# Pour-flush toilets and waste stabilization ponds in a refugee camp

## by Leo Glensvig and Dorte Glensvig

**This issue of *Waterlines* examines some ways of dealing with solid waste — from latrine improvement to waste stabilization ponds. This article looks at the waste disposal problems of a refugee camp in Thailand which sometimes has as many as 26,000 inhabitants. Its solution has been to use communal toilets and waste stabilization ponds.**

PHANAT NIKHOM Refugee Camp is located roughly 110 kilometres south-east of Bangkok and covers an area of 51 hectares. It was established in July 1980 as a processing centre for the Indo-Chinese refugees — Vietnamese, Kampuchean and Laotians — who were transferred from other refugee camps in Thailand to Phanat Nikhom for interview and then for eventual resettlement in a third country.

The population in Phanat Nikhom Camp, which between 1981 and 1982 had risen above 20,000, had by the end of 1985 fallen to 8,400. In April 1986, the Royal Thai Government closed two other camps in Thailand and transferred the refugees to Phanat Nikhom. Since March 1988, the population has decreased to approximately 19,500 people.

There are 1,444 semi-permanent buildings in Phanat Nikhom Camp used for the accommodation of refugees and they are arranged in quadrangles (quads). Each building has an area of 40 square metres and an optimum capacity of up to two families, or 12 people.

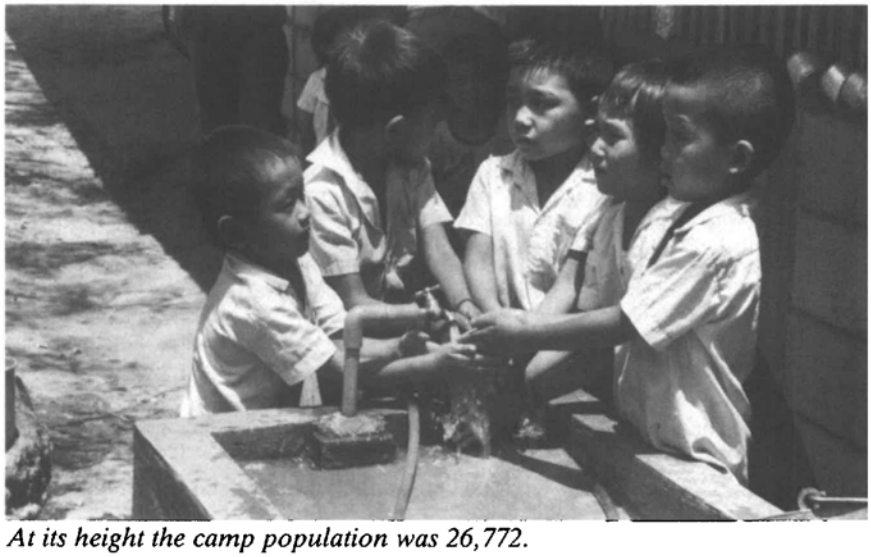
The overall process of collecting and disposing of human wastes carried out by a sanitation system can be broken down to six stages or elements: deposition, collection, transportation, treatment, disposal and re-use.[3]

### Sanitation system

The different elements of a complete sanitation system can be combined in various ways depending on the local conditions, such as cultural and social factors, soil conditions, financial costs, and the operation and maintenance of the system.

In Phanat Nikhom Camp the elements of the sanitation system are combined in the following way:

- Deposition takes place in a prefabricated concrete pour-flush squatting pan with trap or water seal. The pan is concreted into a slab covering the underlaying tank. The excreta is flushed into the tank by pouring a small volume of water down it by hand.
- Collection takes place in a small tank with an outlet for the liquid leading to seepage pits. The tank is located directly underneath the point of defecation and allows the solid material to settle and form a sludge which is partially digested anaerobically at the bottom, while the liquid effluent flows out through the outlet pipe to the seepage pits.
- Transport to the treatment plant of the sludge accumulated in the tank and the liquid effluent stored in the seepage pits is performed regularly with vacuum trucks.
- Treatment of the human waste (comprising only faeces and urine plus small volumes of water used for pour-flushing) takes place in waste stabilization ponds.
- The treated and chlorinated liquid effluent from the ponds is disposed of into a ditch, while the sludge, removed from the ponds every seven or eight years, is disposed of on to a sludge-drying bed.
- Re-use only takes place with the effluent, which is used for irrigation, while the sludge is left unused at the sludge drying bed.



