: www.gspump.com

A unique valve design — SISTAG Absperrtechnik

The Swiss company, SISTAG, is the original manufacturer of WEY® knife gate valves. WEY valves carry the reputation of being non-clogging, fully free passage, bubble-tight shutoff in both directions, and more. They have gained worldwide acceptance in the slurry, wastewater treatment, and other high consistency media, as well as in special applications such as prevention of dust explosion, filter discharge and high pressure offshore mud drilling.

Based on the unique sealing system used in the WEY valve, the WEY sluice gate (Penstock) is another product which is designed for positive shutoff in open or enclosed channels.

The company also manufactures a disc model flanged-style butterfly valve. This valve incorporates a pressure-supported resilient seal in the disc for bubble-tight shutoff and ease of operation.

The WEY® knife gate valve type VN wafer design provides unchanged reliability at an economical cost. This valve design assures long-life reliability and bubble-tight shutoff due to the joint action of various factors during the closing stage:

- Tight shutoff due to the sealing function on the lateral gate side
- Gate guides on full stroke length ensure flutter- and notice-free operation and bi-directional bubble-tight shutoff at full design pressure
- During final closing stage, remaining solids are sheared off by knife-like gate and body-cutting edge
- Special gate geometry prevents jamming during closure because deposits are pushed ahead by the gate into enlarged flushing corners of the body; contoured body interior initiates flushing action to prevent build-up of deposits in seat area
- Unique WEY® transverse seal eliminates stuffing box
- Minimised chest area between port and transverse seal leaves no space for solid build-up or jamming and,
- By tightening packing screws, repacking under full pressure and without system shutdown is always possible.

Last but not least, considering time and cost savings in maintenance work has persuaded customers for decades to install WEY® knife gate valves.

For further information please contact:

SISTAG Absperrtechnik
CH–6274 Eschenbach
Switzerland
Tel: +41 41 449 99 44
Fax: +41 41 448 34 31

Vortex flow control by hydrodynamic separation — Hydro International plc

Formed in 1994 from Hydro Research and Development Limited, Hydro International plc now has offices in UK, USA and Australia. The key focus of the Group is the 'Hydro Way' concept, which applies a paradigm shift to conventional thinking in the wastewater industry by advocating source control of stormwater runoff. This is achieved by the use of vortex flow controls — Hydro-Brake® flow control (Europe) and Reg-U-Flo™ (USA) — and the separation and concentration of sewer solids by hydrodynamic separation using Hydro Storm King® overflow and Hydro Grit King® separators. This lateral approach has been shown to save up to 40 per cent of the capital cost of major schemes. The devices have no moving parts and do not require electrical power; operational costs and maintenance are therefore minimal.

To date, some 7000 vortex flow controls and more than 300 separators have been sold by the Group.

The vortex flow controls are self-activating, relying on the upstream hydraulic head to generate an air-filled vortex within the centre of the casing, which occupies the greater part of the outlet. The consequent generation of high-peripheral velocities further restricts flows and creates back pressure, which then restrains outflows to the periphery of the discharge. As a result, for a given head and flow, the outlet diameter can be up to 600 per cent larger than that of an equivalent orifice plate, reducing the risk of blockage or fouling — an important feature for a sewerage network.

The Group's dynamic separators work at intermediate hydraulic energy levels, with a typical headloss of 300mm. With the use of patented specialist components, the complex swirls and vortices (which are caused by introducing flow tangentially at the periphery of a circular vessel) can be harnessed to separate solids. These solids move towards the base and centre of the vessel by centripetal action to allow their removal. A rate of separation in excess of 95 per cent is typically achieved, dependent on settling velocity and vessel design.

For further information please contact:

Hydro International plc
Shearwater House
Clevedon Hall Estate
Clevedon BS21 7RD
UK
Tel: +44 1275 878371
Fax: +44 1275 874979

Servicing one of the world's largest water supply schemes — Consult 4 (International) (Pty) Limited

Consult 4 (International) (Pty) Limited provides a complete portfolio of services to the water industry. As consulting engineers, they have striven to not only provide the traditional design and project management expertise, but also to provide technical expertise in other associated disciplines, which are often of critical importance to the overall success of a project. These associated disciplines cover the following aspects of the whole sector:

- Catchment management
- Assessment of water resources and water quality
- Assessment of instream flow requirements
- Resettlement of people, flora and fauna where inundation arising from dam construction is inevitable
- Environmental impact assessment and monitoring
- Socio-economic studies
- Privatisation of the water sector, and
- Technical assistance in the management and operation of water supply systems.

Consult 4 is currently providing technical services on the Lesotho Highlands Water Project, one of the largest water supply schemes under construction in the world. The firm is involved in the design and construction supervision of the 180m-high Katse dam, the 45km Transfer Tunnel, the 37km Delivery Tunnel, the Matsoku Weir and 7km diversion tunnel, and the 32km Mohale Tunnel, and the water supply and other infrastructure to service the construction teams. Furthermore, Consult 4 has undertaken environmental impact studies for the Delivery Tunnel, and resettlement and development studies for communities affected by the 150m-high Mohale Dam.

Consult 4 is also the principal consultant of a consortium responsible for the design and supervision of construction of the 105m-high Maguga Dam in Swaziland. In addition to these large bulk water supply schemes, it has been involved in numerous water treatment and urban reticulation projects.

These projects typify Consult 4's overall aim to provide its clients with a comprehensive service, which will enable them to successfully achieve their development objectives in harmony with the environment.

For further information please contact:

Consult 4 (International) (Pty) Limited
Allyson Hall
26 Weltevreden Road
Northcliff, Extension 9
2195 Gauteng
South Africa
Tel: +27 11 476 9485
Fax: +27 11 476 9461

A leader in metering technology — Jesco Dosiertechnik

Jesco Dosiertechnik is a leading worldwide supplier of high-quality chemical feed equipment and measurement and control devices. The company manufactures and sells complete ranges of metering pumps, gas chlorinators, dry feeders, microprocessor-based controllers, accessories and spare parts. Jesco has earned a reputation for quality and reliability in industrial and municipal water treatment markets, as well as in chemical process industries. Through a worldwide network of sales engineers and service personnel, Jesco products are combined with technical expertise and a commitment to total customer satisfaction.

Jesco is now introducing the following state-of-the-art innovations:

- The new Magdos solenoid pumps combine microprocessor technology with versatile control options; a selection of different sizes up to 115 l/h and various features meet all requirements of applications in water treatment and the chemical industry
- The Topax, a microprocessor-based P, PI or PID controller offers flexibility for measurement and control of residual chlorine, pH and Redox/ORP; with its modular construction, it accepts up to four inputs including disturbance feed forward variable and provides up to four control signals as output, and
- For mid-sized or small swimming pool applications (hotels, hospitals, private pools) Jesco now offers a compact station to measure and control chlorine, pH and Redox/ORP; the preassembled plate-mounted unit includes sensors, measuring devices, a controller and pumps.

For further information please contact:

Jesco Dosiertechnik GmbH & Co KG
Am Bostelberg 19
D–30900 Wedemark
Germany
Tel: +49 5130 580 20
Fax: +49 5130 580 268
E-mail: jesco@t-online.de.
Website: www.jesco.de

X-Pando: the problem solver

X-Pando Products Company

Would it not be wonderful if one sealing compound could be used on all threaded pipes and fittings for almost any liquid, gas or liguid gas? Add to these demands a material that will correct problems resulting from using pipes and fittings that have been damaged; from mismatched or improperly cut threads; or from the use of materials from different suppliers with slightly different threads. X-Pando Products Company manufactures such a product in its X-Pando Pipe Joint compound.

The company has enjoyed its fine reputation as 'the problem solver' for more than 55 years, solving pressure-related (up to 6000psig) and temperature-related (up to 1200°F) leaks consistently where other products have failed.

X-Pando differs from other sealants in both formulation and performance. The material is an expanding cement product rather than a filling agent or epoxy. Because X-Pando expands as it sets, it will agressively fill voids, gaps and pits, creating a leak-proof seal.

In addition to these superior qualities, X-Pando is manufactured for a safety-conscious society with high environmental standards. X-Pando is non-toxic, and contains no lead, asbestos or ozone-depleting chemicals. It is UL classified and has been approved for the ANSI/NSF standard 61 for drinking water. X-Pando products also meet the very difficult standards and requirements of the FDA, USDA, API and NASA. Two of the company's products have been tested and approved for medical oxygen.

Another quality product is X-Pando Special No 2. This particular material is made specifically to seal joints of cement-lined pipes that will be welded. Special No 2 is already used extensively throughout the world for old and new construction projects, and is mentioned by name in the American Petroleum Institute's procedures for installing cement-lined pipe.

For further information please contact:

X-Pando Products Company
P O Box 1300W
Trenton
New Jersey 08607
USA
Tel: +1 609 394 0150
Fax: +1 609 989 4847
E-mail: XPANDO@I78.com
Website: http://www.i78.com/xpando

A wide range of screens

Three Star Engineering Limited

Three Star Engineering Limited was established 30 years ago and operates through two divisions, environmental and sub-contract engineering.

The environmental division, which specialises in the treatment of both clean and dirty water, designs, manufactures and installs a wide range of screens dependant on the type of application, that is, sewage inlets, river intakes and power station inlets. The products on offer range from coarse/fine bar screens, travelling band fine screens, cup and drum screens, storm overflow and mobile raking machines. The company also has a comprehensive range of associated equipment such as compactors, conveyors launders and electrical control panels.

The equipment is manufactured in a purpose built, 90,000 ft^2 factory in Sheffield, housing the most up-to-date auto cad systems and manufacturing machinery with all the work being produced in accordance with ISO9002.

Three Star's client base reads like a 'who's who in the water industry' with the company supplying equipment into all the major UK water authorities, be it through direct sales or one of the many process contractors.

As well as a successful UK market, Three Star enjoys a very strong export business to Turkey, Egypt, the Middle East, Chile, India, Hong Kong and Indonesia.

Three Star Engineering is dedicated to client satisfaction, offering the best solution for the clients' problems. To this end, over the past 18 months, they have seen an increase of some 30 per cent in sales to a current level of turnover circa 10 million pounds.

The company employs 200 personnel and is privately owned, which makes it one of the largest companies of its kind in the UK.

For further information please contact:

Three Star Engineering
President Way
President Park
Sheffield
Yorkshire S4 7UR
UK
Tel: +44 114 275 757
Fax: +44 114 275 6625

Valves and hydrants for real-world solutions — Von Roll Valves Limited

Von Roll develops, manufactures, and distributes a vast range of modular shutoff valves for municipal and industrial supply and effluent applications, as well as hydrants for fire-fighting and snow-making water.

