# When the Pits are Full – Selected Issues in Faecal Sludge (FS) Management

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## Quantitative Aspects

*To date, FS produced in most cities of developing countries remains largely unaccounted for.*

Much of the faecal sludge produced, collected and disposed of in urban centres remains as yet unaccounted for. Most inhabitants of cities like Jakarta, Manila, Bangkok, Accra and many others use on-site excreta disposal facilities. Yet, officially reported collection volumes remain far below the anticipated values.

In Manila and Bangkok, e.g. 60 - 65 % of the population are served by septic tanks. City authorities will have to deal with the haulage and treatment of 3 – 5,000 m$^3$ of septage per day[1] (= 500 - 800 vacuum tanker loads) once their FS collection and haulage services are upgraded to collect all the sludges produced (Veroy, Arellano and Sahagun 1994; Stoll 1995).

In large cities of Latin America, generally more than 50 % of the houses are connected to sewerage systems. In medium sized and smaller towns, however, most houses are served by on-site sanitation systems, notably septic tanks from which faecal sludges need to be collected and properly handled.

## Centralised vs. Semi-centralised Treatment

*Long distance haulage of FS is not sustainable. FS should be pre-treated in semi-centralised treatment plants.*

The haulage of relatively small faecal sludge volumes (5 - 10 m$^3$ per truck) through congested roads over long distances in large urban agglomerations is neither an economically nor ecologically sustainable solution. New excreta collection, transport and treatment concepts will, therefore, have to be developed in conjunction with sanitation systems selected or adapted to suit the varying socio-economic conditions of the urban population.

*Sludge dewatering from 98 % to 75 % water content will result in a 12 times volume reduction.*

It is, thereby, of key importance to minimise overall FS haulage volumes and mileage, while guaranteeing safe sludge treatment and disposal. Planning and installing small to medium sized semi-centralised FS treatment plants could contribute to attaining this goal. A semi-centralised treatment system may consist in faecal sludge dewatering and subsequent treatment and discharge (or reuse) of the separated liquid. Assuming that the dewatering process (e.g. by sludge drying beds) yields a reduction from 98 % to 75 % of the water content (equivalent to an increase in solids content from 2 % to 25 %), the transported dewatered sludge volume would be 12 times smaller than the raw FS volume[2]. In contrast to wastewater treatment, FS treatment is not dependent on the available topography.

Use of neighbourhood or condominial septic tanks could be an appropriate sanitation concept for many densely populated urban districts. Accessibility of septic tanks or latrines for emptying vehicles could be improved by locating the tanks at easily accessible sites. Conveyance of the septic tank effluents to wastewater treatment plants via solids-free and, hence, relatively low-cost sewers, would reduce the widely practiced and uncontrolled discharge of septic tank effluents into open drains and ditches. It would also reduce the risk of shallow groundwater pollution, which could result from the infiltration of

[1] Based on an average septage collection rate of 1 litre/cap • day.
[2] The reduction in sludge volume is inversely proportional to the increase in solids content.