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*At its height the camp population was 26,772.*

### Design and construction of pour-flush toilets

Although experience with communal toilets or latrines has been unsatisfactory in most countries it is the only practical solution for sanitation in a refugee camp.

The main recommendations and standards for sanitation requirements in disasters are given by the World Health Organization, which recommends a minimum of one seat and one urinal for every 35 men, and one seat for every 25 women.

After constructing extra toilet buildings at the beginning of 1988, the total number of toilet buildings, with four seats and two urinals each, came to 317, while the total number of toilet buildings with one seat and two urinals came to 28, giving a total of 1,296 seats and 690 urinals in Phanat Nikhom Camp.

Once, when the total population in the camp was 26,772 people, the distribution between the two sexes was 57 per cent men (15,260 people) and 43 per cent women (11,512). Thus the actual number of persons per seat/urinal at the peak of the camp population was well within WHO guidelines.

The tank and the two seepage pits with covers are made of prefabricated concrete parts (rings and slabs) these are available in the local market. The squatting pans with water seals are also readily available in the local market, while the slab over the tank is locally manufactured. The tank is equipped with a ventilation pipe which ends above the roof of the superstructure.

The function of the tank is to receive, store and digest the excreta. The size of the tank depends on the number of people to be served. For privies serving larger groups of people a tank volume of 0.15m is recommended by one authority,[3] while another authority[4] states that experience dictates a design figure of 0.115m per person for the maximum number of people to be served.

On average each tank in the camp serves 80 people which will require a minimum tank volume of 80 x 0.115 = 9.2m$^3$. The actual tank volume is only 4.7m$^3$, or 51 per cent of the recommended minimum volume, which results in poor digestion of the faecal materials. In principle the tank acts as an intermediate storage tank for faecal materials before they are transported to the treatment plant.

The function of the two seepage pits is to receive the effluent from the tank and allow it to percolate away into the ground. The seepage pits have a total volume of 1.5m$^3$. The side walls of the pit are lined with concrete rings and the pit is closed with a tight cover. Percolation or seepage from the pits is very slow because the ground around them is impermeable. If the pits are not emptied regularly, the effluent will slowly accumulate and ultimately overflow.

The toilet buildings' superstructure consist of a wood skeleton with walls and roof of corrugated galvanized metal sheets. An open space between both the walls and the floor and the walls and the roof provides ventilation.

The cost for construction of a complete toilet building with four seats but no urinals was calculated during the construction of a number of new toilets in the first quarter of 1988. The work was actually carried out by unpaid voluntary refugee workers under the supervision of Thai staff. If this work had been carried out by paid Thai workers, then the labour costs could be calculated at 5,120 baht. The cost of materials was 8,350 baht, giving an overall cost of 13,470 baht (US$539) for a toilet building with four seats.

**Table 1. Pond dimensions**

| *Pond* | | *Anaerobic* | *Facultative* | *Oxidation* |
|---|---|---|---|---|
| Volume (m$^3$) | recommended | 178 | — | 3 x 270 |
| | actual | 180 | — | 1 x 900 |
| Depth (m) | recommended | 2 - 4 | 1.2 | 1 - 1.5 |
| | actual | 3 | 1.5 | 1 |
| Surface area (m$^2$) | recommended | — | 479 | — |
| | actual | — | 300 | — |
| Retention time (days) | recommended | — | — | 3 x 5 |
| | actual | — | — | 16.7 |

## Transport system

Phanat Nikhom Camp is located in an area where the soil has a very low permeability. The seepage pits therefore cannot function adequately, and most of the liquid effluent, as well as all the solid material, has to be transported to the treatment plant. This waste can be transported to the treatment plant either in a flow of water through the sewerage system or, as in Phanat Nikhom Camp, with the vacuum truck system. In order to empty the tanks and the seepage pits two Mitsubishi Fuzo vacuum trucks with a tank capacity of 9,000 litres are used. These trucks were purchased in 1980, and are still working. The 1989 initial cost for three locally assembled trucks (one held in reserve) was 3,150,000 baht.