Among the qualities which have positioned Von Roll as a leader in the valve market are innovative real-world solutions and long-term functional integrity.

Von Rolls valves and hydrants are protected against incrustation and corrosion with a heavy epoxy coating to assure freedom of maintenance and a long service life.

To maintain its leadership, Von Roll is committed to ongoing investments in the renewal and optimisation of its production resources, as well as to a comprehensive quality system.

In terms of value creation, the product line is enhanced with responsive delivery, availability of spare parts for decades, competent advice, realistic training, comprehensive warranties, and dedicated customer support.

For further information please contact:

Von Roll Valves Limited
CH–4702 Oensingen,Switzerland
Tel: +41 62 388 1111 Fax: +41 62 388 1188

AWP Gas- und Wasserarmaturen GmbH
Brüssower Allee 91, D–17291 Prenzlau, Germany
Tel: +49 3984 730 Fax: +49 3984 73138

Von Roll AWP Polska GmbH
Doluje Lubieszyn 4B, PL–72 002 Szczecin, Poland
Tel: +48 91 118 346 Fax: +48 9111 8517

Improving on traditional slow sand filter technology — Quadel Industries Incorporated

Quadel Industries Incorporated was founded in 1984 to manufacture water and septic tanks, and has since grown to be the largest water and septic tank manufacturer on the West Coast of the USA. In the past two years one of the company's major interests has been in water filtration. The criteria for the company's filter was to produce a quality product that requires no electricity or chemicals to provide the highest quality water possible. In order to accomplish this task they reproduced tried and tested technology practised for more than 100 years.

The slow sand filter has proved to furnish extremely high-quality water with a minimum amount of cost and maintenance. Traditionally, slow sand filters were reserved for large systems, they were built in place and anything but transportable. Quadel has coupled their expertise in rotational moulding with the technology of slow sand filters to provide a system that is easy to install and is available at a price that is far less than any other slow sand filter.

For further information please contact:

Quadel Industries Incorporated
P O Box 1047, 200 Troy Street
Coos Bay, Oregon 97420, USA
Tel: +1 541 289 7659
Fax: +1 541 269 7300

Process valves for gaseous and liquid fluids — Fr. Buschjost GmbH + Company

Fr Buschjost GmbH + Company produces process valves for gaseous and liquid fluids. The company has the know-how to choose the right materials for housing and seals depending on the fluid which flows through the valve. The main ranges are solenoid valves, externally actuated valves, motor valves, and valves with special approvals. Buschjost offers catalogue valves and modified valves, and designs special valves according to customer's requirements. Since 1994, its quality management system has complied with DIN EN ISO 9001.

The valves are worldwide in operation in various applications: machinery, environmental care, water treatment, basic industries such as agriculture and forestry; wherever water is the main fluid to be controlled. Their technical features include: threaded connection up to G2; flange connection from 15 to 150mm; DIN, NPT, ANSI, pressure range up to 40 bar; and explosion proof.

For further information please contact:

Fr Buschjost GmbH + Company
P O Box 10 02 52-53
D-32502 Bad Oeynhausen
Germany
Tel: +49 5731 791 0
Fax: +49 5731 791 179
E-mail:mail@buschjost.de
Website: http://www.buschjost.com

Italian leader in plastic products — First Corporation SRL

First Corporation SRL is an Italian holding company which specialises in the production of plastic materials for the construction industry. It is a leader in the sector of PVC grids, ground drainage system and PVC raingutters.

Edil Plast SRL, thanks to the brand 'La Ventilazione', is one of the more important companies at international level for the production of grids and ventilation systems.

Masf SRL is specialised in the production of rainwater and wastewater fittings in solvent cement, a range which is completed by Ipa SRL, the last company of the group, which is concerned with the production of plastic profile and pipes. Manufacturing in different types of plastic, such as PVC, PP, ABS and nylon, enables them to be used in many types of civil and industrial works, such as garages, swimming pools, shopping centres, car parks, service station and sports centres.

The varied product range consists of:

- PVC solvent cement fittings
- Products for soil drainage
- Grilled drain channels in PVC
- The PVC raingutter family, and
- A range of airing grids in several models and measurements.

For many years our group, through its individual units, has always tried to offer products of high technical qualities and good service to the customer; it is for this reason that today we can offer through First Plast the certificates UNI-EN ISO 9002, EQNET ISO 9000 and UNI-ITP 9031+FA 1 for raingutters, and the certification AFNOR NF 4 for PVC fittings.

In conclusion, First Corporation has always been synonymous with reliability and professionalism and is considered as one of the leading companies offering Italian-made plastic products to an international clientele.

For further information please contact:

First Corporation SRL
Localitá Isola Grande
17041 Altare (SV)
Italy
Tel: +39 1958 511
Fax: +39 1958 305

Treating Jurong Island's wastewater — Seghers Water

A UNITANK® installation in Singapore is currently under construction. The system is designed to treat the wastewaters of the industrial estate called Jurong Island. The installation will be built on one of the seven natural islands (Sakra Island), that are being transformed by land reclamation into one big industrial area situated on the southern coastline of Singapore. This installation, built for the ENV (Ministry of the Environment), consists of a local wastewater treatment unit and a central sludge treatment unit with complete redundancy.

The wastewater treatment facility has a capacity of 80,000 PE (phase 1), where the wastewaters of Du Pont, Van Onneren, Eastman Chemicals and other petrochemical firms will be treated up to a BOD of 20ppm and a suspended solids concentration of 30ppm. This part of the installation is designed to treat 10,800m3, 4.320kg BOD, 8.640kg COD and 6.480kg SS per day.

Before entering the UNITANK system the raw waters are thoroughly pretreated by automatic coarse screens, self-cleaning fine screens and grid-, fat- and oil-removing chemicals. This pretreatment is already foreseen for the future waster water flow (50 per cent extra capacity), so that extension of the plant will be less disturbing.

The sludge treatment facility of the installation has a global capacity of 160,000 PE. The capacity is large enough to receive sludge from two other wastewater treatment plants (Jurong Island WWTP 2,3) to be built in the near future. First the excess sludge of the UNITANK system is mineralised and reduced in four aerobic stabilisation units. These units have a global retention time of 20 days and can also be operated separately. To reduce the sludge volume the stabilised sludge will be thickened in one of the two gravitational thickeners. The sludge will be fully dewatered up to a dry solids concentration of 20 per cent by a COMPOSTELLA®, consisting of three dry solid decanter centrifuges and three polyelectrolyte preparation units. After final dewatering, the sludge will be transported with hydraulic pumps to one of the two sludge silos for storage and direct truck loading , for final disposal.

The partial start-up of the installation is planned for March 1998, whereas the final completion, including sludge treatment facility, is scheduled for July 1998.

For further information please contact:

Seghers Water
Grote Baan 63
3150 Wespelaar
Belgium
Tel: +32 1 660 8211
Fax: +31 1 660 6164
E-mail: Seghers-water@seghers-water.com
Website: www.seghers-water.com

Helping to solve the water shortage — CELGARD GmbH/formerly HOECHST AG

Over the years, steadily increasing demands have led to a continuing shortage of our most valuable resource; however, technologies have emerged to solve this dilemma. One of these, membrane technology, and especially ultrafiltration, enables there to be a drastic reduction of effluents in a number of industrial applications. For example, in the metalworking industry the use of ultrafiltration extends the life time of degreasing baths, recycling of rinsing baths and lubricants. Spira-Cel® spirally wound modules, tailored to these specific applications, have proven in a number of installations to be reliable and economical. In the pulp and paper industry, with its high water consumption, effluent volumes can be reduced on their way to a zero effluent paper mill. Only the hydrophilic properties of Nadir® membranes made it possible to access these applications.

These industries are not by any means the only ones where membrane technology brings decisive improvements. Another example is biological treatment plants. Membrane technology allows a capacity increase and therefore treatment of a larger wastewater quantity without major expansions. Any germs are removed from water simultaneously, and this takes care of another aspect.

In this application MOLSEP® multi-tubular modules demonstrate reliability and economical water treatment.

As environmental responsibility increases and water regulations become ever more stringent, membrane technology will grow in importance and move in this direction.

For further information please contact:

CELGARD GmbH
Industriepark Kalle-Albert
D-65174 Wiesbaden
Germany
Tel: +49 611 962 6429
Fax: +49 611 962 9237

No limit to fittings for water and sewage pipes — Ludwig Frischhut GmbH

Ludwig Frischhut GmbH was founded in 1945, and was the first German manufacturer of PVC-socket fittings made of cast iron. The company now manufactures approximately 10,000 different fittings for water and sewage pipes. Fittings are made to suit ductile iron-, PVC- and PE- pipes with flanges and different kinds of sockets. Other highlights of the Frischhut product range are flexible couplings and tension-anchor systems.

Heavy-duty coating protection ensures a high level of corrosion resistance. The production range has several national and international approvals, and the company is a member of several national and international organisations.

Ludwig Frischhut GmbH is a member of the Frischhut Group, which is managed by the holding company, Ludwig Frischhut Holding GmbH.

The privately-owned Ludwig Frischhut Foundry Company (now Ludwig Frischhut GmbH of Pfarrkirchen) has over recent years made several corporate acquisitions, so it made sense from a control point of view to establish Group status under the new holding company.

The Frischhut Group is now focussed on product development, improved quality products at competitive prices and continuous improvement in service to its many customers. Each day brings many new challenges and with the strength and depth of the Frischhut Group new products are developed and new market opportunities are continually opened. The close attention to our customer needs is always of highest priority. The Group members represent some of the leading companies in the foundry and valve business, serving not only our local and regional municipal gas and water distributors but also the general building, industrial and power plant sectors both nationally and internationally. The products of the Frischhut Group are distributed through a Group-owned network of trading companies as well as other national and international agents and distributors.

For further information please contact:

Ludwig Frischhut GmbH
Gambacher Weg 1A
D–84347 Pfarrkirchen
Germany
Tel: +49 856 1300 80
Fax: +49 856 1300 8169
E-Mail: lf@frischhut-gruppe.de
Website: www.frischhut-gruppe.de/lf

Focusing on the root cause of the problem

Interstate Assessment Technologies

Interstate Assessment Technologies (IAT) has the breadth and depth of resources and capabilities to accommodate projects requiring site investigation, problem analysis, programme development, research and development, prototype development and subsequent product manufacturing.

With extensive field and application-oriented experience, the company has the ability to focus quickly and effectively on the root cause of the problems and avoid costly and untimely efforts.

