SOS - Management of Sludges from On-Site Sanitation

Faecal Sludge (FS) Treatment - Highlights

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Current Field Research Programme and Outlook

Our SOS field research is currently focusing on the following three major treatment options involving three selected partner institutions:

Option/Process	Partner
Solids-liquid separation:	
- Settling-thickening	- WRI
- Sludge drying beds	- WRI
- Planted sludge drying beds (sludge humification; constructed wetlands)	- AIT
Pond treatment:	
- Anaerobic ponds	- WRI
- Attached-growth facultative ponds	- AIT
Soil reclamation:	
- Restoration of soils damaged by volcanic eruptions	- UP/ NEC

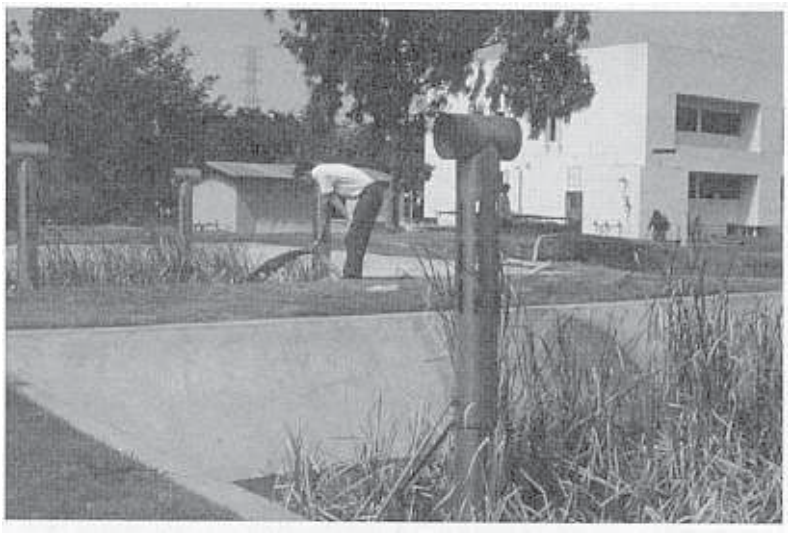
The main features and preliminary results of the current field research on planted and unplanted sludge drying beds, as well as on soil reclamation are highlighted in the sections below.

Within the next six month to one year, our FS-related field research will centre primarily on planted sludge drying beds, attached-growth facultative ponds and on anaerobic ponds. The activities might be expanded to comprise anaerobic digestion of fresh, high-strength sludges. These proved to not be inducive to solids-liquid separation or pond treatment.

The soil reclamation studies in the Philippines, which are planned to be continued as scaled-up pilot/field tests, will form part of an urban sanitation project co-financed by the Asian Development Bank. The recultivation experiments shall be complemented by a technical-economic feasibility study on options of FS management.

Results from Selected Field Research Projects

Planted Sludge Drying Beds ("Sludge Humification")



Picture 1

A 2-month old AIT pilot sludge drying bed planted with cattail and loaded with Bangkok septage. Ventilation pipes ensure natural aeration of the root zone and prevent anaerobic conditions and root damange.

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The field tests with planted sludge drying beds aim at determining process feasibility for faecal sludge treatment, optimum loading limits to attaining satisfactory/desired sludge dryness and percolating water quality, optimum bed configuration, advantages over conventional, unplanted sludge drying beds, and obtaining sufficient performance data to develop process design guidelines.

Bench-scale drying beds planted with cattail and loaded with septage were used to generate data which subsequently allowed selection of appropriate FS loading rates for the pilot cattail beds. Starting end of April 1997, three pilot-scale sludge drying beds, each 5 x 5 m, were planted with cattail (*Typha*) and loaded with Bangkok septage (avg. TS = 14,000 mg/l) at 3 - 7 day intervals. The three beds are intermittantly loaded at rates equivalent to 80, 125 and 250 kg TS/m^2·year, respectively. Owing to their short operating period, no conclusions can yet be drawn on the long-term feasibility and performance of the planted drying beds. Significant COD (95 - 99 %), NH_4 (80 - 99 %) and phosphorus (75 %) removal was observed in the percolating liquid during the first few weeks of operation. This effect was probably linked to mechanical filtration, mainly. It is assumed that the microbial biomass responsible for degradation was still comparatively small due to the relative shallowness of the overall filter bed at start-up (depths of accumulated sludge = 1 - 5 cm, depending on loading rates). Loading rates appear to have played only a minor role on the quality of the drained liquid. Compared to the unaerated conventional sludge drying beds (see below under "Unplanted sludge drying beds"), natural ventilation appears to significantly enhance nitrification and stripping of ammonia. Average oxygen concentration in the drained liquid amounted to 3.3 mg 0_2/l, and substantial levels of nitrate were observed.

The solids content of the drying sludge ranged between 40 and 60 %TS. The database is not yet large enough to determine the effect of bed loading rate on solids content.

The first tests were performed during the dry season on a still insufficiently deep sludge media to retain enough moisture for plant growth (sludge depths amounted to 1 and 5 cm in the beds loaded with 80 and 250 kg TS/m^2·year, respectively). This led to retarded cattail growth. Measures for restricted ponding of the drained liquid are being developed to prevent water shortage during the early phases of plant growth.

Unplanted ("Conventional") Sludge Drying Beds

Picture 2

Four 4 x 4 m drying beds installed and operated on the premises of WRI in Accra, Ghana. Three beds are equipped with conventional sand and gravel media, and one bed contains a fleece developed especially for sludge dewatering by an Austrian manufacturer.

