

# Waste stabilization ponds in Tanzania

by Michael Yhdego

**It is claimed that waste stabilization ponds provide an efficient, inexpensive and appropriate form of wastewater treatment for developing countries. On the basis of negative experiences in Tanzania, Michael Yhdego disputes this claim.**

IN TANZANIA, waste stabilization ponds (WSPs) are used extensively in the treatment of domestic and industrial wastes; about 20 ponds are located in the country's main urban centres. It has been claimed that WSPs are an efficient, effective, inexpensive and appropriate wastewater treatment in comparison with conventional treatment methods.<sup>1,2,3</sup> They require little maintenance and the effluent is largely free from pathogenic and parasitic organisms.<sup>4</sup> These factors make WSPs an apparently attractive treatment system, if sufficient land is available on which to build them.

A survey carried out in several urban areas over 1985 and 1986 however, showed that the majority of the pond systems in Tanzania were either not working at all, or else performing poorly, for various reasons:

- Standard design formulas were adopted without considering local environmental factors, with the result that ponds were not designed with proper care.
- The lack of maintenance and desludging had adversely affected the ponds' performance and turned them into breeding sites for mosquitoes.

- There was a scarcity of funds and skilled operational supervision.

Furthermore, the effluent from ponds had already polluted some rivers; for example, the Ubungo ponds in Dar es Salaam and the Arusha ponds badly polluted the Msimbazi and Themis Rivers, respectively.

## Dar es Salaam ponds

The city of Dar es Salaam is located along the Indian Ocean and is the major industrial, commercial and institutional centre of Tanzania. The central business area and the high- and medium-density residential areas around the city centre are served by a sewerage system; this reaches 12.8 per cent of the city's population. The sewage is discharged through an ocean outfall which is defective and too short. The large quantity of untreated sewage has generated a high level of biological pollution in Tanzania's coastal waters, and reports of fungal infections caught by people bathing along the polluted beaches of Dar es Salaam are widespread.<sup>3</sup>

Of the people not served by a sewerage system, 11 per cent use septic tanks and soakage pits while

the remaining 76 per cent use pit latrines.<sup>6</sup> However, 70 to 80 per cent of Tanzania's industries are concentrated in Dar es Salaam, and the wastewater from industries such as breweries and textile plants is discharged into the Indian Ocean without any form of on-site treatment.<sup>5</sup>

During the mid-1960s and the beginning of the 1970s, WSPs were constructed to treat wastes from semi-urban residential areas, industrial sites and institutions such as the university and army camps. There are now nine ponds in the city.

Table 1 presents a summary of the population, areas served, net pond areas and type of system used. The data are based on the author's observations and research over the period from May 1985 to October 1986. His findings were correlated with two other major surveys.

A number of interesting points emerge from Table 1. Firstly, anaerobic ponds were not incorporated into the pond systems. Secondly, the net pond area did not take into account the incremental development of the area. Thirdly, industrial wastes were supposed to be treated by ponds; yet the Ubungo industrial area, for instance, does not have facilities for the removal of heavy metals and dyes. Finally, no feasibility study was carried out on alternative combinations of ponds which might minimize capital and operational costs.

## Design

The ponds were designed by engineering firms from the United Kingdom and Denmark, and the designers' criteria, approach and methods varied from firm to firm. Assumptions were based on the firms' experience in similar projects, not necessarily in hot climates, as well as their own expertise.

At the time that the Dar es Salaam ponds were designed and constructed, there was no central authority to verify the designs before construction. Today, despite the absence of data on the methods used in the design of the ponds, it is necessary to point out just why the pond systems failed. To begin



*A burst sewage pipe near a WSP encourages mosquito breeding.*

**Table 1. Pond locations and specifics**

<i>Pond</i>	<i>Population designed to serve</i>	<i>Net pond area (hectares)</i>	<i>Pond system</i>	<i>Areas served</i>
Airport/Airwing	Not available	0.8	F <sub>1</sub> M (2 units)	DSM airport Airwing staff houses
Buguruni	13,000	3.2	F <sub>1</sub> M (3 units)	Buguruni development area
Lugalo	20,000	5.2	F <sub>1</sub> M (7 units)	Military barracks
Mgulani	10,999	1.5	F <sub>1</sub> M (3 units)	Police, army and marine barracks
Msasani	19,500	3.7	F <sub>1</sub> C (4 units)	Mikocheni, Kijitonyama and Regent estate
Ubungo	Not available	Not available	F <sub>1</sub> M <sub>1</sub> ST (5 units)	Ubungo industrial area
Ukongu	Not available	Not available	F (1 unit)	Prison and officers training college
University	4,975	1.7	F <sub>1</sub> M (7 units)	University of Dar es Salaam
Vingunguti	Not available	4.5	F <sub>1</sub> M (4 units)	Industrial area

**KEY**

F = Facultative pond      C = Chlorination pond  
M = Maturation pond      ST = Settling tank

with, the engineering firms failed to carry out a thorough study of essential factors such as temperature, climate, infiltration, soil and other design factors. Most of the ponds were designed using Gloyna or McGarry and Pescod systems, and this uncritical approach to the methods, and their adaptation in Tanzania without consideration of environmental factors, was the cause of the total deterioration of the ponds. The assumptions made by the engineers had little relevance to Tanzania.