A significant database of practical applications has enabled IAT to refine the techniques and tools (hardware and software) employed on projects as part of its methodology. Some of the applications include, but are not limited to, predictive/failure analysis, materials engineering, specialised NDE techniques, design to applicable codes and standards, corrosion evaluations, biological environmental remediation techniques, wastewater systems, fatigue and dynamics analysis, risk-based assessment programmes, structural analysis and equipment quality and reliability programmes (EQRPOR).

IAT' s engineers and scientists have performed extensive design analysis and modelling of above-ground steel storage tanks for both water and petroleum products. They have designed a unique seismic anchorage system for retrofitting existing anchored storage tanks to increased earthquake requirements. Additionally, IAT has written a software program to document inspections, maintenance, corrosion loss, mimimum wall calculations, safe fill height, settlement, and so on, which is fully compliant with API 653.

Recent international projects have included odour and corrosion control for municipal sewage systems, using a line of biological systems which also demonstrated significant reductions in solid wastes. In addition, clear water ponds and lakes are treated for algae and weed control, which improves not only the water quality but the habitat for fish and other wildlife.

For further information please contact:

Interstate Assessment Technologies
2113 S 48th Street
Suite 103
Tempe
Arizona 85282
USA
Tel: +1 602 438 6070
Fax: +1 602 438 6080
E-mail: iatinphx@netzone.com
Website: www: iat-eztyme.com

Smart metering systems

Acromet Australia Pty Limited

Acromet Australia has added an exciting new product line to complement their own manufactured range of metering equipment. The new EMP series microprocessor- controlled, motor-driven diaphragm metering pump introduces a high level of automated control and interactivity wherever metering functions are critical, for example in water treatment. Available with flows ranging from 1.4 to 120 litres per hour, they are able to accept Analog or Digital control signals to facilitate fully-automated process-dependant dosing. Voltage-free remote on/off facilities are provided to interlock dosing with other process conditions. Communication is not just one-way, however; the EMP series offers error reporting and performance feedback, allowing operators to monitor pump activity remotely.

The EMP's innovative design is seen to offer the most favourable characteristics of motor-driven metering pumps: gentle stroke action, smoother delivery, and easy priming, without the need for overload or isolation protection — the EMP will shut down automatically and raise an alarm in such conditions. The pump liquid ends are available in PVDF, polypropylene, and 316 stainless steel, so they are able to accommodate any water treatment chemical.

Combined with Acromet's comprehensive and complementary product range, which includes automatic gas chlorination systems, dry chemical feeders, water analysis and control instrumentation, chemical transfer pumps, and submersible drainage, effluent and sewage pumps, the EMP smart pump provides the user with that extra dosing element for their water treatment system.

While the company aims to continue — as it has for more than 35 years — to supply the international water treatment industries with leading edge technology in metering equipment, it also realises the need in many developing countries for user-friendly systems that are not maintenance-intensive, or operationally complex. To this end, Acromet has developed small turnkey packages for municipal, commercial and domestic water sterilisation, tradewaste neutralisation, horticulture and agriculture fertilisation and water treatment, as well as for cooling towers boilers, and swimming pools.

For further information please contact:

Acromet Australia Pty Limited
14 Winterton Road
Box 1105 RMDC
Clayton 3168, Victoria, Australia
Tel: +61 3 9544 7333
Fax: +61 3 9543 6706

World leaders in valve technology

Guest & Chrimes Limited

Guest & Chrimes lead the way in the design, manufacture and supply of valves and other related products to the water industry. The company maintains this advantage with new and innovative products constantly being added to its already extensive range. Its commitment to the water industry is unrivalled, and its driving force is the determination to stay at the forefront of valve technology and customer service.

The range of products is constantly being reviewed to meet the industry's requirements today and into the next millennium. Of key importance in this philosophy are the build quality and engineering excellence that have contributed to the company's reputation worldwide. Machining is completed in its extensive workshops, which are well equipped with a full range of CNC multi-functional work centres. These departments are continuously receiving a high level of capital investment to ensure that the company keeps up with the latest manufacturing and finishing techniques.

In order to provide the best and most durable coatings for all valves (particularly for potable water) and give advanced anti-corrosion protection, the water industry Coating Standard W.I.S. 4-52-01 has been adopted as the standard. This is in the form of a fusion-bonded epoxy coating on all valves including gate valves, hydrants, air valves, check valves and butterfly valves.

Guest & Chrimes has an experienced Technical Support Team to advise on the selection of valves. This gives the customer confidence to use this advice and install the valves that are correct for the application.

Guest & Chrimes employs a highly skilled work force that supply the largest range of water valves from any one manufacturer. The valves have been supplied to many of the major water projects throughout the world.

In the early 1990s Guest & Chrimes was acquired by Tomkins plc to form part of their valve division. Tomkins is active in most countries, with an annual turnover in excess of £4 billion.

For further information please contact:

Guest & Chrimes Limited
P O Box 9
Don Street, Rotherham
South Yorkshire S60 1AH, UK
Tel: +44 1709 828 001 Fax: +44 1709 828 012
E-Mail: Sales@guest-chrimes.demon.co.uk
Website: Internet: http://www.guest-chrimes.com

Your global partner for pure solutions

Bechtel Water Technology Limited

With representation and/or execution resources in five continents, Bechtel Water can justly claim to be global in reach, local in touch. Bechtel, the engineering and construction contractor which brought the world the Hoover Dam, helped bring Kuwait back to life after the Gulf War and delivered infrastructure projects ranging from roads, airports and railways to many customers world-wide, is now firmly established as a front-rank player in the world's water industry.

Engineering capability

Our main engineering execution centre is in Warrington, UK, where Bechtel Water Technology Limited is engaged upon a £1.5 billion programme to enhance and sustain North West Water Limited's extensive water and wastewater facilities within the five-year phase 2 of their Asset Management Programme.

This programme consists of more than 500 individual projects, ranging in value from £100,000 to more than £100 million. One thousand two hundred employees dedicated to the water industry provide an unrivalled capacity to undertake your projects, from the smallest study to the largest constructions, in municipal water as well as industrial.

Specialities and availability

Specialist skills are available which find application in many water management organisations — supplier or user — including, as examples, process studies and optioneering, geotechnical evaluations and recommendations, computational hydraulic analysis and network analysis.

Development projects

Through our project development sister company, Bechtel Enterprises, which is 50 per cent owner of International Water Limited and 50 per cent owner of US Water, we are also positioned for the provision of EPC services for privatisations, concessions and BOT/BOOT projects. Other developers may also avail themselves of these services.

International locations

Regional offices are in London, Hong Kong, San Francisco and Buenos Aires, and representatives can also be found in Bechtel offices in Manila, Cairo, Jakarta and Gaithersburg (Maryland, USA).

For further information please contact:

Bechtel Water Technology Limited
Chadwick House
Warrington Road
Warrington WA6 3AE, UK
Tel: + 44 1925 857533 Fax: + 44 1925 857557

Principal components in water installations — Structural Europe N.V.

Structural Europe in Herentals, Belgium, the world leader in non-metallic pressure vessels since 1954 and the first and only supplier in their industry to obtain ISO 9001-certification, is the European establishment of the international group Essef Corporation (Chardon, USA). Its glass-fibre, reinforced vessels are used for the movement, storage and treatment of water.

From their two plants in Belgium (of which one produces GRP tanks and filters and the other composite materials), they export 90 per cent to Europe, the Middle East, North Africa, South-East Asia, Australia and New Zealand. More than 20 million tanks from Structural are the principal component in virtually all water treatment installations.

The growing success of composite tanks against steel tanks can mainly be explained by their superior resistance to corrosion, their limited weight and consequent easy handling. Also, the products come with certificates from recognised national and international institutes.

The product range consists of:

- Pressure tanks: residential high-pressure tanks, commercial tanks for softening and filtration, industrial high-pressure tanks, industrial top and bottom flange tanks
  Bajonet: distribution systems for tanks
  Codeline: membrane housings
  Wellmate: hydropneumatic pressure tanks
- Triton poolfilters: sandfilters with top-mounted valve
- Tagelus poolfilters: sandfilters with top-mounted valve
- Delta filters: professional, high-pressure filters
- Challenger pumps: high-performance pumps
- Pinnacle pumps: medium-head pool and spa pumps
- Supertanks: the engineering approach to specific needs, and
- Enpac: secondary containment and hazardous equipment.

Having noticed a growing need for bigger tanks, Structural Europe made a thorough market analysis, after which specifications were drawn up. Research and development also led to the birth of the 'Supertank', which withstood all tests successfully. This has a thermoplastic liner, CNC-wound with glass fibre impregnated in epoxy, and has been designed for high purity, flange connections, integrated systems, and containment. Its markets are water treatment, swimming pools, waste recovery, biologicals and chemicals. The Supertank is the total solution for the treatment and transport of fluids under pressure.

For further information please contact:

Structural Europe N.V.
Industriepark Wolfstee
B-2200 Herentals
Belgium
Tel: +32 14 25 99 11
Fax: +32 14 25 99 75

Socrates: a breakthrough in leakage technology — Bristol Water plc

Socrates — a revolutionary instrument for analysing leakage in water distribution networks — has been launched by Primayer, after a year of developing and field-testing with Bristol Water. The equipment provides a much clearer view of the true state of leakage, using patented auto-correlation techniques developed by Bristol Water and specialist consultancy Silkleaf Design.

Currently, monitoring systems use flow data averaged over technically convenient 15-minute intervals. Trials at Bristol Water, however, showed that faster measurements reveal valuable details in flow patterns which can point users toward real rather than assumed trouble spots. High-resolution data is particularly useful on mixed domestic/industrial sites. Comparative trials showed conventional measurements on such sites can be out by as much as 80 per cent.

Even more useful is Socrates' ability to estimate customer night use much more accurately than using conventional data loggers. Trials have shown improvements in the order of 15 to 20 per cent over conventional methods.

For further information please contact:

Bristol Water plc
P O Box 218
Bridgwater Road
Bristol BS99 7AU
UK
Tel: +44 117 953 6470
Fax: +44 117 953 6471
E-mail: corporate.affairs@bristolwater.co.uk
Website: www.bristolwater.co.uk

A full range of pumping technologies — The Verder Group

The international Verder Group supplies liquids handling equipment and technological assistance to a broad spectrum of companies involved in the water cycle, including initial treatment, filtration, effluent treatment, groundwater contamination and flow monitoring.

