Message in a bottle

Solar Water Disinfection

by Simavi World Waterfund

Waterfund

working together for health development

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Simavi

Simavi, a Non-Gouvernmental Organisation (NGO), was founded in 1925 and is the oldest association in The Netherlands for direct support to medical and health related projects in developing countries. Since its foundation Simavi has been given assistance to partners who contribute to improving medical and health care in their own countries. The association is working with local partners to help them realize their initiatives and ideals, provided these correspond with Simavi's policy. The support is given on a small scale irrespective of race, religion or political conviction.

In 1995 Simavi started its World Waterfund with the aim to use the available expertise in the Netherlands to improve the quality of drinking water and sanitation in developing countries. Nowadays around 30% of the annual budget is invested in these type of projects.

Invitation for fresh ideas

As part of its 75'th anniversary celebration Simavi World Waterfund organised a prize competition. Organisations and persons were invited to submit an innovative and workable idea or project that would improve the water supply and/or sanitary conditions for rural or slum areas in developing countries.

This booklet presents the results of the prize competition. It starts with some information about the entries, the appraisal process and the composition of the jury. It continues with the appraisal of the four best entries. The booklet ends with the winning entry, SODIS.

Entries, appraisal and jury

A total of 63 entries, originating from as many as 27 countries in Africa, Asia, Latin America, USA, and Europe, were received.

For its appraisal the jury decided to use two categories of criteria. The first category of criteria consisted of: 1) the contribution of the entry to sector innovation 2) the potential of the entry to be widely applied and 3) the ability (financially and organisationally) of users to take care of operation and maintenance. On each of these criteria all the entries were given a score between 1-10 points. A second category of criteria dealt with health and sanitation impact, environment, participation of users, level of training required, poverty alleviation and gender.

Together, the 63 entries covered a wide variety of issues in the sector. For example, a number of interesting proposals were received for domestic level water treatment systems ranging from simple household filters to UV and sunlight disinfection. Also a number of proposals were submitted for natural treatment of waste water from hospitals and small communities; a number of entries proposed projects in rural communities for water conservation in combination with water supply, sanitation and health education; and there were proposals for watershed management in combination with cost recovery, proposals for improved latrines in refugee camps making use of local materials, a few proposals for simple water pumps such as the adopted hydraulic ram and the rope pump, a proposal to create water associations for village owned water systems etc. Of course this wide variety of pluriform proposals made the jury's work very difficult.

Most entries were from NGOs, about 15 entries were sent by individuals and a few came from government institutions. Many documents were beautifully made, some came with audiovisual materials such as cd rom, video, or with hand drawn designs and pictures. For the jury it was a pleasure to go through the many entries, and to see how organisations and indivuals are dedicated to improve the sector.

The 63 entries were appraised by a jury of professionals. Ir. K. Munneke, Member of the Board of Directors of the Water Supply Utility DZH was the chairman, Ir. H. van Schaik of RIVM, Bilthoven was the secretary, and the members of the jury were Ir. J. Oomen of DHV consultants, Amersfoort, Drs. P.B. Peereboom, private consultant/medical docter , Mrs. K. Shordt of International Reference Centre, Delft and Mrs. Drs. S. Visser of Agricultural University, Wageningen.

Results

Fourth

Fourth place was for the proposal by Mr Roshan from Kathmandu Nepal of the city planning commission, for his plan to construct a wetland for wastewater treatment for the Kusunti ward of Kathmandu. This ward of 3,000 people presently discharges its untreated domestic waste water into the Nakkhu river, one of the drinking water sources for Kathmandu. Though constructed wetlands is not a new idea, it was first developed in the thirties in Germany, Mr. Roshan together with Dr. Shresthra (of the Environment and Public Health Organization) successfully introduced this low cost technology in Nepal in 1994. The technology essentially makes use of reeds growing on a uniformly graded sand bed. The plants assists in the cleaning process by transporting oxygen to the micro-organisms in the bed, which in turn degrade the pollutants. Wider application is now persued in Nepal. The technology is low cost both in investment and in operation costs because the local community is heavily involved with its labour and management and because locally available materials can be used. The jury commends the idea because the initiative can serve as a feasible and cheap solution for the treatment of grey and black water discharged by many suburbs and towns around the world. The idea deserves also special mention because it is an example of collaboration between civil servants assisting a community with advice for a simple solution to their problem at a reasonable investment cost of about US 20 per person for the treatment plant, but leaving the community as the project owner responsible for operation and upkeep.

Third

Third came the proposal of Mr. Juan Gago Gonzalez of the Technology Transfer Division of the Rope Pump Firm in Nicaragua, the firm which has done so much for the development of the rope pump. This pump has now acquired its place among the so called VLOM (village level operated and maintainable) pumps. The rope pump is rather a newcomer in the hand pump market. During the eighties it was developed and introduced in Peru and Nicaragua. In 1987 the pump was considered an interesting option by the World Bank which at the time had a team for the development of new hand pumps based on plastics. The World Bank team considered the rope pump interesting because of its applicability for rural communities and households, its easy maintenance and its low cost (only about US $ 75 per rope pump, very cheap compared to other market leading handpumps such as the India Mark II which costs a few hundred dollars a piece). Though the rope pump was not tested in the World Bank testing programme, it has gradually become a widely used handpump and is considered a good option for domestic and community water supply, even by the World Bank. The third place is therefore well deserved by this institution. It has worked so hard and largely on its own strength with assistance from some external advisors. We name here mr. Alberts and Dr. Gorter who have both contributed a lot to the development and acceptability of the handpump in Nicaragua and abroad.

