AGUASAN Workshop 1998
Septae/Faecal Sludge Treatment in Ghana
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1. Project Context

The total population of Ghana is about 20 million people. Total urban population is about 30 %, of which 40 % lives in the five major urban centres. Thus, the estimated total daily quantity of faecal sludge produced in the five urban centres is about 2,400 cu. m. This figure may increase to about 4,000 cu. m by the year 2015. Currently, the total installed capacity of available treatment plants in these major urban centres is about 250 cu. m per day (i.e. only about 10.4 % of requirement in the five major urban centres).

The treatment of septage and faecal sludges in Ghana received serious attention in the late eighties with support from the Ministry of Local Government and Rural Development. The initiatives started in Accra, the capital city of Ghana under the then Accra City Council Waste Improvement Project with financial assistance from the GTZ/KfW.

The objectives for taking the initiative included:

- To provide an opportunity for the city of Accra, and subsequently other major cities in Ghana to be provided with facilities for the treatment and safe disposal of collected septage and faecal sludges from w.c. septic tanks, public latrines (acqua privies, VIPs) and domestic bucket latrines.
- To optimize use of the limited number of collection vehicles by decentralising disposal sites in order to reduce travel distances and time thereby reducing the cost of haulage, the incidence of unauthorized dumping, and increasing the number of trips per vehicle per day.

The main collaborating partners have since been:

- The Ministry of Local Government and Rural Development,
- the City of Accra,
- GOPA consultants/GTZ,
- SANDEC,
- the Water Research Institute (WRI) and other research institutions,
- the World Bank/IDA.

In particular, Sandec and WRI have carried out systematic research activities to adequately characterize the sludges and also monitor the performance of existing plants, and to help prepare guidelines for the design and operation of treatment systems for such sludges.

1.1 Previous Activities

From 1986 to 1989, various research activities were carried out which included the following, among others:

- construction, operation and performance monitoring of 3 No. pilot septage treatment plants at two different locations in Accra;
- review of the design of some system components in order to optimise operational performance;
- field sampling and laboratory analyses of faecal material collected from the various sources of origin, notably, public toilets (aqua Privies), pan latrines and wc/septic tanks;
- review of the limited literature available on septage treatment; and
- consultation with expatriate professionals with similar research interests.

The first prototype plant was constructed in 1989/90 at Achimota in Accra in order to:

- Provide a disposal facility to the north of the city as part of a strategic plan for septage/faecal sludge management.
- Test run to obtain adequate operational data for system components of a prototype treatment plant.

A follow up intervention supported by the Government of Ghana through the Ministry of Local Government and Rural Development (MLGRD), was initiated in Koforidua in 1990 as a result of incessant requests by the New Juaben Municipal Assembly. Construction was started in 1992 and commissioned mid 1995.

The third prototype plant was constructed at Teshie in Accra in 1994/95 to test new conceptual designs in an attempt to improve on operational performance.

From 1993 to 1997, a collaborative research between SANDEC, WRI and the Waste Management Department of the AMA, was undertaken with the following objectives:
- to further characterise faecal sludges,
- to provide additional and adequate data through performance monitoring of the two prototype plants in Accra, and
- to enable preparation of design and operational management guidelines for septage treatment, among others.

As a result of the experience gained so far, the Government of Ghana in partnership with the World Bank and other donor agencies, has been implementing the Urban Environmental Sanitation Project (UESP) in the five major cities in Ghana. The sanitation component of the project seeks to improve on excreta management by providing adequate facilities for on site sanitation and septage treatment.

1.2 Present and Future Activities

Local consultants have been engaged to plan, design and supervise construction of septage treatment facilities to be provided in the five major cities. Given the previous local initiatives with regard to research and design, conceptual designs have been prepared to guide detailed design of all septage treatment facilities to be provided under the UESP.

Further collaborative research into plant performance is needed with the objective of improving on system components thereby improving on the overall performance of the plant. In particular, the need to investigate options for reduction of ammonia toxicity, effective use of deep anaerobic ponds, aeration systems, etc. cannot be overemphasized.