Verder manufactures six own-name product ranges, and acts as a distribution arm for a select number of manufacturing groups. A key product is the Verderflex peristaltic hose pump, manufactured in the UK and currently in use at a number of effluent treatment plants. Thanks to the pump's dry running and high suction abilities, significantly improved performance capacity is possible. The Verderflex is ideal for dosing both clean and dirty water, and can be supplied with an add-on flow control unit. A fundamental benefit of this pump over its peers is the Verder hose, manufactured especially for the Verderflex and shown to have more than 75 per cent longer lifetime on certain applications. In addition, hoses are made of 100 per cent EPDM and give double the discharge pressure rating of other similar hose pumps (VF10 and VF15). Another product range used in the water cycle is the Verdermag centrifugal mag drive pump, thanks to the totally sealless design, giving 100 per cent product containment. These pumps are most commonly used for bulk transfer and unloading. Verder's air-operated double diaphragm pump, the Verderair, is used in the transfer of wastewater, filter press charging and treatment of effluent runoff. In addition, Verder is the main distributor of Robbins & Myers, world leaders in progressing cavity pumps.

Since the Group's formation in the 1950s, a large share of the overall delivery programme has been comprised of pumps. By the 1990s, a change in direction had taken place: by acquiring some well-known production companies, concluding joint venture/private label agreements and with continuous R&D, the former distribution company developed into a major manufacturing and supply organisation. Customer input is fed into the R&D and production stages, and the Group prides itself on its successful two-way relationship with its larger blue chip customers.

A full programme of service products has recently been developed to cover items such as maintenance contracts, stock option and on site inventories, where the pump unit forms only part of the overall contract. This has met with a favourable reaction from water companies and municipal environmental departments, who see the need for more than just a 'one-off product' service from their suppliers.

For further information please contact:

Verder Limited
Whitehouse Street
Leeds LS10 1AD
UK
Tel: +44 113 222 0250
Fax: +44 113 246 5649
E-mail: verder@legend.co.uk
Website: http: www.verder.com

Hobas centrifugally cast GRP pipe systems — Hobas Engineering GmbH

During the past 30 years, the Hobas Group has grown into a major producer of GRP pipes for municipal applications with currently 20 manufacturing plants around the world. More than 20,000kms of Hobas pipes are already in service in all kinds of soil and climatic conditions. The pipes are produced from DN 150 to DN 3000 and in pressure classes up to PN 35. The flexibility of the manufacturing process permits any stiffness class to be produced.

The success of the Hobas pipes in the world's pipe markets are due to the inherent corrosion resistance and the possibility to build engineered pipes with a very high strength according to the requirements of each individual application. Hobas pipes are non-conductors of electricity and immune to electrochemical reactions caused by acids, bases and salts that cause corrosion in metals. The pipe can be buried in directly in highly acidic or saline soils. There is no electrolytic corrosion and no requirements for cathodic protection. Induced stray currents from electrical equipment do not affect the performance of the pipes. The Hobas pipes have a high abrasion resistance which ensures that the initial chemical and mechanical properties remain long term, as well as allowing the cleaning of sewer lines with water jets. The smooth external surface and constant outside diameter permits the pipes to be cut and joined anywhere along their length on site without the need of special machining to provide a tight coupling seal.

The pipes are today produced on five continents in Switzerland, Austria, Germany, Czech Republic, UK, Slovenia, Belgium, Spain, Romania, USA, Abu Dhabi, Lebanon, Japan, China (two plants), Philippines, Australia, South Africa, Turkey and Egypt. Further plants are under construction to come into operation during 1998.

For further information please contact:

Hobas Engineering GmbH
Pischeldorferstrasse 128
A–9020 Klagenfurt
Austria
Tel: +43 463 482 424
Fax: +43 463 482 121
E-mail: hobas.engineering@aon.at

Setting industry standards

Glynwed Pipe Systems Limited

Glynwed Pipe Systems (GPS) provides customers – whatever their global location – with a total capability in water distribution, treatment and disposal.

Technical expertise and support is just part of the comprehensive service offered by GPS in conjunction with a complete product range comprising most pipework materials with complementary jointing systems.

Many of the present operating companies within GPS were instrumental in defining the materials, product specifications and installation codes which have now become industry standards. An example is Durapipe–S&LP, which was formed following the integration of Victaulic into the Glynwed International Group, and now comprises:

- Durapipe, which pioneered ABS systems in the 1950s and now produce fittings, valves and specialist pipes in most thermoplastics materials.
- Stewarts and Lloyds Plastics, which began producing plastic pipes some 30 years ago
- Vulcathene, joint-developers of PE Electrofusion jointing systems with British Gas, and
- Calder, which produces the complimentary range of pipe jointing equipment, installation tooling and accessories.

Durapipe–S&LP now produces PE, PP and ABS pipework systems for water distribution/treatment, together with a total customer service and installation equipment programme.

Additional GPS/UK companies include: Viking Johnson, with a unique range of pipeline jointing, adaption and repair products; Wask–RMF, manufacturers of transition fittings and under-pressure drilling equipment; Valvestock, specialist suppliers of valves and actuators; VIP–Heinke, manufactures of moulded rubber sealing products; and Capper, distributors of complete plastics pressure and drainage pipework systems.

In mainland Europe Kunststoffwerk Höhn manufactures PE and PP pipework systems in sizes up to 1200mm, while MASA/Spain specialises in PE pipe up to 400mm. GPS Couplings (The Netherlands), FIP and AVF Astore Valves & Fittings (Italy) and Innoge (Monaco) complete the GPS European manufacturing and distribution programme.

Australia is served by market-leading compression fittings manufacturer, Philmac, whose distribution network extends around the world.

PE systems alone range from 4mm (for micro-irrigation) to 1200mm, thereby catering for every aspect of potable water distribution. For water treatment GPS has a variety of systems in PVC-u, ABS, PE and PP.

For further information please contact:

Glynwed Pipe Systems Limited
De Montfort House
High Street
Coleshill
Birmingham B46 3BP
UK
Tel: +44 1675 467557
Fax: +44 1675 465977

Managing water for 150 years

West of Scotland Water

West of Scotland Water is the largest public water and wastewater utility in the UK with more than 1 million service connections operated by highly motivated and well-trained staff of around 3000.

The Authority and its local government predecessors have developed and operated the public water supply, sewerage infrastructure, and waster and wastewater treatment facilities in the west of Scotland for the past 150 years.

The Authority is able to provide a range of services to clients both within the UK and internationally. This includes engineering design and construction; operation and maintenance; laboratory services; human resource development; institutional development; and training and development which can be delivered either in-country or at the Authority's accredited training centre. Due to the multi-disciplinary nature of its staff, the Authority can also offer assistance in a range of support activities including legal, financial, land management and IT.

This places West of Scotland Water as a leader in developing skill and capacity building within the water sector.

For further information please contact:

West of Scotland Water
419 Balmore Road
Glasgow G22 6NU
UK
Tel: +44 141 355 5103
Fax: +44 141 355 5440

Flocculant and chemical dosing

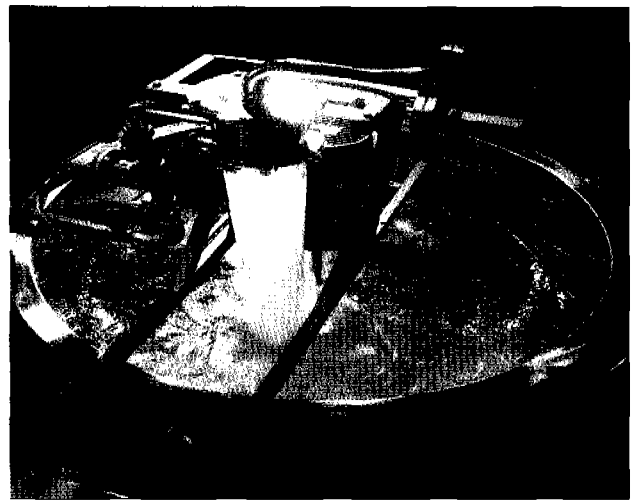
Allied Colloids Limited

Allied Colloids is the largest supplier in the world of flocculants and make-up systems. This gives the company a unique interest in the combined performance of both polymer and equipment with the experience and resources to provide equipment and service anywhere in the world.

Allied Colloids' JETWET technology for wetting and dissolving powder flocculant has been proven in thousands of installations, and in many places it has become the industry standard. There is a JETWET suitable for all applications, from a few kilograms a day to several tonnes an hour, and for using powder from bags, drums, big bags and semi-bulk and bulk deliveries. In all systems the critical wetting-out process takes place in the proprietary JETWET disperser which ensures complete dispersion before the polymer enters the mixing tank. This produces a high-quality solution that will obtain maximum benefit from the polymer.

With Allied Colloids' integrated storage units and integrated tank units, the handling of solid grade flocculants reaches a new level of simplicity with a fully self-contained outdoor installation, proven in all environments. The company has a full range of standard equipment for all dry and liquid polymer handling, dilution, dosing and process control, and its engineering and project management resources are able to offer supply-only or turnkey packages for all projects, large or small.

The unique combination of polymer application expertise and technical service with worldwide project engineering support, manufacturing facilities and service centres provides an unrivalled package for all flocculant and chemical dosing applications.



For further information please contact:

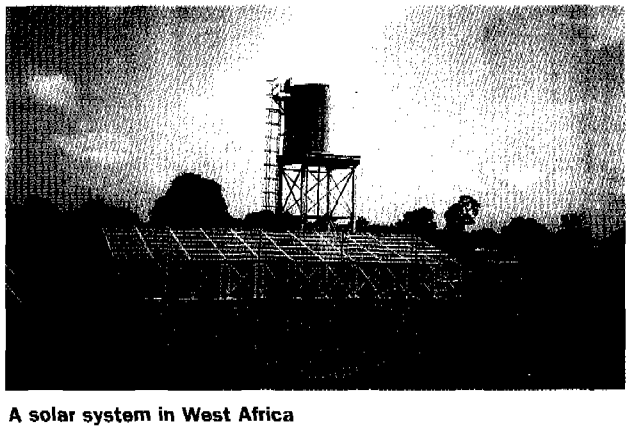
Customer Engineering
Allied Colloids Group
PO Box 38
Bradford BD12 OJZ
UK
Tel: +44 1274 417111
Fax: +44 1274 417779
E-mail: equipment@allied-colloids.co.uk

Solar systems for our own world

Franklin Hodge Industries Limited

At Franklin Hodge Industries we have been manufacturing liquid storage systems for 25 years, providing proven capability in the potable, process, fire protection and waste water markets worldwide.

We design and supply site-bolted tanks and associated equipment to control, store and distribute volumes of water and waste. All products are designed and manufactured under ISO 9001 and approved by various insurance bodies.



A solar system in West Africa

Our reputation is based on innovative design, precision manufacture and integrity of installation. Differentiation from our competitors is clearly identified by our development of special linings and coatings to handle the cleanest and dirtiest of waters, and the application of appropriate energy resource to power the system.

Do you require reliable and cost-effective systems that meet your liquid storage needs now and address 'whole of life' requirements for the future?