The tests performed at WRI, Accra, aim at determining feasibility of conventional sludge drying beds for treating various types of FS (see News No. 2 for FS classification), and at fomulating appropriate design criteria and guidelines.

18 sludge drying tests have been conducted to date with public toilet sludge - septage mixtures, unmixed public toilet sludge, and primary pond sludge. The monitoring periods lasted from 5 to 14 days. The sand media was damaged during sludge loading activities in one of the test runs. This indicates the need to protect the filter media and to exert care when hosing the sludge onto the drying beds.

In contrast to the conclusions drawn after the first three test runs, the high-strength and largely undigested public toilet sludges appear to exhibit a rather erratic dewaterability. This can probably be attributed to the fact that such sludges hardly lend themselves to solids-liquid separation and drying

on conventional sludge drying beds. Septage, septage/public toilet sludge mixtures and primary pond sludge, however, exhibit a rather reliable dewaterability, with sludge solids contents amounting to 70 - 80 % for public toilet sludge/septage mixtures within 8 days at nominal solids loading rates of 130 kg TS/m^2·yr, and to approx. 30 % TS for primary pond sludges within 8 days at 200 kg TS/m^2·yr.

50 - 80 % of the total FS volume applied to the drying beds drained as percolating water. Contaminant removal in the percolating water (compared to the raw sludge) amounted to ≥ 95 % for susp. solids, 70 - 90 % for COD, 100 % for helminth eggs, and 40 - 60 % for NH_4. COD and NH_4 removal tends to be lower than in planted drying beds (see above). This may be attributed to the fact that since unplanted beds are not equipped with a natural aeration system, anaerobic conditions are likely to develop in the lower sections of the beds. The degree of oxidation and nitrification of carbonaceous compounds is, therefore, most probably lower than in the aerated cattail beds tested in Bangkok.

Considerable levels of helminth eggs at solids (TS) concentrations ≤ 70 % were still observed in drying sludges. This is not surprising as the maximum drying periods lasted only 12 days. Either TS concentrations of >> 90 % or sludge storage periods of several months are required to achieve total or near total egg die-off.

Soil Reclamation

The Lahar reclamation investigations conducted by UP/NEC in Manila aim at determining the cultivation potential and mechanical properties of septage-amended "soil" (see Picture 3 for the definition of Lahar). The investigations will also contribute to gaining experience on the basic use of septage for reclaiming or amending soils which may have been damaged in different ways than through Lahar flooding.

The experiments were conducted on 33 plots of 1 x 1 x 0.6 m each. The bottom of the plots was filled with a layer of 25 cm Lahar onto which 35 cm of varying mixtures of Lahar and soil were added. 25 plots were subsequently loaded with septage. A predetermined number of plots was then planted with Talahib grass (*Saccharum spontaneum L*), a pioneer plant, and Petsai (*Brassicaoleracea*), a locally used leafy vegetable. Allowance was made for varying septage loads (40 and 80 l/m^2, respectively); application methods; i.e., mixing or mulching (surface spreading); and for natural or artificial watering methods. The results obtained to date indicate that the cultivation potential appears to be significantly enhanced by septage amendment in contrast to non-amended Lahar (De Sales et al. 1997). This is true for both the pioneer and the edible crop.

Restoration of Soils Damaged by Volcanic Eruptions

Picture 3
Lahar, the sand-like, infertile volcanic material originating from the Pinatubo volcano eruption in 1991, now covers the flood plains downstream.

Picture 4
Experimental plot planted with Talahib grass, a pioneer plant, on a Lahar/soil mixture amended with septage.

Dissemination of Information

Project Seminars

R+D work is part of our mandate and focuses on existing and foreseeable future problems. The main objectives of SANDEC's applied research comprise the development of technical and managerial solutions with a high degree of sustainability under the varying conditions prevailing in developing countries. Organisation of national or regional seminars with the major problem holders and solvers (government and non-governmental agencies, consulting engineers, external support agencies, applied researchers) are believed to offer an effective way of disseminating the results of applied field research. They allow for critical discussions of recommendations and results of the field research, and also raise awareness of the applied researcher to the most pressing and challenging problems, including the most appropriate future R+D efforts. Furthermore, such events may provide a platform for decision-makers and planners to discuss strategic, economic and institutional issues.

A national/regional seminar, jointly organised by WRI, local consultants and SANDEC, will be held in Accra, Ghana, in late 1997. Its aim is to present results, conclusions and recommendations of the WRI/SANDEC field research on FS settling/thickening, drying and pond treatment. It will also provide a forum for engineers, planners and decision-makers for discussions on FS management problems in Ghana. The seminar coincides with the planning of sanitation upgrading schemes for Ghana's major cities, which will be co-financed by the World Bank.

Similar events shall be organised and implemented jointly with some of our other field research partners.

Publications

SANDEC News No. 2 announced the publication of several reports on selected faecal sludge treatment options. A timely publication of the reports was, however, not possible for several reasons. The document entitled "Anaerobic and Facultative Ponds for Treatment of Septage and Public Toilet Sludges in Tropical Climates" has been externally reviewed by a number of experts. Comments from the reviewers shall be incorporated in the final document. The various reports will be made available in the near future.

Contacts

If you wish to obtain further information on SANDEC's faecal sludge treatment activities, advice on a pressing FS problem, or to discuss possibilities of field research collaboration, please contact:

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Forthcoming