2.0 Background on Technological Choice

2.1 Choice of Technology

A number of options were considered, notably, Waste Stabilization Ponds, Chemical Treatment, Bio digestion, etc.

Technical Considerations

- Simplicity of design and construction
- Use of natural treatment processes
- Low operation and maintenance requirement
- Use of simple plant appurtenances
- Limited use of electro mechanical contraptions, etc
- Minimum requirement of skilled labour input

Economic / Other Considerations

- Economic benefit through use of partly digested sludge for compost production
- Effluent reuse in agriculture
- Availability of land
- Highly improved effluent quality (hygienic quality)
- Social and environmental acceptance
- Possibility of decentralised location planning for the plant to enable optimization of the collection system.

2.2 Technical Details of the Treatment System

The treatment systems consist of a series of waste stabilization ponds, notably, anaerobic, facultative and maturation ponds. The anaerobic ponds are preceded by settling tanks.

Receiving/Settling Tanks

These allow settling and thickening with the formation of thick layers of sludge and scum. Supernatant is decanted into the primary anaerobic units for digestion. Two tanks are operated alternatingly to allow dewatering and maintenance. Accumulated sludge is mixed with saw dust or domestic refuse (predominantly organic) and removed by means of a front loader for composting.

The tanks are designed as settling basins with retention time of 1 to 3 days. However, they tanks tend to pose operational difficulties after a few weeks in operation. In particular, the efficiency with regard to solids removal is greatly reduced. The problem is now tackled by a review of tank design with regard to tank geometry, inlet and outlet arrangements, retention time, sludge storage volume, hygienic quality of accumulated sludge during removal, etc.

Anaerobic Ponds

These consist of primary and secondary units provided with sludge storage volumes, simple overflow and underflow appurtenances and connected to smaller ponds, which allow periodic removal of sludge based on the principle of siphoning. This reduces the need for pumping of accumulated sludge. Removal of consolidated sludge is by means of a front loader after dewatering and drying.

They are designed as anaerobic ponds with up to 10 days retention time and depth of about 3.0 m. Considerations for design review include the possibility of use of deeper ponds to allow for adequate sludge storage and digestion. The primary and secondary ponds will have retention time up to 20 days and 10 days, respectively.

Facultative and Maturation Ponds

These are shallower ponds with virtually no provision for sludge storage.
Designed with flow depths of about 1.7m (facultative) and 1.0m (maturation). Facultative ponds are designed based on surface loading criteria while the maturation pond design is based on retention time of about 7 days. Ponds tend to operate as anaerobic ponds with limited algael growth. While there may be several reasons for this observation, recent reviews suggest the need to consider reduction of ammonia toxicity caused by the high levels of ammonia.

Effluent Reuse

The effluent initially was used to irrigate sugarcane plantations as a means of disposal through evapo transpiration processes. However, as a result of the persistent accumulation of salts in the soil thereby increasing soil salinity, plant production (yield) is adversely affected after a few harvests.

Sludge Composting

A mixture of sludge and saw dust or domestic refuse removed from settling tanks and/or anaerobic ponds is composted by forming windrows which are turned periodically. Initially, temperatures range between 33 and 40 deg cent., and rise to about 55 deg. cent after about 12 weeks.

Summary of Operational Performance-Accra Plants (Feb., 1998)

Parameter	% Overall Reduction	
	Achimota Plant	**Teshie Plant**
Ammonia-N	62.0	38.0
Biochemical Oxygen Demand	80.0	70.0
Chemical Oxygen Demand	60.0	74.0
Suspended Solids	70.0	91.0
Volatile Suspended Solids	66.0	85.0
Faecal Coliforms	99.0	98.0

3.0 Organisational /Institutional Aspects

3.1 Awareness Creation

Several discussion meetings are held with city authorities including relevant technical staff to introduce and explain the project before implementation commences. Additionally, durbars are organised to inform and educate nearby communities on the project as a means of creating community awareness and facilitate acceptance.

Given the experience gained with previous projects, and the various research activities carried out in the past with collaborating institutions like SANDEC, WRI, etc., the stage has been set for a more structured public information dissemination and introduction of the project to other prospective district assemblies. The effort by government in partnership with the World Bank to support implementation of similar projects in the five major cities is a major step towards spreading of the technology.