For further information please contact:

Franklin Hodge Industries Limited
Ramsden Road
Rotherwas Industrial Estate
Hereford HR2 6LR
UK
Tel: +44 1432 269605
Fax: +44 1432 277454

Potable water and drainage systems — Polypipe plc

Polypipe plc manufactures a comprehensive choice of potable water products. The 20mm to 63mm service pipes cover blue MDPE, kitemarked to BS 6572:1985, black MDPE kitemarked to BS 6730:1986, and black LDPE kitemarked to former specification BS 1972:1967.

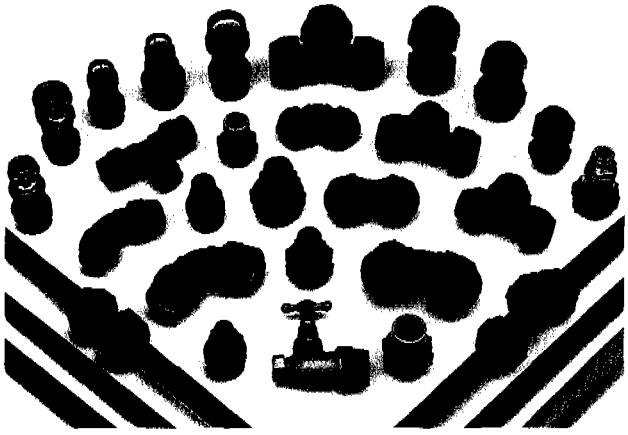
Two comprehensive ranges of service fittings are manufactured: Pushfit with its simple strong joints and neat slim-line design; and Polyfast compression fittings. The latter are extremely durable, easily installed and have maximum versatility, with reducing sets from 63mm down to 20mm and adaptability from MDPE to black LDPE/HDPE, copper, PVC, galvanised steel and even lead.

A range of 40mm fittings has recently been introduced. Both types have passed the stringent testing of the UK Water Research Council and are certified to the UK water fittings bye-law scheme. Boundary meter boxes are also manufactured with either Pushfit or Polyfast ends or 25mm MDPE tails, compete with integral stopcock, non-return valve and meter point, in engineering plastic or traditional gun-metal. Mains supply pipes manufactured by Polypipe cover 90mm to 450mm in blue and black MDPE and HPPE to UK Water Industry Specification WIS 4-32-03, 4-32-0 9 and 4-32-13.

The complementary range of fittings include Electrofusion, which is a simple-to-use fusion system requiring a control box and generator; and Long spigot/Pupped Fittings requiring butt fusion equipment.

All products are manufactured under a quality management system complying with the requirements of BS EN 150 9002:1994, BSI Certificate FM003 I 8.

Polypipe and its subsidiary companies, Aquapipes, Hayes Pipes, B & H and Norflex, also offer a wide range of single and twin-wall underground drainage pipes and fittings up to 1000mm diameter.



Compression joints in 20, 25, 32, 40, 50 and 63mm.

For further information please contact:

Polypipe plc
Broomhouse Lane
Edlington
Doncaster DN12 IES
UK
Tel: +44 1302 326 161 / 144
Fax: +44 1302 326171

Your world-class partner in pipe systems — Wavin Overseas B.V.

Wavin Overseas B.V. is the central export organisation of the Wavin group of companies, Europe's leading plastic pipe systems manufacturer. The company is dedicated to supplying complete PVC, PE and PP pipe systems for a variety of applications throughout the world. In addition to the sale of products, the technology and equipment to manufacture them can be offered under licence.

For nearly 30 years Wavin Overseas has provided products for water distribution and sanitary applications globally via an extensive network of agents, distributors and manufacturing licensees. Access to the various pipe and fitting ranges of its own ISO 9000 certified manufacturing plants in 20 European countries, often in combination with those of local licencees, gives Wavin the leading edge. They supply the right package of products to suit every type of pipeline application, from minor works to major supply and distribution projects, wherever they may take place.

Together with our partners, we aim to be your world-class partner.

For further information please contact:

Wavin Overseas B.V.
P.O.Box 158
7700 AD Dedemsvaart
The Netherlands
Tel: +31 523 624911
Fax: +31 23 624600
E-mail: wavin.overseas @wxs.nl
Website: http://www.wavin.com

SBR sewage and wastewater treatment — Prentec (Pty) Limited

Applying Sequencing Batch Reactor (SBR) technology to the activated sludge process produces many process treatment advantages. By combining the SBR treatment process with an innovative technique of constructing reinforced concrete biological reactor basins, Prentec (Pty) Limited can design and construct, on a turnkey basis, both sewage and industrial wastewater treatment plants throughout the world at extremely competitive prices.

SBR biological treatment plants are inherently of a modular design and hence they are ideal for installations, which require phased development, as is the case in most treatment works. Standard single modules range in capacity from 100m³/d to 1000m³/d each. A 5000m³/d plant could therefore consist of 5 x 1000m³/d reactor units.

Larger reactor basins constructed by conventional civil construction methods have operating volumes of up to 3000m³. A population of 100,000 (20,000m³/d) could therefore be served by 8 to 10 SBR reactors.

SBR treatment plants are therefore ideal to serve communities with populations of up to 100,000.

SBR technology applied to the activated sludge process offers the following advantages over through flow plants:

- Total capital costs are significantly reduced due to the elimination of clarifiers and recirculation facilities
- Operating flexibility is greatly increased by it being a controlled periodic process in an unsteady state system
- Effluent quality is of a higher and more reliable quality including biological removal of nitrogen and phosphorus
- Plant reliability is greatly improved because the SBR process is not sensitive to either hourly, daily or seasonal feed variations.
- Operating costs are greatly reduced due to the biological treatment process being fully automatic and the minimising of housekeeping requirements
- Plant extensions are simplified due to the SBR inherent modular design, and
- Flow measurement is of a much greater accuracy (99 per cent) due to batch measurement.

In summary, the ruggedness, performance reliability and competitiveness of Prentec SBR wastewater treatment plants demand their consideration in both domestic and industrial applications.

For further information please contact:

Prentec (Pty) Limited
Corner of Proton and Molecule Roads
P O Box 12181, Chloorkop 1624, South Africa
Tel: +27 11 976 5234 Fax: +27 11 976 2802
E-mail: prentec@iafrica.com

Lightly and tightly anchored pipes — Alphacan

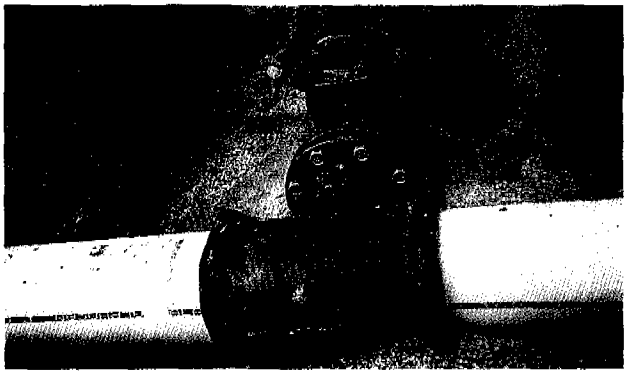
Alphacan is the leading French manufacturer of plastic tubes, in PVC, PE or PP. It is 100 per cent owned by Atochem, which is the chemical branch of the biggest French industrial group, ELF Aquitaine.

The company has an annual turnover of $290 million, employs 1600 people, processes 180,000 tonnes of plastics every year, and has 14 industrial sites in Europe. Its subsidiaries are: Alphacan Omniplast (Germany); Alphacan Omniplast (The Netherlands); Alphacan Somo (Switzerland); Alphacan España (Spain) and Alphacan Italia (Italy).

Production

Alphacan Pipe System Division develops and manufactures the following products:

- PVC pipes: water supply and sewerage, drainage, drilling, air conducting, and ducts for optical fibres, electrical wires
- PE tubes: potable water supply (blue stripes), sewerage (brown stripes), gas supply (yellow stripes), optical fibres (green stripes), and electrical wires (red stripes)
- PP tubes: all purposes
- PE-X: sanitary applications (hot & cold water distribution), radiator supplying, underfloor heating



The new bi-oriented PVC pipe: Alphacan B O

Quality, approvals and standards

Alphacan manufacturing sites are all ISO 9002 certified, and its process is approved by several European organizations, such as RAL, TUV, AENOR, BECETEL KIWA and BBA. The company's standards department enables it to adapt to all required standards.

Research

The Research and Application Service is dedicated to the improvement and development of new products. The company can therefore design and manufacture special products.

1998 news

In the water supply business Alphacan has recently developed a bi-oriented PVC process, and will soon propose a range of high pressure PVC pipes with a nominal pressure of 25 bar, together with corresponding fittings. This new offer will have a strong effect on the way design offices and water operating companies consider water supply mains likely to be operated at pressures above 16 bar.

In the PE pipes business the company has increased the capacity of its technical support team which can offer a service dedicated to export: training for welders, assistance on site, and so on.

In the sewage business, the company proposes a new range of PE moulded visiting chambers, which guarantee lightness, tightness, and excellent anchorage, especially in a water table situation.

For further information please contact:

Alphacan Export Department
Elysée 2, 12–18 avenue de la Jonchère, B P 2
78170 La Celle Saint–Cloud, France
Tel: +33 1 30 82 58 00
Fax: +33 1 30 82 59 49

Energy-less dosing-feeders — MSR Dosiertechnik GmbH

For 15 years, MSR Dosiertechnik GmbH has been producing dosing-feeders and systems which work without any source of energy.

Because of their module structure they can be used with different water treatment materials such as hypochlorite peroxide, flocculents, acid and alkaline, as well as for many other kinds of dosing applications: cleaning and disinfection, mechanical engineering, printing machines, fire-fighting, carwash, concrete industry, horticulture, agriculture and animal breeding.

The dosing feeders and systems are driven by water flow only. The dosing of up to four different liquids works flow-proportional and remains practically constant and independent of variations in pressure or flow. The adjustment of the dosing rate can be regulated by hand or by motor.

A special development is the WPS 1000/Fontaix, a dosing system which purifies water from rivers, rain or surface water, for drinking. It is mainly used in developing countries. The system was inspected by the Pasteur Institute in Paris. Other systems include water purification systems, polymer dosing systems, systems for dosing cooling oils, direct-injection systems for plant protection material, and foam dosing systems for fire-fighting (FireDos).

For further information please contact:

MSR Dosiertechnik GmbH
Am Heiligenstock 2, D–61200 Wolfersheim, Germany
Tel: +49 603 697 960 Fax: +49 603 697 9630

Advice and support for the pipeline industry — Transco

The Pipeline Maintenance Centre and Construction Services have for many years provided specialist engineering advice and operational support to the pipeline industry.