Second

The second place is for the proposal submitted by Mr. Sam Mutiso, field manager of SASOL in Kenya. The Kenyan NGO SASOL, which is the abbreviation of Sahelian Solution Foundation is a small, village based local NGO in Kitui District whose mission is to serve local people in finding solutions for their water shortage problem. Kitui District is about 200 km east of Nairobi, a district on the escarpment connecting the Kenyan highlands with the coastal flats. It is a district frequently hit by droughts.

SASOL was established in 1992 by a group of three professionals, two hydrogeologists and a sociologist. All SASOL activities are implemented under the highly dedicated leadership of the field manager, who is assisted by a technician and a secretary. It is a very small organisation, rooted in the villages, which provide unskilled labour and accomodation for SASOL supported activities and staff. SASOL's proposal is about the introduction of sand dams in the river beds of an area of about 200 km2 of the Kitui district. Many seasonal rivers cut their way from the highlands down to the plains, rivers and rivulets carrying the about 1000 mm precipitation down to the sea. The SASOL proposal is innovative and participatory. The field team is supported by high level technical advisors/volunteers, who are well connected and able to attract the attention of financiers among others WaterAid and Simavi. SASOL is an example of a modern village based networking partnership which bridges the villages with professionals, and through communication and networking also outside benefactors. Yet, the core business of SASOL is and remains helping people to water access and water resource management: wells for schools of which 87 have been constructed at a cost of about US $ 2,000 per well and windlass plus 30 % community contribution, rain water tanks for schools of which 13 were constructed and sand dams at a cost of US $ 3,000 per water conservation dam of which 30 were constructed. The mission of SASOL and the achievements of its staff are an example of collaboration between local people and outside support. An example which is well documented "Where there is no water" of which there are copies available here from our sister organisation WaterAid.

First

The first place was for SANDEC from Switserland for their entry in solar water disinfection: the so called SODIS technology, a technology so simple that anybody could have developed it. The idea is just to paint the backside of a bottle black, fill the bottle with water, lay it for a couple of hours in the sun, and after a few hours, the water inside the bottle is disinfected, ready to be drunk. Sunlight will have disinfected the water by killing all the disease causing micro-organisms.

The jury unanimously chose this entry as the first price because it is so simple and yet also scientifically sound. SODIS links water and health, a very important concern for the rural and peri-urban slum population. They may collect their drinking water free from bacterial pollution at the water point, but by the time it is consumed it is likely infected by the vessel or the container in which drinking water is kept. SODIS has addressed this issue, not by looking for an expensive, high tech solution such as UV or a chemical solution such as chlorination, or by recommending to cook water which requires often scarce and costly fuel wood, and which makes water horrible to drink. No, you simply make use of the omnipresent sun. Though the idea of using the sun for disinfection is not new, the method has never gained wide application, in particular not in rural areas. And that is exactly what SODIS is about. SANDEC scientifically tested the results of the SODIS method in its laboratories. Equally important is that SANDEC developed a strategy for the wide but also controlled dissemination of the technology in the rural areas of many countries. SODIS can help hundreds of millions of people in developing countries, whether using a piped water supply, handpumps or open wells. SODIS deserves promotion and dissemination through workshops, publications and through local NGOs, and this has started already, for example via the NGO Yayasan Dian Desa of Yogyakarta, Indonesia.

The jury commended the initiative aimed at convincing and motivating rural and peri urban people to take care of the quality of their water by their own means. The jury hopes that the first prize will help in further dissemination of the idea and will contribute to less water related infections. Apart from the prize money to introduce SODIS in Indonesia and Bolivia Simavi offered its own network of collaboration with NGOs for the dissemination of the SODIS idea, and offered its support for promoting the SODIS technology.

Solar Water Disinfection (SODIS)

From Theory to Practice

*By Bruno Gremion *, Christina Aristanti +, Martin Wegelin **

SODIS Winner of SIMAVI World Water Fund Contest

In 1999, the SIMAVI World Water Fund launched an international contest on innovative ideas to improve the water supply and sanitary conditions of developing countries. The submitted proposals had to be reproducible and especially applicable in poor rural and slum areas. The projects, judged by a jury of experts in the field of water and sanitation, had to meet several criteria, such as wide applicability, training possibility for local people, self-financing in terms of maintenance, and reproducibly by the beneficiaries.

SODIS (Solar Water Disinfection) actually meets all these criteria, as it offers communities without a safe water supply a simple and cheap alternative to purify drinking water at household level. Among more than 60 submitted applications, the SODIS Promotion Project was attributed the first prize by the expert jury. This prize will be used to initiate new promotion campaigns and strengthen on-going projects in Bolivia and Indonesia.