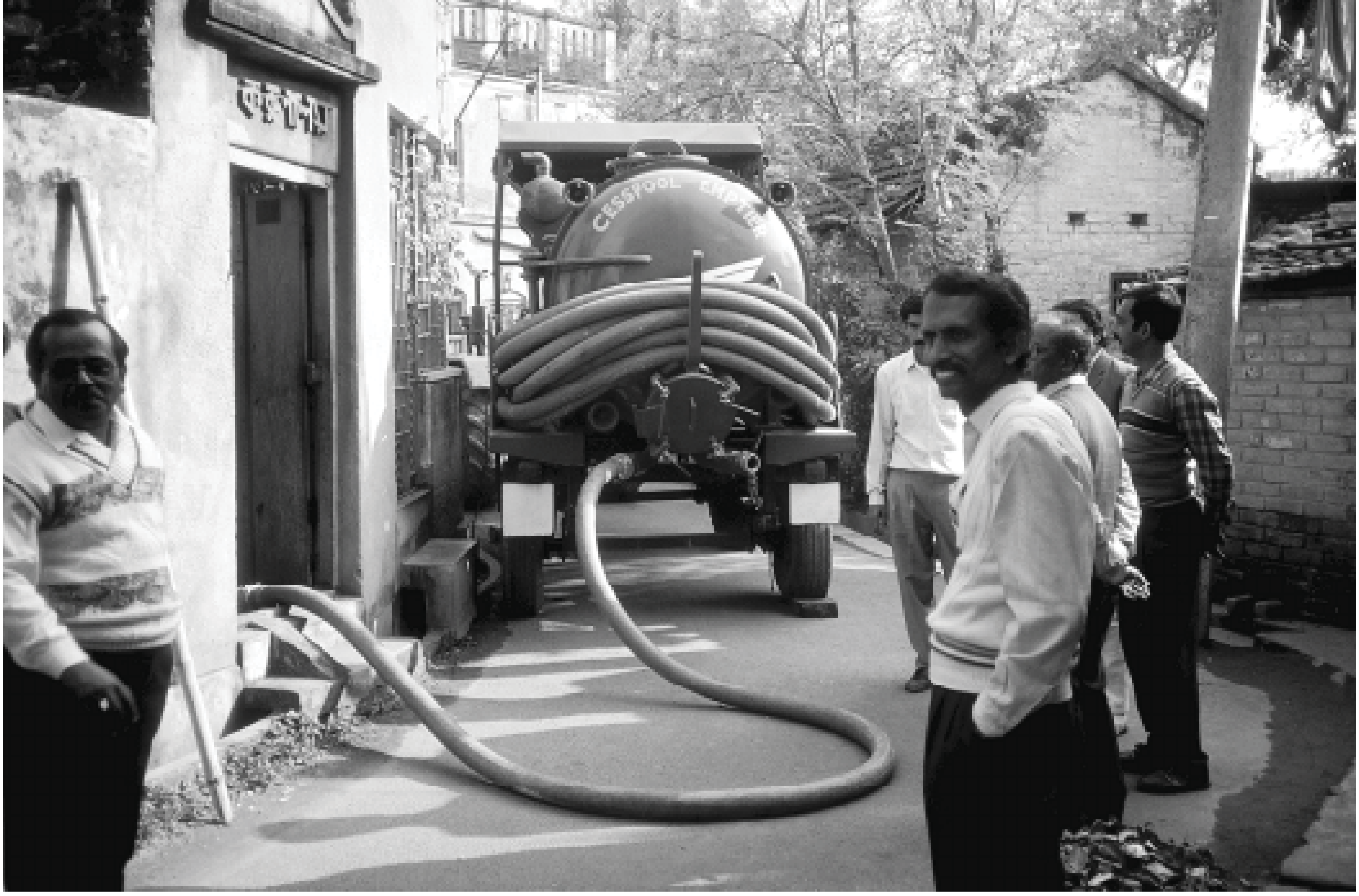

**Fig. 1 Septage collection with a 2-m³ cesspool emptier in a side lane in Bharakpur, West Bengal, India. Hauling small volumes of FS over long distances in metropolitan areas is uneconomical. Sustainable strategies involving semi-centralised treatment must, therefore, be developed**

septic tank effluents. A reduction of the transported FS volumes could be attained by installing septage dewatering/drying beds (planted beds, foremost) near condominial septic tanks or at semi-centralised treatment sites as described above. The drained liquid may be discharged into the solids-free sewer.

## Effluent Quality Standards

*The effluent standards are too stringent and not enforced in many developing countries.*

The majority of economically less developed countries have issued effluent discharge standards for wastewater treatment (WWT). Apparently, the enacting of separate standards for FS treatment has not been considered in most of these countries to date. WWT standards are usually applied instead. Given the unfavourable economic conditions prevailing in most of these countries, the established standards are often too high to be met. Effluent standards are frequently not controlled or enforced.

Examples of faecal sludge treatment standards are known from China and Ghana. In the Province of Santa Fé, Argentina, current WWT plant effluent standards also apply to FS treatment. A helminth egg standard has been established for sludges used in agriculture (Ingallinella 1998).

In industrialised countries, the tightening of environmental protection legislation has occurred gradually. It ran parallel with the economic and institutional growth in these countries. This allowed a stepwise upgrade of the wastewater and sludge treatment technologies to control an increasing number of contaminants and to reduce the overall pollution loads (Johnstone and Horan 1996). A suitable strategy for less industrialised countries may also comprise the selection of a phased approach pertaining to stringency of standards and choice of components (pollution indicators), including certain types of waste to be targeted for. Regarding faecal sludges, emphasis should be placed in a first phase on the removal of organic contaminants to reduce surface and groundwater pollution.