Part of British Gas, the units are at hand to propose and offer solutions to operational engineering problems relating to the construction, rehabilitation and maintenance of pipelines and associated plant, to both internal and external customers.

Close working relationships with both suppliers and the Research and Technology Centre allows new products to be developed and tested from inception to full approval-status with the minimum of delay.

Recent developments include:

- Alternative methods of flowstopping on polyethylene mains
- Large diameter polyethylene connections
- No dig pipeline technology, and
- Live CCTV surveys through small diameter entry points.

The centres, based at Ambergate, Derbyshire, and Hitchin, Hertfordshire, are staffed by multi-skilled personnel with experience of working on all types of pipeline, throughout the pressure range both in the UK and overseas.

For further information please contact:

Transco
Construction Services
Cadwell Lane, Hitchin, Hertfordshire SG4 OSL, UK
Tel: +44 1462 450861
Fax: +44 1462 451932

Transferring skills to the community — Africa Drilling & Mining Consultants (Pty) Ltd

'Water is both the servant and yet the master of man.'

Since the beginning of time we have been well aware of this unique relationship of man to water. Our past achievements in the development of groundwater resources in rural areas of Southern Africa has provided the reliable potable water supplies necessary for the raising of social and economic standards.

We intend building on these successes by providing quality products and improved services in close co-operation with local communities with the transfer of essential skills to maintain project viability.

Our proven skills in the geological and geophysical sciences, rotary percussion and reverse circulation drilling, yield testing and pump installation fields, as well as our design and training capability, enable Africa Drilling & Mining Consultants (Pty) Limited (ADMC) to make a significant contribution to development in sub-Saharan Africa.

Above all we believe people to be our greatest asset. The motivated team at ADMC will assuredly supply the reliability and professionalism clients demand.

For further information please contact:

Africa Drilling & Mining Consultants (Pty) Limited
Box 2490, Honeydew 2040
South Africa
Tel: +27 11 957 3331
Fax: +27 11 957 3279

Pipe rehabilitation processes — Subterra Limited

Subterra Limited is a leading developer of pipe rehabilitation processes for the gas, water and oil industries.

Using standard grade polyethylene pipe, their Rolldown process provides structural liners for existing pipelines in sizes form 100-500mm which are suffering from bursts due to the reduction of structural strength caused by internal and external corrosion, ground movement, and so on.

Subterra's Subline process also uses standard PE pipe in this application, to provide non-structural liners for pipes in the diameter range of 100 to 1600mm, which are leaking from mechanical joints and small corrosion holes. The thickness of the liner can is designed to give an acceptable life bridging the gaps from which leakage is occurring, while otherwise relying on the existing pipeline to give general structural support.

The ELC Epoxy resin lining system applies a 1mm coating to the internal surface of potable water mains to provide a cost-effective long-term solution to internal corrosion and water quality problems.

The above processes are currently being used by Subterra licensees in North America and Europe.

For further information please contact:

Subterra Limited
Developments Division
Dullar Lane
Sturminster Marshall
Wimborne, Dorset BH21 4DA
UK
Tel: +44 1258 857556
Fax: +44 1258 857960

The number one for waterworks flanges — CAB Incorporated

CAB Incorporated, founded in 1977, is one of the world's leading suppliers of pipe flanges for use in water and wastewater applications. From stocks of steel flanges built to American Waterworks Standards (AWWA) to flanges produced to international standards such as DIN, BS, ISO, SABS, and special designs or large diameters, CAB enjoys a worldwide reputation as the number one source for waterworks flanges.

The CAB management team has more than 100 years of combined experience in flanges. Through its worldwide network of flange manufacturers, CAB can meet your requirements for large quantities, fast delivery schedules or large diameters up to 200in (5080mm) nominal.

In addition to flanges for steel pipe applications, CAB also stocks ductile iron, stainless steel or carbon steel back-up flanges up to 48in (1219mm) nominal diameters for use in plastic pipe systems. Flanges to ANSI and ASME designs are also available in carbon, stainless or alloy materials.

The company has extensive experience in supplying large projects worldwide, so let its knowledge and contacts help you to meet your contract requirements on time and within budget.

For further information please contact:

CAB Incorporated
5964-G Peachtree Corners East
Norcross GA 30071
USA
Tel: +1 770 662 3010
Fax: +1 770 368 8086

Products and Services

Analysis
Umgeni Water 17

Chemical dosing
Acromet Australia Pty. Ltd 83
Hydro International Ltd 91
Jesco Dosiertechnik GmbH & Co KG 94
Stockhausen GmbH & Co KG 37
VERDER Group 86
Vulcan Chemicals OBC

Chemical storage and containers
Balmoral Group Ltd 109
Franklin Hodge Industries Ltd 109
Structural Europe NV 104

Chemicals for water treatment
Ionics Inc IBC
Stockhausen GmbH & Co KG 37
Umgeni Water 17
Vulcan Chemicals OBC

Chlorinators
Acromet Australia Pty. Ltd 83
Enting Water Conditioning Inc 39
Jesco Dosiertechnik GmbH & Co KG 94

Consulting engineers
Ballenden & Robb 17
Electric Submersible Pumps 97
Enting Water Conditioning Inc 39
Hydro International Ltd 91
Umgeni Water 17

Control systems engineering
Bristol Water Plc 73

Corrosion prevention
BG PMC Ambergate/Construction Services 6
Umgeni Water 17

Drainage design
Polypipe plc 55
REDI Spa 55
West of Scotland Water 49

Environmental
Hydro International Ltd 91
Structural Europe NV 104
Umgeni Water 17

Flood & river engineering
REDI Spa 55

Geological surveys
Africa Drilling & Mining Consultants Pty Ltd 18

Industrial waste treatment
Grundfos Management A/S 84
Hydro International Ltd 91
Structural Europe NV 104
Umgeni Water 17

Procurement, construction and project management
Africa Drilling & Mining Consultants Pty Ltd 18

Water & effluent treatment
Bristol Water Plc 73
Guest & Chrimes Ltd 97
Hydro International Ltd 91
Structural Europe NV 104
Umgeni Water 17
West of Scotland Water 49
Zickert Products AB 46

Water resources and landfall
Bristol Water Plc 73
Umgeni Water 17

Water supply and sewerage systems
Bristol Water Plc 73
Georg Fischer Piping Systems Ltd 13
Grundfos Management A/S 84
Guest & Chrimes Ltd 97
Hydro International Ltd 91
IBP Conex, Conex Sanbra Ltd 63
REDI Spa 55
Structural Europe NV 104
Umgeni Water 17
West of Scotland Water 49

CCTV inspections and surveys
BG PMC Ambergate/Construction Services 6

Computerised telemetry command & control systems software
Bristol Water Plc 73
Electric Submersible Pumps 97

Control instruments
Acromet Australia Pty. Ltd 83
Fixturlaser AB 24
Fluid Control Division- A United Dominion Company 4
Glynwed Pipe Systems Ltd 70
Jesco Dosiertechnik GmbH & Co KG 94

DATA logging and processing equipment
Bristol Water Plc 73

Flow meters
Fluid Control Division- A United Dominion Company 4
Glynwed Pipe Systems Ltd 70

Flow switches
Glynwed Pipe Systems Ltd 70

Ground water monitoring
Grundfos Management A/S 84

Instrumentation and control panels
Acromet Australia Pty. Ltd 83

Laboratory equipment
Ionics Inc IBC

Leak detection and controllers
Acromet Australia Pty. Ltd 83
Bristol Water Plc 73
VERDER Group 86

Monitors
Acromet Australia Pty. Ltd 83
Ionics Inc IBC
Jesco Dosiertechnik GmbH & Co KG 94

Remote control of water supply networks
Bristol Water Plc 73
Electric Submersible Pumps 97
Jesco Dosiertechnik GmbH & Co KG 94

Sampling equipment
Jesco Dosiertechnik GmbH & Co KG 94

SCADA systems
Hydro International Ltd 91

Water test kits and analysers
Enting Water Conditioning Inc 39

Customer services
Enting Water Conditioning Inc 39
Fluid Control Division- A United Dominion Company 4
Guest & Chrimes Ltd 97
Ionics Inc IBC
Umgeni Water 17
West of Scotland Water 49

Delegated management
Electric Submersible Pumps 97
Ionics Inc IBC
Umgeni Water 17
West of Scotland Water 49

Concrete pipes and fittings
Hepworth Building Products Int. Ltd 61

Couplings and mechanical seal products
Glynwed Pipe Systems Ltd 70
Hepworth Building Products Int. Ltd 61
Underpressure Engineering plc 75
Viking Johnson 75

Directional drilling
Africa Drilling & Mining Consultants Pty Ltd 18
BG PMC Ambergate/Construction Services 6
Imeco Handelsgesmbh 61

Drill pipes, rods and casing
Africa Drilling & Mining Consultants Pty Ltd 18
Imeco Handelsgesmbh 61

Ductive iron pipes and fittings
Underpressure Engineering plc 75

Grease traps
Hepworth Building Products Int. Ltd 61
Hydro International Ltd 91

Joints and fittings
Fluid Control Division- A United Dominion Company 4
Georg Fischer Piping Systems Ltd 13
Glynwed Pipe Systems Ltd 70
IBP Conex, Conex Sanbra Ltd 63
Polypipe plc 55
Underpressure Engineering plc 75
Viking Johnson 75

Maintenance and repair
Africa Drilling & Mining Consultants Pty Ltd 18
Georg Fischer Piping Systems Ltd 13
Glynwed Pipe Systems Ltd 70

Metal pipes and fittings
BG PMC Ambergate/Construction Services 6
Fluid Control Division- A United Dominion Company 4
Franklin Hodge Industries Ltd 109
Glynwed Pipe Systems Ltd 70
IBP Conex, Conex Sanbra Ltd 63
Oy JA-RO Ab 73
Underpressure Engineering plc 75
Viking Johnson 75

Microtunnelling
Imeco HandelsgesmbH 61

Petrol/oil interceptors
Hydro International Ltd 91
Zickert Products AB 46

Pipe installation, laying and rehabilitation
BG PMC Ambergate/Construction Services 6
Bristol Water Plc 73
Georg Fischer Piping Systems Ltd 13
Pipelife International Holding GmbH 57
REDI Spa 55

Pipejacking
BG PMC Ambergate/Construction Services 6
Hobas Engineering GmbH 67
Imeco HandelsgesmbH 61
Owens Corning Pipe Systems 78

Pipe lining
BG PMC Ambergate/Construction Services 6
Glynwed Pipe Systems Ltd 70
Hobas Engineering GmbH 67
Owens Corning Pipe Systems 78