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Water is life...

In industrialised Western countries, people are often unaware of how precious clean water is that flows abundantly by just turning on the tap, as if it were self-evident. For many inhabitants in developing countries, this privilege generally remains a remote and unrealistic dream, as their water source is often of doubtful quality. At the beginning of the new millennium, more than 1 billion people have no access to safe water, and this number is increasing despite all efforts made to improve water supply coverage and treatment!

...but too often also death

Consumption of microbiologically contaminated water presents one of the major public health problems in developing countries. The World Health Organisation (WHO) estimated that about 80 % of all diarrhoeal diseases are transmitted through contaminated drinking water and cause the death of over 3 million people annually. The most vulnerable are elderly people and young children whose resistance and immunity are not as strong as adults. In many developing countries, diarrhoeal diseases are still one of the most frequent causes of mortality among children under the age of five. Families often consider the loss of a child from acute diarrhoea as a stroke of fate. If it does not lead to death, frequent diarrhoeas can severely impair a child's development. When affecting adults, it also means considerable reduction in productivity and personal well-being.

How can such problems be solved and what are the strategies to drastically reduce the occurrence of water-borne diseases? Several options can be considered, such as improvement of water supply services, increase in health attention capacities, water protection measures, promotion of household purification methods, and hygiene education to attain a behavioural change. Obviously, all options are desirable and should be applied in combination. However, most experts agree that it will not be possible in a predictable future to provide the entire population with safe water through construction of new water treatment plants or improvement of existing ones. On the other hand, medical treatment is curative and can often be life-saving. However, preventive measurements to avoid contracting diseases are far better.

In that context, water disinfection at household level and hygiene education are often the most suitable option to prevent the spread of water-borne disease on a short and medium-term basis.

When is water safe for consumption?

People have always developed simple methods to improve their drinking water quality. Sedimentation and filtration are, for example, widely diffused methods to remove coarse solids. This kind of treatment normally produces relatively clear water which is, however, still unsuitable for human consumption. Safe drinking water actually has to meet a wide range of physico-chemical and microbiological criteria.

The physico-chemical characteristics of water include water turbidity, concentration of heavy metals, nitrates, pesticides, and other chemical pollutants. Removal of these compounds often requires the use of quite sophisticated treatment technologies which are hardly applicable at household level.

The microbiological water quality is measured by the living organisms in water like bacteria, viruses or parasites. The microorganisms which can cause diseases, mostly diarrhoeal affections, are pathogens. These pathogens have to be removed, inactivated or killed in a treatment step called disinfection. A simple and representative analysis of faecal coliforms can be conducted to determine the microbiological water quality and efficiency of a disinfection process.

In developing countries, the microbiological contamination of water often poses the most crucial problem, as many people do not have any other alternative than to use highly contaminated surface water (rivers, ponds) or water from unprotected shallow wells. Furthermore, treatment plants, if available, often do not warrant sufficient disinfection efficiency due to their inadequate operation.
Water disinfection at household level is, therefore, often required. This is probably also the most sensible approach, since only about 2-10 % of the water is used for drinking purposes and requires a high quality standard.

Household disinfection alternatives

The following table lists different household disinfection methods and their specific advantages and limitations.

Disinfection	Level of dispersion	Advantages	Disadvantages / Limitations
Boiling	*medium/high*	- *complete disinfection*	- *high energy costs (fuel, firewood)* - *potential environmental problem (deforestation)* - *time-consuming* - *change in taste*
Chlorination	*low/medium*	- *high efficiency* - *residual effect*	- *high chemical costs* - *chemical dependency* - *difficult dosage* - *change in taste and smell* - *can produce hazardous by-products* - *often low acceptance*
Other chemicals *(iodine, silver chloride, etc.)*	*low*	- *high efficiency* - *residual effect*	- *often expensive* - *chemicals generally not available* - *change in taste and smell*
Slow Sand Filtration	*Low*	- *no chemicals or combustibles required* - *does not alter smell/taste*	- *difficult to operate (continuous flow required)* - *generally requires pre-treatment to separate the solids* - *hardly reproducible*
Other filter options *(ceramic, active carbon)*	*low*	- *no chemicals or combustibles required* - *does not alter smell/taste*	- *high costs* - *hardly reproducible*
UV-light *(artificial)*	*low*	- *high efficiency* - *does not alter smell/taste*	- *very high costs* - *requires special equipment* - *requires supply of electricity*
Solar pasteurisation	*low*	- *no chemicals or combustibles required*	- *high investment costs* - *efficiency is dependent on climatic conditions* - *requires time until fully disinfected* - *uses only part of solar radiation*
Solar disinfection *(SODIS)*	*emerging*	- *no chemicals or combustibles required* - *low cost* - *very simple and not time-consuming* - *safe storage container* - *self-help system, easily reproducible*	- *efficiency is dependent on climatic conditions* - *requires time until fully disinfected* - *requires relatively clear water*

The two most common methods; i.e., water boiling and chlorination, are unfortunately not always applicable or even rejected for reasons such as lack of chemicals or firewood, costs, alteration in taste, etc. Other methods, like home filtration, are hardly reproducible on a self-help basis. Therefore, new treatment methods have to be developed and diffused in order to offer alternative options. As illustrated by the following story, the real challenge is, however, not only the actual technology applied.