*Effluent standards for FS treatment plants should focus in a first phase on organic contaminants and helminth eggs.*

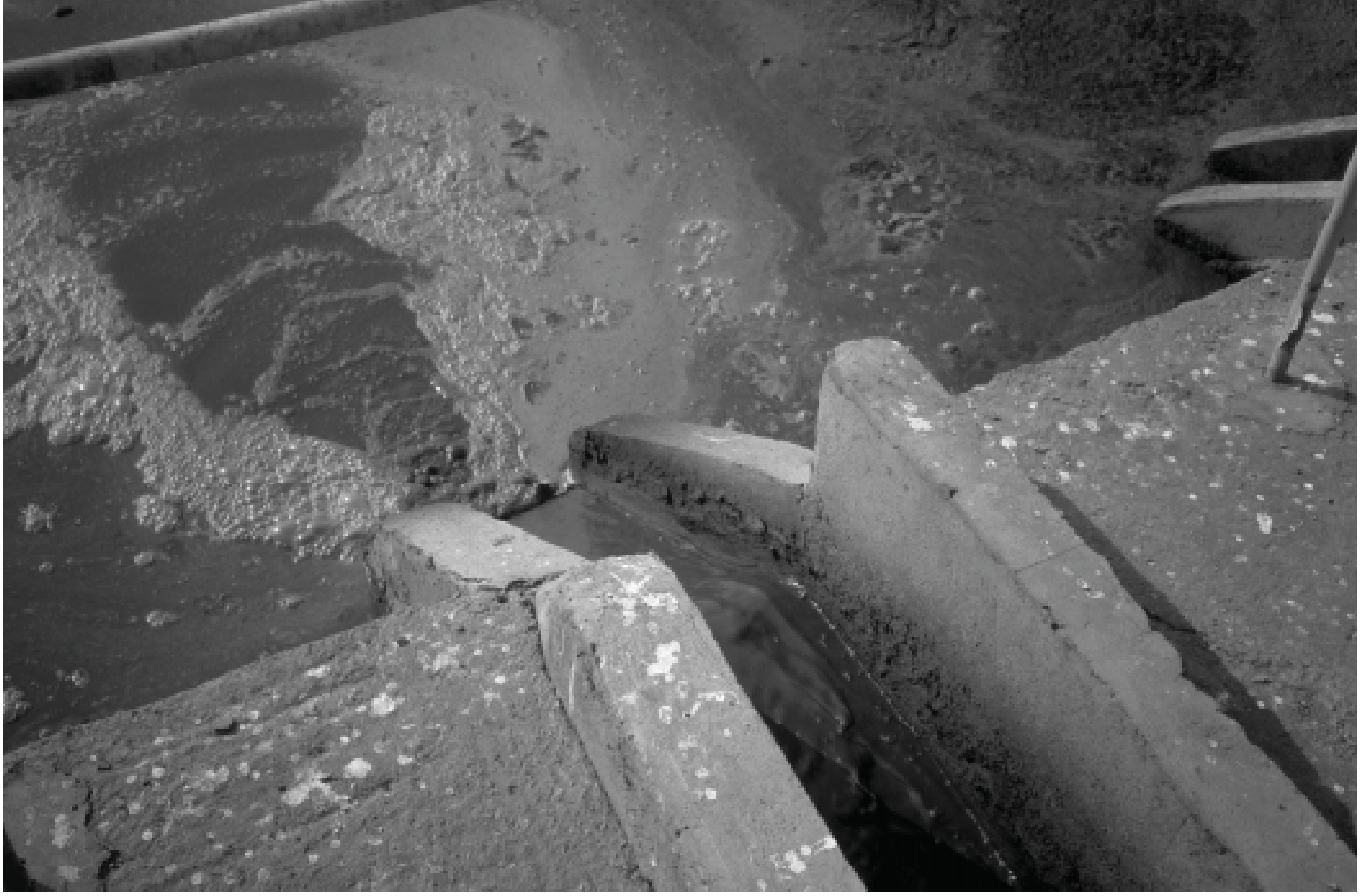

**Fig. 2 Supernatant from a FS settling tank overflowing into an anaerobic pond at the Achimota FSTP in Accra, Ghana. What standards should be established and how many ponds in series are required to meet these standards?**

Furthermore, removal and inactivation of excreted pathogens is important as it will lower public health risks in densely populated urban areas, and enable the safe use of treated effluents and biosolids in agriculture.