**Operation and maintenance**

A proper management and maintenance programme is essential if a pond system is to be operated efficiently. Maintenance work consists of good pond-keeping, making repairs to embankments, cutting down weeds and grass and periodic desludging. The operation and maintenance of facultative and maturation ponds was not carried out in Dar es Salaam, mainly because the responsibility for the sewerage system and ponds has been shifting

from the local city council to the regional government and back for the past 20 years. It is worth highlighting the following points:

- When the Dar es Salaam city council resumed responsibility in July 1978 there were major operational problems both in the sewerage and the pond systems. It was impossible to maintain the ponds as many of the components were broken and would require major rehabilitation before they could resume operating.
- The people and industries served by the sewerage and pond systems are supposed to pay a certain sum of money for their services. However, nothing had been collected for many years, due to the shifting responsibility, and, as a result, no finance was available to run and maintain the systems. For industries who helped maintain the WSPs, their industrial waste was indiscriminately dumped into the WSPs, totally ignoring their chemical and toxic properties.
- There is a shortage of local professionals in the city and town councils — such as public health engineers — who could approve



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*A partially overgrown malfunctioning waste stabilization pond.*

the designs prepared by the overseas consultants.

There is a great deal of literature on the design of ponds and the removal of organic matter and pathogenic organisms, but no manuals giving guidelines on the operation and maintenance of pond systems are available in Tanzania. Generally, WSPs are able to continue in operation, making effluent fairly good quality even when maintenance is poor. Over time, however, they become overloaded with weeds and grass and deteriorate due to the lack of maintenance.

The total deterioration of the pond and sewerage systems in Dar es Salaam was due, in part, to the absence of a single authority to oversee efficient operation and maintenance systems. The formation of the Dar es Salaam Sewerage and Sanitation Department (DSSD) in 1984 to manage the design, maintenance, operation and control of the systems was an important corrective step. This department is now responsible for the operation and maintenance of the Msasani and Mgulani ponds in Dar es Salaam, and it has already started work on them. A number of problems, however have already become apparent, including a shortage of technicians, equipment, transport and funds.

### Location of ponds

Availability of land is certainly a controlling factor, and sites should not be located near where people live on sandy soil or at lower elevations. Zoning or distance restrictions required for wastewater disposal are also important. From a

practical point of view, a minimum distance of 500m from housing areas has proved satisfactory; if anaerobic ponds are incorporated, a minimum distance of one kilometre is recommended.<sup>2</sup>

The siting of ponds in Dar es Salaam was somewhat haphazard. The WSPs of Mgulani, Msasani, Buguruni and Ubungo are located at 10m, 15m, 20m and 5m respectively from the nearest houses. All these ponds are breeding places for mosquitoes; they produce foul smells and attract flies. The direction of prevailing winds (during the day and at night-time) was another factor not given proper consideration.

### Assessment of the technology

Compared to conventional treatment methods, pond systems do not need sophisticated technologies and energy requirements for operation. However, as one authority warns 'despite their apparent simplicity they do represent a complexity of interactions between biological, physical, chemical and environmental factors'.<sup>8</sup> The myth that ponds are an appropriate technology for the treatment of wastewater in developing countries is dangerous. The question is, in what conditions are they appropriate? Appropriate technology is not just hardware; it is composed of technique, know-how and management. Ponds might seem to be appropriate but know-how and management factors must also be considered.

From much of the literature on ponds, more misconceptions have developed that they are easy to design, operate and maintain, and that they are appropriate. As the same expert notes, 'ponds are not appropriate if there is not sufficient land available. They are not appropriate if an effluent free of algal burden is required. They may not be appropriate if a moderate level of technical competence is not available'.<sup>8</sup>

In Dar es Salaam, the pond systems have not been a success story. All the designs and approaches were oriented towards foreign consultant engineering firms. Lack of know-how, management and funds in many urban areas of Tanzania have been one of the major causes of the

operation and maintenance problems. With regard to the design method and construction, Tanzania's technological infrastructure is not yet equipped to modify or rectify a technology, whether it is called appropriate or capital intensive.

The Dar es Salaam experience has shown that waste stabilization ponds will totally deteriorate if there are inadequate funds, management and technical competence to operate and maintain them. Even after the rehabilitation of some of the ponds, the newly established Department of Sewerage and Sanitation is facing problems: the familiar shortage of technicians, transport, equipment and funds.



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