Learning from past errors

A brand new water system, equipped with a full treatment plant and chlorination step, was constructed in an African village. The engineers were quite satisfied with their work and the villagers were happy that they no longer had to go to the river to collect water for almost all their domestic tasks. But to the surprise of the experts, women still draw their drinking water from the nearby polluted river. Since people simply reject the chlorinated water for its artificial and strange taste, water from the river is still being consumed without any previous treatment!

A main lesson can be learned from this rather depressing story: projects often focus on the technical aspects and neglect the human and socio-cultural parameters, thereby, leading almost inevitably to failures. Consumers have to be fully aware of the microbiological transmission routes of water-borne diseases, and of the manner to reduce or avoid them. In that sense, only a strong educational component can induce the necessary behavioural changes and ensure a long-term use of the methods or facilities, which also implies a willingness to pay for maintenance and renewal of the water supply system.

Development of SODIS as a new alternative

Due to the urgent need to develop alternative water purification options at household level, and also aware of the limits of a purely technical approach, the Department of Water and Sanitation in Developing Countries (SANDEC) of the Swiss Federal Institute for Environmental Science and Technology (EAWAG) embarked in 1991 on an integrated project to assess the potential of Solar Water Disinfection (SODIS), and to develop it as an effective, sustainable and

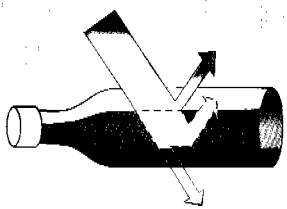
low-cost water treatment option. The research project, which has been substantially cofinanced by the Swiss Agency for Development and Cooperation (SDC), consisted in three successive study phases: scientific validation, technical feasibility and, last but not least, socio-cultural acceptance and affordability.

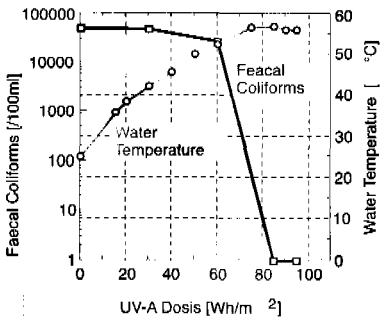
Scientific and technical background

How does SODIS work ?

The treatment process is a very simple technology using solar radiation to inactivate and destroy pathogenic microorganisms present in the water. SODIS basically consists in filling transparent containers with water and exposing these to full sunlight for several hours. Thereafter, the treated water is safe to be consumed directly from the containers! In fact, inactivation of the pathogens present in the water and responsible for diarrhoeal diseases is achieved by the combined action of two factors: direct sunlight irradiation and increase in water temperature.

The properties of sunlight are described thereafter to acquire a better understanding of the SODIS method. Solar radiation reaching the earth's surface is divided into three main wavelength ranges: the ultraviolet or UV radiation, the visible light and the infrared radiation.

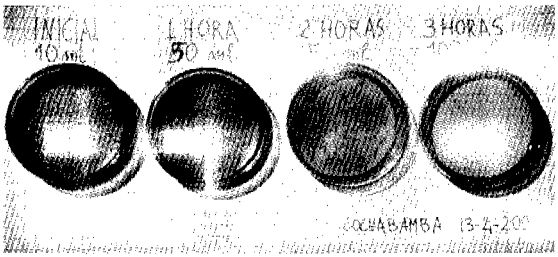




The visible light can be directly perceived by the human eye and is composed of the different colours of the rainbow: violet, blue, green, yellow, orange, and

red.

The long-wave radiation beyond the red spectrum, the so-called infrared radiation, cannot be seen by the human eye, but our skin can feel it in the form of heat when approaching for example glowing coal. The infrared radiation absorbed by the water is mostly responsible for heating the water in the recipients exposed to the sun, and submitting the microorganisms to a process similar to a low temperature pasteurisation.



From left to right: faecal coliforms analysis of untreated water after 1, 2 and 3 hours of sun exposure. Each point on the filter paper represents a colony of bacteria after an incubation time of about 24 hours. In the two pictures on the left, bacteria have grown so close to each other that the support is literally overgrown with bacteria and, therefore, hardly countable. On the last picture, no colony was found: the water has been disinfected and is now safe for consumption.

Beyond the violet spectrum lies the UV range, which is a very aggressive radiation that can cause severe damage to skin (sunburn, skin cancer) and eyes due to its high energy intensity. UV radiation has an even stronger effect on pathogens responsible for water-borne diseases. Most of these organisms find optimal living conditions in the gastrointestinal tract, and are very sensitive to other aggressive environmental factors such as UV radiation. UV light is indeed considered a strong disinfectant and is commonly used in water treatment plants in Western countries where contaminated water is exposed for a few seconds to a very high radiation intensity produced artificially by an UV lamp.

SODIS is based on the following "enlightening" idea: as most human pathogens transmitted through contaminated water are vulnerable to both heat and UV radiation, solar energy, which is freely and abundantly available throughout the year in most developing countries, could be used to develop a low-cost and efficient method for water disinfection at household level.