To date, Colan Consult have played a key role in the attempt to spread the technology through their work as sector consultants to district assemblies and, in particular the MLGRD.

3.2 Ownership and Management Responsibilities

The respective metropolitan or municipal assemblies (city authorities) are the owners of facilities provided under the project. The Waste Management Departments/Units of the Assemblies are assigned management responsibilities. Franchised arrangements for operation and maintenance of the facilities are planned by beneficiary cities.

3.3 Training

The operational staff of the Waste Management Departments/Units of the Assemblies, are the target group for training on operation and maintenance. Given the extensive experience gained by the city of Accra, the practical aspects of such training is provided in Accra in collaboration with the relevant city technical staff.

3.4 Post Project Experiences

3.4.1 Problems Relating to Operation and Maintenance

- Non availability of water for cleaning.
- Lack of adherence to proper operation and maintenance schedules.
- Frequent replacement or transfer of trained staff.
- Inadequate training of operational staff.
- Inadequate record keeping at plant site.
- Breakdown or absence of equipment for maintenance, etc.

3.4.2 Problems Relating to Performance Monitoring

- Lack of adequate budgeting for performance monitoring.
- Inability of operational personnel to use results of performance monitoring to guide plant operation.

3.4.3 Problems Relating to Compost Production and sale

- Sometimes inadequate turning (aeration) of windrows.
- Inadequate equipment for sieving composted material.
- Compost sold to farms and horticulturists mainly by means of trucking.

4.0 Financial/Economic Aspects

4.1 Costs (Capital and O&M)

Location	Capacity (cu. m)	Capital Cost ('000 US $)	O&M Cost ('000 US$)	Const. Period	Designed & Supervised by	Funded by:
Existing						
Accra						
• Plant A	150	-	25.0-30.0	1988/89	AMA/GOPA	GTZ/KfW
• Plant B	80	75.0	16.5	1994/95	Colan	GTZ/KfW
Koforidua	100	45.0	18.0	1992/95	AMA/GOPA	GOG/City
Obuasi	400	300.0	?	1997	Ash. Goldfields	Ash. Goldfields
Proposed						
Kumasi	300	400.0	?	1998/99	Conterra/Africon	IDA/GOG
Tamale	150	250.0	?	1998/99	Conterra/Africon	IDA/GOG
Takoradi	250	350.0	?	1998/99	Conterra/Africon	IDA/GOG
Kumasi	250	350.0	25.0	1998	Colan	IDA/GOG
Accra	250	350.0	25.0	1998/99	Colan	IDA/GOG
Tema	150	250.0	19.0	1998/99	Colan	IDA/GOG

4.2 Remarks

- Tipping Fees are charged to cover cost of operation and maintenance including small repairs. Currently in Accra, Tipping Fee is about US$ 8.5 per trip for private operators and organizations.
- Tipping Fees are paid based on a monthly billing system. Difficulties encountered include irregular payments by the private operators.
- Collection Fees are about US$ 20.0 per trip.

Typical Revenue from Tipping Fees (Accra)

Operator	Total No. of Trucks	No. of Trips per Annum	Total Revenue (Tipping Fees)
City (AMA)	7	9,050	-
Private Operators/Organizations	29	11,050	US$ 93,925
Total	**36**	**20,100**	**US$ 93,925**
Total O&M Costs/Annum			**US$ 55,000**

Typical Revenue from collection Fees (Accra)

Operator	Total No. of Trucks	No. of Trips per Annum	Total Revenue (Collection Fees)
City (AMA)	7	9,050	181,000
Private Operators	15	9,250	185,000
Organizations	14	1,800	36,000
Total		20,100	402,000

Important Issues

Lack of adequate and proven technology
Inadequate legislation and its enforcement
Inadequate public education on poor environmental sanitation practices and the related consequences
Availability of qualified Personnel
Motivation of Staff
Career Development
Cultural perceptions
Political will/support by authorities
Lack of adequate
Feasible technologies available
External support – Tech. Knowhow, financial, etc.