Pipe locating
Bristol Water Plc 73

Plastic pipes and fittings
BG PMC Ambergate/Construction Services 6
G Forge (Civil Engineering) Ltd 84
Georg Fischer Piping Systems Ltd 13
Glynwed Pipe Systems Ltd 70
Hepworth Building Products Int. Ltd 61
Hobas Engineering GmbH 67
IBP Conex, Conex Sanbra Ltd 63
Owens Corning Pipe Systems 78
Pipelife International Holding GmbH 57
Polypipe plc 55
REDI Spa 55
Underpressure Engineering plc 75

Sewer rehabilitation
BG PMC Ambergate/Construction Services 6
Hobas Engineering GmbH 67
Pipelife International Holding GmbH 57
REDI Spa 55
West of Scotland Water 49

Thrustboring
BG PMC Ambergate/Construction Services 6
Imeco HandelsgesmbH 61

Trench shoring
Imeco HandelsgesmbH 61

Tunnels and shafts
Imeco HandelsgesmbH 61

Vitrified clay pipes and fittings
Hepworth Building Products Int. Ltd 61

Centrifugal pumps
Acromet Australia Pty. Ltd 83
Africa Drilling & Mining Consultants Pty Ltd 18
Electric Submersible Pumps 97
Grundfos Management A/S 84
Imeco HandelsgesmbH 61
VERDER Group 86
Weir Pumps Ltd 100

Chemical pumps
Acromet Australia Pty. Ltd 83
Enting Water Conditioning Inc 39
Jesco Dosiertechnik GmbH & Co KG 94
VERDER Group 86

Diaphram pumps
Acromet Australia Pty. Ltd 83
Imeco HandelsgesmbH 61
Jesco Dosiertechnik GmbH & Co KG 94
VERDER Group 86

Dosing pumps
Acromet Australia Pty. Ltd 83
Jesco Dosiertechnik GmbH & Co KG 94
VERDER Group 86

Gear pumps
Acromet Australia Pty. Ltd 83
VERDER Group 86

Pump control
Acromet Australia Pty. Ltd 83
Africa Drilling & Mining Consultants Pty Ltd 18
Electric Submersible Pumps 97
Jesco Dosiertechnik GmbH & Co KG 94
VERDER Group 86
Weir Pumps Ltd 100

Pumping stations
Acromet Australia Pty. Ltd 83
Africa Drilling & Mining Consultants Pty Ltd 18
Grundfos Management A/S 84
Hydro International Ltd 91
Pentair Pump Group 98
Weir Pumps Ltd 100

Sewage pumps
Acromet Australia Pty. Ltd 83
Grundfos Management A/S 84
Imeco HandelsgesmbH 61
Pentair Pump Group 98
VERDER Group 86
Weir Pumps Ltd 100

Sludge pumps
Hydro International Ltd 91
Pentair Pump Group 98
VERDER Group 86
Weir Pumps Ltd 100

Solar water pumps
Africa Drilling & Mining Consultants Pty Ltd 18
Franklin Hodge Industries Ltd 109
Grundfos Management A/S 84

Submersible pumps
Acromet Australia Pty. Ltd 83
Africa Drilling & Mining Consultants Pty Ltd 18
Electric Submersible Pumps 97
Grundfos Management A/S 84
Imeco HandelsgesmbH 61
Pentair Pump Group 98
VERDER Group 86
Weir Pumps Ltd 100

Aeration equipment
Balmoral Group Ltd 109
Hydro International Ltd 91
Nopon Oy 45

Effluent water treatment plant
Hydro International Ltd 91
Kaufmann Umwelttechnik 43
Umgeni Water 17
VERDER Group 86

Odour control
Balmoral Group Ltd 109
Kaufmann Umwelttechnik 43
Vulcan Chemicals OBC
West of Scotland Water 49

Sludge dewatering plant
Hoechst Aktiengesellschaft 43
Hydro International Ltd 91
Umgeni Water 17

Sludge scrapers
Zickert Products AB 46

Sludge thickening
Hydro International Ltd 91
Umgeni Water 17

Solid/liquid separating equipment
Balmoral Group Ltd 109
Fluid Control Division- A United Dominion Company 4
Hydro International Ltd 91

Actuators
Fluid Control Division- A United Dominion Company 4
Glynwed Pipe Systems Ltd 70
Guest & Chrimes Ltd 97

Air valves
Guest & Chrimes Ltd 97

Ball valves
Fluid Control Division- A United Dominion Company 4
Georg Fischer Piping Systems Ltd 13
Glynwed Pipe Systems Ltd 70
IBP Conex, Conex Sanbra Ltd 63

Butterfly valves
Fluid Control Division- A United Dominion Company 4
Georg Fischer Piping Systems Ltd 13
Glynwed Pipe Systems Ltd 70
Guest & Chrimes Ltd 97
SISTAG 49
Von Roll Valves Ltd 93

Electrically operated valves
Fluid Control Division- A United Dominion Company 4
Guest & Chrimes Ltd 97
SISTAG 49
Von Roll Valves Ltd 93

Fire hydrants
Guest & Chrimes Ltd 97
Von Roll Valves Ltd 93

Gate valves
Fluid Control Division- A United Dominion Company 4
Georg Fischer Piping Systems Ltd 13
Guest & Chrimes Ltd 97
IBP Conex, Conex Sanbra Ltd 63
SISTAG 49
Von Roll Valves Ltd 93

Non-return valves
Fluid Control Division- A United Dominion Company 4
G Forge (Civil Engineering) Ltd 84
Glynwed Pipe Systems Ltd 70
Guest & Chrimes Ltd 97
IBP Conex, Conex Sanbra Ltd 63
REDI Spa 55
SISTAG 49
Von Roll Valves Ltd 93

Pneumatic valves
Guest & Chrimes Ltd 97
SISTAG 49
Von Roll Valves Ltd 93

Solenoid valves
Georg Fischer Piping Systems Ltd 13
Glynwed Pipe Systems Ltd 70

Stop valves
Georg Fischer Piping Systems Ltd 13
Glynwed Pipe Systems Ltd 70
IBP Conex, Conex Sanbra Ltd 63
SISTAG 49

Aeration equipment
Hydro International Ltd 91
Nopon Oy 45

Boundary meter boxes
Polypipe plc 55

Borehole servicing rigs
Africa Drilling & Mining Consultants Pty Ltd 18

Centrifugal separators
Zickert Products AB 46

Clarifiers
Franklin Hodge Industries Ltd 109
Hydro International Ltd 91

Desalination
Africa Drilling & Mining Consultants Pty Ltd 18
Christ Holland BV 34
Enting Water Conditioning Inc 39
Hoechst Aktiengesellschaft 43
Ionics Inc IBC
Structural Europe NV 104
Weir Pumps Ltd 100

Drilling rigs - hydraulic top drive
Africa Drilling & Mining Consultants Pty Ltd 18
Imeco HandelsgesmbH 61

Drilling rigs - mobile
Africa Drilling & Mining Consultants Pty Ltd 18

Drinking water treatment plant
Acromet Australia Pty. Ltd 83
Africa Drilling & Mining Consultants Pty Ltd 18
Bristol Water Plc 73
Christ Holland BV 34
Glynwed Pipe Systems Ltd 70
Hoechst Aktiengesellschaft 43
Ionics Inc IBC
Jesco Dosiertechnik GmbH & Co KG 94
Kaufmann Umwelttechnik 43
Umgeni Water 17
Weir Pumps Ltd 100

Filtration
Africa Drilling & Mining Consultants Pty Ltd 18
Christ Holland BV 34
Enting Water Conditioning Inc 39
Fluid Control Division- A United Dominion Company 4
Hoechst Aktiengesellschaft 43
Plenty Filters 105
Structural Europe NV 104

Flow measurement
Enting Water Conditioning Inc 39
Fluid Control Division- A United Dominion Company 4
Glynwed Pipe Systems Ltd 70
VERDER Group 86

Industrial effluent treatment plant
Acromet Australia Pty. Ltd 83
Hoechst Aktiengesellschaft 43
Hydro International Ltd 91
Ionics Inc IBC
Kaufmann Umwelttechnik 43
Umgeni Water 17
VERDER Group 86

In hole equipment
Africa Drilling & Mining Consultants Pty Ltd 18
Electric Submersible Pumps 97

Liners
Africa Drilling & Mining Consultants Pty Ltd 18
Franklin Hodge Industries Ltd 109
Glynwed Pipe Systems Ltd 70

Maintenance
Africa Drilling & Mining Consultants Pty Ltd 18
Guest & Chrimes Ltd 97
West of Scotland Water 49

Meters
Enting Water Conditioning Inc 39

Mineral water filtration and preparation
Christ Holland BV 34
Enting Water Conditioning Inc 39

Package sewage treatment plant
Balmoral Group Ltd 109
Fluid Control Division- A United Dominion Company 4
Hydro International Ltd 91
Kaufmann Umwelttechnik 43
Umgeni Water 17

Package drinking water plants
Africa Drilling & Mining Consultants Pty Ltd 18
Enting Water Conditioning Inc 39
Fluid Control Division- A United Dominion Company 4
Ionics Inc IBC
Jesco Dosiertechnik GmbH & Co KG 94
Kaufmann Umwelttechnik 43
Umgeni Water 17
Weir Pumps Ltd 100

Process control
Christ Holland BV 34
Jesco Dosiertechnik GmbH & Co KG 94
VERDER Group 86

Sampling equipment
Balmoral Group Ltd 109
Jesco Dosiertechnik GmbH & Co KG 94
Umgeni Water 17
VERDER Group 86

Sewage treatment
Balmoral Group Ltd 109
Glynwed Pipe Systems Ltd 70
Hoechst Aktiengesellschaft 43
Kaufmann Umwelttechnik 43
REDI Spa 55
Structural Europe NV 104
West of Scotland Water 49

Water storage tanks
Balmoral Group Ltd 109
Enting Water Conditioning Inc 39
Franklin Hodge Industries Ltd 109
Owens Corning Pipe Systems 78
Pipelife International Holding GmbH 57
Structural Europe NV 104

Water sterilization
Acromet Australia Pty. Ltd 83
Bristol Water Plc 73
Christ Holland BV 34
Enting Water Conditioning Inc 39
Hoechst Aktiengesellschaft 43
Jesco Dosiertechnik GmbH & Co KG 94
Umgeni Water 17