An idea put into effect

The idea of using solar radiation for water disinfection was actually not new when EAWAG/SANDEC started its research on Solar Disinfection in 1991. In the eighties, Professor Acra at the American University of Beirut already demonstrated the potential of solar UV light for treating drinking water [1]. Another method, known as solar pasteurisation, focused on infrared radiation

to raise the water temperature over 70 °C. The simultaneous use of both properties of sunlight - UV and infrared radiation - therefore seemed a good idea which needed to be investigated.

An interdisciplinary team composed of sanitary engineers, photochemists, bacteriologists and virologists conducted extensive laboratory and field tests and discovered the strong synergetic effects of direct UV radiation and heat on the inactivation of faecal coliforms. A synergy occurs, since the combined action of two parameters has a greater effect than the mere sum of each one taken independently. In other words, the mortality of microorganisms increases dramatically when these are exposed simultaneously to both temperature and UV light. The scientists at EAWAG/SANDEC and at partner institutions in developing countries systematically tested SODIS efficiency on different viruses and bacteria (including Vibrio cholerae, agent of the cholera disease), with different water qualities, using different types of containers (including a SODIS reactor with continuous flow), and under different climatic conditions. The tests revealed a 99.9 % reduction of faecal bacteria after 5 hours exposure time at lower temperatures, and after only about one hour at a threshold water temperature of 50 °C. No regrowth or revival of faecal bacteria was observed even after prolonged storage of over two weeks in water samples treated with SODIS [2, 3].

However, like other technologies, SODIS also has its specific limitations: it requires relatively clear water for sunlight to pass through the entire water layer, and certainly sufficient solar radiation. The generally recommended exposure time of 5 hours under clear to partly cloudy skies should be prolonged to two consecutive days under fully cloudy skies. Furthermore, large volumes of water cannot be treated by SODIS, nor does the process alter the chemical water quality.

Special SODIS plastic bags and locally available bottles were tested as possible containers. Though the plastic bags made of a transparent and a black PET sheet allow faster disinfection, they are rather difficult to handle and not durable. Therefore, commonly available transparent plastic bottles are more appropriate for SODIS use. Since treatment efficiency improves drastically at a water temperature above 50 °C, it is strongly recommended to use half-blackened bottles and, if available, a corrugated zinc sheet or other dark material for bottle support. The black colour absorbs the remaining radiation passing through the entire water layer and enhances the heating process.

After almost 5 years of carefully conducted research, simple and practical guidelines were developed on exposure time, turbidity, water layer thickness, and appropriate containers [4].

The container itself ensures a safe water quality. SODIS bottles are actually safe and hygienic containers for water storage! This turns out to be quite an important advantage as water is very frequently polluted in the household by wrong storage or handling practices, like use of dirty and uncovered containers or through direct hand contact. If the family has about two 1???-2 litre bottles per person, the first bottle serves as a safe container for the treated water while the other is exposed to sunlight for disinfection. Thus, each person will have safe water round the clock, and the treated water can cool down overnight before it is used the following day!

Socio-cultural acceptance in demonstration projects

People's health will only improve if the new equipment or facilities are actually used. To study the socio-cultural acceptance and affordability of SODIS, demonstration projects were conducted from 1996 to 1997 by local institutions in seven countries: Indonesia, Thailand, China, Burkina Faso, Togo, Bolivia, and Colombia. The survey carried out after one-year experience revealed that around 84 % of the users intended to continue applying SODIS after conclusion of the project as they consider this water treatment method to be an easy, practical, time and cost-saving method to reduce diarrhoea and stomach-aches. Only 3 % definitively rejected to further treat their drinking water with SODIS.

The cost of the plastic bottles differs widely from one country to another, but can generally be considered as very low compared to the cost of fuel or firewood for water boiling. Furthermore, reduction in medical expenditure and increase in productivity on improved health condition also belong to the expected economic benefits.

It is interesting to note that over the last decade the rapid diffusion of soft drink plastic bottles with good screw tops can greatly facilitate diffusion of SODIS. These bottles can often be easily purchased on a self-help basis, even from the poorest families. Availability of appropriate containers may, however,

still be a problem, particularly in remote rural areas and in some African countries.

During SODIS implementation, great importance should be placed on educational and cultural aspects. Integration of the method in an on-going project addressing hygienic or educational issues is indeed strongly recommended to ensure an appropriate follow-up until users have integrated SODIS in their daily routine activities. Certainly the main lesson learned from the demonstration projects is that dissemination of SODIS is not a technological problem, but really a question of information and appropriate educational activities. In fact, to cause behavioural changes is a much more complex and time-consuming task than the SODIS process itself... . Five hours are sufficient to produce safe drinking water with SODIS, how long will it take until people definitively change their habits and give up drinking untreated water? This is obviously dependent on the level of people's awareness, however, experience has shown that SODIS implementation projects require at least one year of regular follow-up.

SODIS' widespread application

After years of laboratory research, field tests and demonstration projects revealing SODIS efficiency and potential, the method is now ready to be widely diffused. Although EAWAG/SANDEC is a research-oriented institute, it is committed to a wider dissemination of the SODIS idea. It would be a waste of effort to stop research at laboratory doors !