The following aspects should be taken into consideration when stipulating FS treatment plant (FSTP) effluent and plant sludge quality guidelines:

- Discharge vs. reuse. When stipulating quality levels for plant effluent and biosolids, a distinction should be made between their discharge into the aquatic or terrestrial environment, and their reuse in agriculture or aquaculture, respectively. Variables like COD or BOD and $NH_4$ are of prime importance for FS discharge. Hygienic characteristics (helminth eggs and faecal coliforms) and nitrogen are the relevant criteria in reuse practice.

- Total vs. filtered BOD (COD) effluent standards. Where ponds are used to treat faecal sludges or co-treat FS and wastewater, effluent standards for BOD or COD should be stipulated for filtered rather than for unfiltered samples. This is necessary since algal cells produce about 70 % of the BOD in the effluent of well-functioning ponds. Algal BOD has a different potential impact on the receiving waters than BOD of untreated wastewater or FS. Algae produce oxygen during daylight hours and are likely to be consumed by the zooplankton before they exert their BOD in the receiving water (Mara 1997).

Table 1 contains a set of effluent and plant sludge quality guidelines. The suggested values are based on the considerations outlined above.

**Tab. 1 Suggested Effluent and Plant Sludge Quality Guidelines for the Treatment of Faecal Sludges (Heinss, Larmie, Strauss 1998)**

| | **COD** [mg/l] | **BOD** [mg/l] | **Helm. eggs** [No./l] | **Faecal colif.** [No./100 ml] |
|---|---|---|---|---|
| **A: Liquid effluent** | | | | |
| *Treatment for discharge into receiving waters:* | | | | |
| • Seasonal stream or estuary | | | | |
| - unfiltered | 300-600 | 100-200 | 2-5 | $10^4$ |
| - filtered | 100-150 | 30-50 | | |
| *Treatment for reuse* [a]*:* | | | | |
| • Unrestricted irrigation [b] | n.c. | n.c. | 1 | $10^3$ |
| • Restricted irrigation [c] | n.c. | n.c. | 1 | $10^5$ |
| **B: Treated plant sludge** | | | | |
| • Use in agriculture | n.c. | n.c. | 3-8/g TS [d] | Safe level if egg standard is met |

n.c. - not critical
[a] Irrigation rates and effluent quality standards must be established so as not to exceed the crops' nitrogen requirements (100 ... 200 kg N/ha · year depending on the crop).
[b] Irrigation of crops likely to be eaten uncooked, sports fields, public parks (WHO 1989)
[c] Irrigation of cereal crops, industrial crops, fodder crops, pasture, and trees (WHO 1989)
[d] Based on the nematode egg load per surface unit area derived from the WHO guideline for wastewater irrigation (WHO 1989), and on a manuring rate of 2-3 tons of dry matter/ha · year (Xanthoulis and Strauss 1991)

## References


Heinss, U., Larmie, S.A., Strauss, M. (1998). *Solids Separation and Pond Systems for the Treatment of Septage and Public Toilet Sludges in Tropical Climate - Lessons Learnt and Recommendations for Preliminary Design*. EAWAG/SANDEC Report No. 05/98.

Ingallinella, A.M. (1998). Personal communication.

Johnstone, D.W.M., Horan, N.J. (1996). Institutional Developments, Standards and River Quality: A UK History and Some Lessons for Industrialising Countries. *Water Science and Technology*, **33**, No. 3, pp. 211-222.

Mara, D.D. (1997). *Design Manual for Waste Stabilization Ponds in India*. Lagoon Technology International, Leeds, U.K.

Stoll, U. (1995). Master Plan on Treatment and Disposal of Sewage and Nightsoil Sludges, Including Oil and Grease Residues for Bangkok Metropolitan. In: *Proceedings, Workshop on Management of Sewage and Nightsoil Sludges: Treatment, Reuse and Disposal*. Bangkok, 18-19 October.

Veroy, L. S., Arellano, F.L., Sahagun, V.A. (1994). Septage Management Plan for Metro Manila. In: *Asia Pacific Regional Water Supply Conference Exhibition*. Manila, 6-10 November.

WHO (1989). *Health Guidelines for the Use of Wastewater in Agriculture and Aquaculture*. Technical Report Series 778.

Xanthoulis, D. and Strauss, M. (1991). *Reuse of Wastewater in Agriculture at Ouarzazate, Morocco* (Project UNDP/FAO/WHO MOR 86/018). Unpublished mission reports.