Automation
Acromet Australia Pty. Ltd 83
Bristol Water Plc 73

Drainage
Pipelife International Holding GmbH 57

Drip irrigation
Pipelife International Holding GmbH 57

Fertigation
Acromet Australia Pty. Ltd 83
Jesco Dosiertechnik GmbH & Co KG 94

Micro-sprinklers/sprayers
Glynwed Pipe Systems Ltd 70

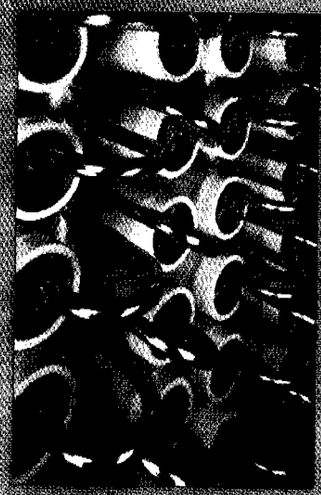
Sprinklers
Bristol Water Plc 73
Glynwed Pipe Systems Ltd 70
Pipelife International Holding GmbH 57

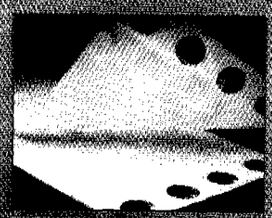
Turnkey projects
Electric Submersible Pumps 97
Ionics Inc IBC

Alphabetical List of Advertisers

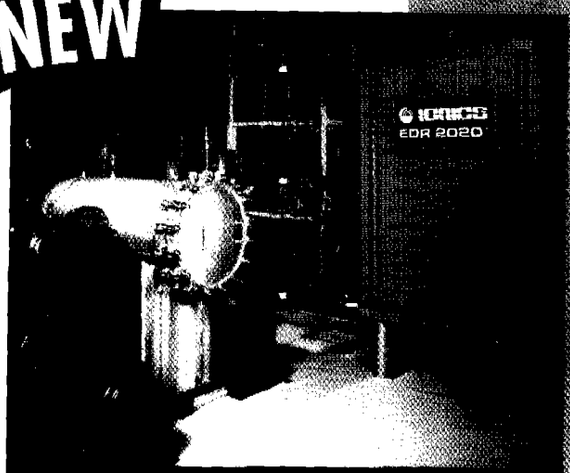
A	AQUAMAR	105
	Acromet Australia Pty. Ltd	83
	Africa Drilling & Mining Consultants Pty Ltd	18
	Alamo Water Refiners Inc	50
	Allied Colloids	34
	Alphacan	119
	American Cast Iron Pipe Co	76
	Aquasystems International nv	45
B	BG PMC Ambergate/Construction Services	6
	Ballenden & Robb	17
	Balmoral Group Ltd	109
	Bechtel Water Technology Ltd	IFC
	Bristol Water Plc	73
C	CAB Inc	63
	Capital Controls	24
	Chemsystems	18
	Cherrington (Australia) Pty Ltd	118
	Christ Holland BV	34
	Consult 4	14
D	DataLoggers	28
	Divwatt	21
E	EA West Water Treatment	39
	Electric Submersible Pumps	97
	Enting Water Conditioning Inc	39
	Environmental Products USA Inc	102
F	First Plast srl	52
	Fixturlaser AB	24
	Fluid Control Division- A United Dominion Company	4
	Fr. Buschjost GmbH & Co	84
	Franklin Hodge Industries Ltd	109
G	G Forge (Civil Engineering) Ltd	84
	Gast International (Pty) Ltd	22
	General Pump Inc	91
	Georg Fischer Piping Systems Ltd	13
	Glynwed Pipe Systems Ltd	70
	Grundfos Management A/S	88
	Guest & Chrimes Ltd	97
H	HQ Link Pte Ltd	3
	Hepworth Building Products Int. Ltd	61
	Hobas Engineering GmbH	67
	Hoechst Aktiengesellschaft	43
	Horizontal Wells & Environmental Consultants	111
	Hydro International Ltd	91
	Hydro International plc	69
I	IBM	31
	IBP Conex, Conex Sanbra Ltd	63
	Imeco HandelsgesmbH	61
	Interstate Assessment Technologies	111
	Ionics Inc	IBC
J	Jesco Dosiertechnik GmbH & Co KG	94
K	Kaufmann Umwelttechnik	43
	Kleiss & Co BV	58
L	Ludwig Frischhut GmbH	58
M	MSR Dosiertechnik GmbH	44
	Mather & Platt (India) Ltd	83
N	NAFTA AS	112
	NSF International	12
	Nist Control Systems CC	26
	Nopon Oy	45
O	Owens Corning Pipe Systems	78
	Oy JA-RO Ab	73
P	Pentair Pump Group	98
	Pipelife International Holding GmbH	57
	Plenty Filters	105
	Pleuger Worthington GmbH	98
	Polypipe plc	55
	Prentec (Pty) Ltd	14
Q	Quadel Industries Inc	48
R	R.S. Technical Services Inc	64
	REDI Spa	55
S	SISGEO	32
	SISTAG	49
	STRATE GmbH	10
	Savino Barbera	86
	Schlumberger	32
	Seghers Engineering Water	69
	Soilmec	OFC
	Stockhausen GmbH & Co KG	37
	Structural Europe NV	104
	Subterra Ltd	64
	SwyCo Well Cleaning Products	40
	Synthetic Industries Inc	8
U	Umgeni Water	17
	Underpressure Engineering plc	75
V	VERDER Group	86
	Viking Johnson	75
	Von Roll Valves Ltd	93
	Vulcan Chemicals	OBC
W	Wavin Overseas BV	56
	Weir Pumps Ltd	100
	West of Scotland Water	49
	Wetterauer Pumpenbau GmbH	93
X	X-Pando Products Ltd	76
Z	Zickert Products AB	46

Desalination
for the 21st Century





NEW



Ionics EDR 2020™ System

-New Performance

-New Affordability

Drinking Water Supply

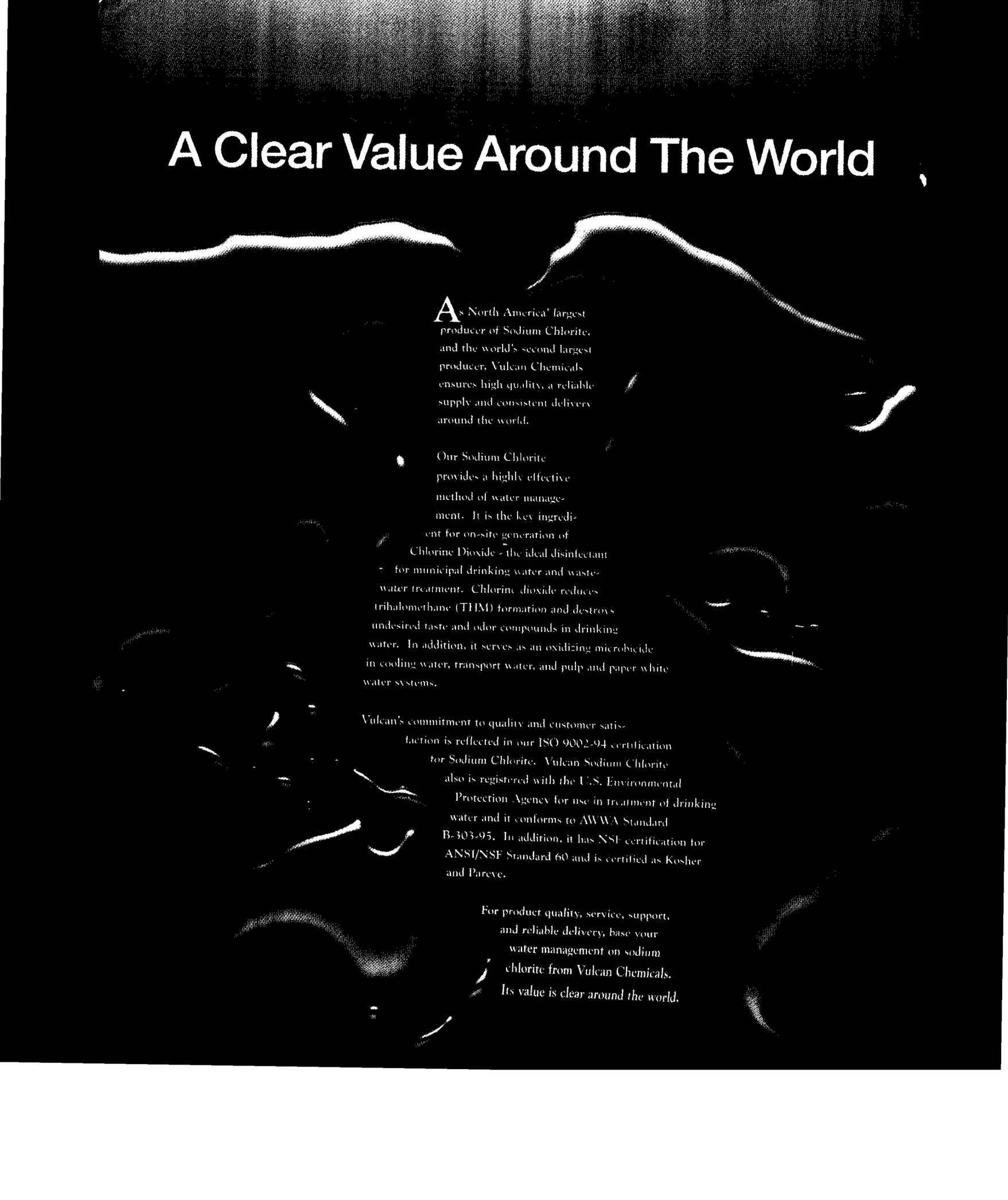
Drinking Water Monitoring

Brackish or Seawater Desalting

The Ionics Toolbox® of Separations Processes

Ionics Users, Experts or Systems Sales

A Clear Value Around The World



As North America' largest producer of Sodium Chlorite, and the world's second largest producer, Vulcan Chemicals ensures high quality, a reliable supply and consistent delivery around the world.

Our Sodium Chlorite provides a highly effective method of water management. It is the key ingredient for on-site generation of Chlorine Dioxide - the ideal disinfectant for municipal drinking water and wastewater treatment. Chlorine dioxide reduces trihalomethane (THM) formation and destroys undesired taste and odor compounds in drinking water. In addition, it serves as an oxidizing microbicide in cooling water, transport water, and pulp and paper white water systems.

Vulcan's commitment to quality and customer satisfaction is reflected in our ISO 9002-94 certification for Sodium Chlorite. Vulcan Sodium Chlorite also is registered with the U.S. Environmental Protection Agency for use in treatment of drinking water and it conforms to AWWA Standard B-303-95. In addition, it has NSF certification for ANSI/NSF Standard 60 and is certified as Kosher and Pareve.

For product quality, service, support, and reliable delivery, base your water management on sodium chlorite from Vulcan Chemicals. Its value is clear around the world.