A widespread diffusion of SODIS is rather an information problem than a technological issue. To fill this information gap, an informal Newsletter ("SODIS News") is being published since 1997. SODIS News and other information material can now be directly downloaded from the SODIS website (www.sodis.ch). A video was produced to illustrate the laboratory development of SODIS and also shows case studies from Asia, Africa and South America. In more than a dozen countries, local institutions are spreading the technology, and all stakeholders share the opinion that SODIS is a very simple and reliable method. However, these initiatives still remain quite isolated and a long-term success can only be ensured if a certain "critical mass" is reached.

SODIS also needs to be fully accepted as an alternative household-based water treatment option by national and international institutions, to be totally

integrated in national programmes and regulations. In the last few years, SODIS has been presented at various international conferences, and contacts have been established with the main international agencies working in the water sector (e.g. UNICEF, WHO, World Bank / UNDP). Last year, an e-mail conference between several authorities from such institutions and local partners reviewed and discussed SODIS as a new water treatment option. The participants endorsed a common declaration on SODIS' potential and limitations, and formulated some key recommendations. So far, these institutions have shown an interest in new and unconventional methods like SODIS, and have agreed on the fact that the so-called "appropriate technologies" will gain ground in the next few years as they often present a valid alternative to the old technocratic approach.

For EAWAG/SANDEC's local partners, the best technology has always been the one that combines efficiency with feasibility, affordability and sustainability. However, let us have a look at the current SODIS promotion projects in Bolivia and Indonesia to see how SODIS can be brought to people.

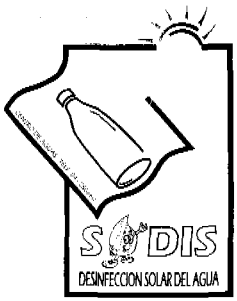
Bolivia: safe water thanks to the Sun-God

In the Andean cosmovision, the Sun-God Inti is the most important figure together with Pachamama, Mother Earth. The Inca rulers themselves were considered as direct descendants of Inti. Nowadays, the sun still forms an important part of Bolivian culture. Native New Year is, for example, celebrated at the winter solstice on 21 June, when days begin to get longer. This rich cultural relationship with the sun, together with the very high average solar radiation on most of the territory, made Bolivia an ideal country for SODIS application.

Bolivia is a very sparsely populated country (8 million habitants distributed over about 26 times the surface of The Netherlands) in the hearth of South America. The climate varies from wet and tropical in the eastern Amazonian lowlands to very arid and cold in the Andean highlands, the so-called Altiplano. Most of the population lives in the Andean region (Altiplano and valleys). Due to the difficult economic situation, water supply facilities are often either lacking or in poor condition. Water shortages are very common in towns, especially in low-income periurban areas. In rural areas, many

communities depend on surface water of doubtful quality. Household-based disinfection is often the only feasible alternative: safe drinking water systems are not likely to be constructed in the near future for lack of financial resources and low population density.

Based on all these considerations, a cooperation agreement was signed in 1996 between EAWAG/SANDEC and the Bolivian research institute Centro de Aguas y Saneamiento Ambiental (CdA, Centre for Water and Environmental Sanitation) based in Cochabamba. In a first step, CdA conducted its own SODIS investigation to confirm whether the results from the former investigations were reproducible under the specific climatic conditions of the high Andean valleys and Altiplano, where temperatures are generally low but solar radiation extremely high. In a second phase, CdA headed one of the demonstration projects conducted in seven different countries to assess SODIS' socio-cultural acceptance. The project revealed the high interest in SODIS by the 30 participating families. However, it also revealed the real difficulty in achieving its long-term use without reinforced educational activities.



In Bolivia, EAWAG/SANDEC's partner the Centro de Aguas y Saneamiento Ambiental" developed its own SODIS logo featuring the Magic Droplet. In most of the promotion material, like children booklets or SODIS short stories on tape, the Magic Droplet is a friendly character initiating the children to SODIS.

The next phase focused on the preparation of appropriate diffusion material, such as booklets, posters, videos, short stories, etc., some of which is intended for the executive and technical staff of local institutions, other material for different user groups (children, adults, illiterate people). In mid-1999, CdA started a series of institutional workshops throughout the country to inform governmental and non-governmental institutions working in the water and sanitation sector about SODIS. The 2-day workshops included an intensive practical course on SODIS use with highly contaminated water, and bacteriological analysis of raw and treated water. During group discussions, emphasis was placed on the socio-cultural aspects and implementation strategies. The results of the water analysis were shown at the end of the workshop, and all the participants were invited to a "closure aperitif" where SODIS water was served ! From theory to practice! The workshops were very well attended, and most of the participating institutions showed a great interest in the method. Obviously, the objective of theses workshops is not to

inform just about SODIS, but also to motivate the participating organisations to diffuse SODIS in their own working area with the technical support of CdA. Still in 1999, first projects were started in collaboration with local NGOs and others were planned with both NGOs and governmental institutions. This year, new institutions have manifested their interest in working with SODIS. This is quite remarkable considering that the participating institutions did not receive any financial support. CdA itself is running the entire project at a very moderate budget, and is now clearly facing problems to meet all the expectations.

To understand how SODIS knowledge is transferred to the users, let us describe more explicitly one of the first projects which was initiated in Potosi, a Bolivian town located at an altitude of 4000 m above sea level. CENPOSEP, a local NGO working in education and health issues in a low-income district, was preoccupied by the changing water quality delivered by the municipality. Most people living in the area do not boil the water due to the high cost of gas and lack of awareness about potential risks. CdA was asked for technical support, and a one-day workshop was promptly organised. The participants were taught in a very participatory way about hygiene, health and water-related issues, including of course SODIS practical training throughout the day. Some young volunteers, trained as "Popular Health Promoters" by the NGO, proposed to replicate the workshops with their school or other neighbourhood associations like "Mothers Clubs". Within two months, not less than five workshops were held under the auspices of the NGO and participation of one CdA staff member. Some people attended various workshop to learn more about SODIS. They made the best possible publicity for SODIS as they could relate their own experience with the method, and could motivate their neighbours to follow their example. At the end of the cycle, the young "Popular Health Promoters" were best trained to take over the challenge of maintaining diffusion of SODIS in their neighbourhood. The project shall continue over the year 2000 with less intensive follow-up activities.

Very strong gender and generation attention was given to the project. Young people of school age and woman feel particularly concerned as they are normally in charge of the household tasks. Young mothers are very likely to start using SODIS, as they feel responsible for their baby's health. Of course, men should not be neglected, but the approach should be slightly modified.

SODIS training workshop in Potosi on the Bolivian Altiplano

All these promotional and educational activities are very time-consuming and cannot be reproduced indefinitely due to the limited capacity of the leading institution CdA. In order to reach larger target groups, cooperation was started with teacher training colleges and nursing schools, in the hope to attain a greater multiplication effect. Other governmental institutions working in poor rural areas are also participating. However, working together with governmental institutions also means having to face greater administrative and bureaucratic difficulties.

Current projects in Bolivia are promising, although very demanding due to the remoteness of many areas, and to the not always simple political context. At the beginning of April 2000, the government declared a state of emergency to react against the massive strikes and protests in the so-called "War of Water": the population rose up against a new liberal Law of Water and the private attribution of an ambitious water project aiming to suppress water shortage in the Cochabamba valley, but also involving severe water rate increases. Finally, the government cancelled the contract under the pressure of the population. Water rates will not be increased, however, rationing and poor water quality will persist. Once again, the story shows that it is necessary to considered soft alternatives instead of a high-cost technological approach disregarding any social consideration... .

Three-level implementation in Indonesia

Despite high sanitary risks, a high percentage of the Indonesian population still drinks raw or untreated water, especially in rural areas. There are many reasons why people do not drink boiled water: lack of firewood, costs of other combustibles, taste, and also belief. In some regions, such as the East Nusa Tenggara (NTT), people consider boiled water as "dead water". Other find that raw water tastes better than boiled water.

For Yayasan Dian Desa (YDD), an Indonesian NGO involved in providing clean water to the people, SODIS is a potential treatment option providing safe drinking water to people who refuse to drink boiled water.

After participating in the first demonstration projects in 1996 to 1997, YDD amplified its SODIS promotion activities in the communities by targeting three different user groups.

SODIS for the children

Children are usually the most vulnerable group and are the first affected by a lack of drinking water. Secondly, to implement a new technology or methodology which should be incorporated into people's life, it should be introduced at a very young age. Thirdly, children/students at school are also expected to bring home to their families the new method they learn at school.

In the NTT region, many people still drink raw water, including the students at school. The teachers told YDD that when the students are thirsty after playing during school break, they just go and drink water from an available water source nearby, such as an open well or rain water catchment. Some can find better sources such as shallow wells equipped with handpumps. Such attitudes naturally present quite a high risk for the students to contract water-borne diseases.

Due to the aforementioned reasons, YDD started to train the elementary and high schools students on the SODIS water treatment method. The teachers, the concerned Departments of Health and also of Education are very pleased and also support this initiative.

The response from the students is very good, and an increasing number of schools are currently using SODIS. One school with a dormitory, for example, introduced a rule that new students who come to the school and stay at the dormitory have to bring along two transparent half-blackened plastic bottles of 1???-litre capacity, also simply called "SODIS bottles". The nuns who run the dormitory said that not only the students are healthy, but that they were able to make some substantial savings on the fuel expenses.

YDD conducted an intensive training and promotion programme with more than 50 schools on Flores Island.

During the first SODIS training series organised for students, YDD collaborated with the NTT Office of UNICEF Indonesia. Till April 2000, YDD provided training and guidance to 18 schools in four different districts. From May 2000, YDD will train more schools as a large number of requests were made after YDD's first SODIS courses for schools. For this particular SODIS project, YDD was supported by the Canadian funds through the Canadian Embassy in Indonesia to train and promote SODIS in 50 elementary and high schools.

SODIS for the family

As aforementioned, numerous families still drink untreated raw water. Therefore, it is very important to introduce SODIS to these families, especially to women who are the providers of water in the household. Apart from the influence of the children who learned about SODIS at school, the YDD team also provides training to village communities that have shown an interest in SODIS as they learned it from the nearby school. In addition, YDD also trains villagers who require such a technology and who have shown a keen interest in SODIS.

Families generally like SODIS because it is easy and also because it is very practical. Women, who usually had to wake up early in the morning to boil water for their husbands to take to the fields, expressed their happiness by saying that they could now sleep longer and, thereby, save a lot of time. The husbands can just take the SODIS bottles from the previous day to the fields.

Although a systematic epidemiological study has not been conducted yet, the mothers told the YDD staff that frequency of diarrhoeal outbreaks in the family, and especially among children, had reduced significantly.

SODIS for the refugees

In Indonesia, as in any parts of the world when political struggles or natural disasters occur, the refugees are the most affected group.

Third target group of the Indonesian SODIS diffusion strategy. Refugees from the East Timor conflict are provided with SODIS bottles. Since there is a very high risk of outbreaks of diarrhoea in densely populated areas with precarious sanitary conditions, great importance should be placed on appropriate drinking water treatment.

In one of the seminars of the World Water Forum in The Hague in March 2000 it was observed that emergency aid programmes generally come first along with food and medical supplies, but water and sanitation generally always come later. Measures to implement safe drinking water and sanitation facilities as early as possible to the refugees were discussed and recommended.

Sanitary conditions at refugee camps are known to be very poor and contamination of the available water sources is usually very high. However, boiling of drinking water will not be an easy task for the refugees, since they have a limited amount of fuel and are short of convenient equipment to boil water. YDD, thus, considers that SODIS is an appropriate technology for people living in refugee or resettlement camps, since SODIS will provide displaced people with safe drinking water. SODIS will hopefully at least help to maintain them as healthy as possible.

In the SODIS dissemination project for refugees of the East Timor conflict, YDD collaborated with USAID Indonesia and received additional support in the form of the required plastic bottles from a mineral water company, PT Aqua Golden Mississippi, based in Jakarta. At the same time, it is hoped that once back to their home or resettled in any other new region, the displaced people will continue treating their drinking water with SODIS.

Accepting the challenge

Based on past experience acquired nearly everywhere in developing countries, we can say that it is not easy to find the right balance between educational and technical aspects in cooperation projects. Many projects end up in pure educational campaigns and do not succeed in providing practical learning for direct application. On the other hand, a too technically-oriented approach may not give enough weight to social parameters and jeopardise the long-term sustainability of the method. SODIS hopes to conciliate both aspects, as it provides an efficient and, at the same time, simple and cheap water treatment method that can be easily integrated into comprehensive hygiene and health education activities. Thanks to its low cost and simplicity, SODIS can also be readily reproduced on a self-help basis, thereby, enhancing its potential.

In Indonesia, YDD is exploring successful ways of working in emergency situations with displaced people from the Timor crisis, as well as under socially stable conditions at family and school levels. In both cases, an important demand exists, and current activities should be expanded to new communities and areas.

In Bolivia, CdA is planning to diffuse SODIS in remote rural communities of the Altiplano. The available educational material in Spanish will, therefore, be adapted to the native cultures and languages, especially to Aymara and Quechua. Local community leaders and rural teachers will play a key role in these new SODIS promotion efforts.

Both Indonesian and Bolivian projects will benefit from the prize awarded by SIMAVI World Water Fund. EAWAG/SANDEC will keep on sharing its knowledge and developing the SODIS network worldwide, in order to improve the sanitary conditions amongst the poorest rural and peri-urban population in less developed countries.

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SIMAVI samen werken aan een gezonde ontwikkeling

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Geachte heer/mevrouw,

Zoals u wellicht bekend, vierde Simavi vorig jaar haar 75-jarig jubileum o.a. met een Internationale Waterprijsvraag, die tot doel had vernieuwende en uitvoerbare voorstellen met betrekking tot verbetering van de drinkwatervoorziening in ontwikkelingslanden te verkrijgen. Hierop ontvingen wij 63 inzendingen uit 27 verschillende landen. De jury, die bestond uit deskundigen uit de water- en ontwikkelingssector, had er nog een hele kluif aan om daaruit de beste voorstellen te kiezen.

Uiteindelijk werd het voorstel van EAWAG/SANDEC uit Zwitserland beloond met een geldprijs, waarmee het ingediende project gefinancierd kan worden. Het betreft de methode SODIS voor het zonder veel kosten desinfecteren van licht vervuild water, zodat het drinkbaar wordt. Een onderdeel van de prijs bestaat tevens uit de publicatie van de vier beste inzendingen. Daaraan is de afgelopen maanden gestaag gewerkt en wij presenteren u hierbij met trots het boekje

"Message in a bottle"

Het wordt u toegezonden omdat u op de een of andere wijze belangstelling heeft getoond voor de drinkwatersituatie in ontwikkelingslanden in het algemeen en het werk van Simavi in het bijzonder.

Wij wensen u veel leesplezier.

Ruud van den Hurk
directeur

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