For designing the pits and soakaway trenches for infiltration of sewage and sullage, one authority states that a typical load on a conventional pour-flush toilet used by five to 10 people would be 50 to 100 litres per day.[1] For designing waste stabilization ponds, each person may contribute one to two litres per day of nightsoil, not diluted with sullage.[1] The quantity of human waste produced per person per day mentioned by another authority is lower, and it is even suggested that for design purposes a total excreta production of 1kg/person/day should be used.[4]

Some possible reasons for the low volume of human waste could be:

- that approximately 25 per cent of the camp population are under the age of six, and that members of this group very seldom use the toilets;
- that a number of men urinate outside the toilets;
- that some infiltration takes place in the seepage pits which are not totally clogged with organic matter;
- that the quantity of water available to each refugee for flushing is limited.

## Waste stabilization ponds

Waste stabilization ponds are the most advantageous method of waste treatment in hot climates. They consist of a series of shallow lakes in which the sewage is treated through natural physical, chemical and biological processes without the necessity of machinery or energy (except sunlight).

The treatment plant for Phanat Nikhom Camp consists of one anaerobic pond with a concrete ramp for the dumping of waste, one facultative pond and one oxidation or maturation pond with chlorinator for the effluent. These ponds are located at a distance of 2.9km from the camp. Construction costs in 1988 prices came to 209,116 baht. Table 1 shows the actual dimensions of the pond system. The required standard of quality of the effluent discharged from the ponds will depend on the uses to which the effluent will be put. In Phanat Nikhom the effluent is discharged into a ditch and later used for irrigation of rice fields.

The treatment plant has not been in a position to reduce BODs (biochemical oxygen demand)

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*The construction cost per head of the camp sanitation system is $15.45.*

satisfactorily for discharge into a river when the camp population was at a maximum. The facultative pond should be able to reduce the BODs from 400 to 700mg per litre to 50 to 100mg/1, if correctly designed.[2] The facultative pond is only in a position to reduce BODs from 351mg/1 to 266mg/1, which is due to the fact that the surface area is smaller than recommended. Too small a surface area leads to inadequate photosynthesis and the biochemical oxygen demand will outrun the oxygen supply, causing the pond to turn anaerobic.

## Operation and maintenance

Operation and maintenance of the sanitation system in Phanat Nikhom Camp is the responsibility of COERR (Catholic Office for Emergency Relief and Refugees).

### Coming in the October issue

The next issue of *Waterlines* will take the theme of handpumps. The editorial lead piece will be written by Dr Peter Morgan of the Blair Research Institute in Zimbabwe.

Topics to be included will be: how to choose a pump; how to ensure a successful pump programme; pump repair and maintenance; and new pump developments.

COERR is a Thai voluntary agency (partly funded by UNHCR), which uses drafted as well as voluntary refugee workers for the operation and maintenance. Their work encompasses the following activities:

- Daily disinfection of all toilets by hand-spraying with 'Lysol'.
- Replacement of broken squatting pans. Repair and maintenance of toilet tanks and superstructure.
- Operation of vacuum trucks, emptying of sewage pits every two to three days after request by the quad leaders to COERR and, more importantly, desludging the tanks every four to seven months.
- Maintaining pond banks, controlling vegetation growth, operating chlorinator and desludging of the ponds every three to five years.

The total itemized construction cost (in 1988 prices) for the sanitation system looks like this:

| | |
|---|---|
| 324 Toilet buildings | 4,364,280 baht |
| 3 Vacuum trucks | 3,150,000 baht |
| Waste stabilization ponds | 209,116 baht |
| Total construction cost | 7,723,396 baht |

With an average population of 20,000 people in the camp the per capita construction cost comes to 386 baht or $15.45.

After having seen how well the sanitation system in Phanat Nikhom Camp functions, and with low operation costs, it is difficult to understand the criticism of aqua privies.

## Refugee activities

The United Nations High Commission for Refugees (UNHCR) is, according to its mandate, a non-implementing agency. It must use the host government or a voluntary agency as the implementing partner. UNHCR's role is therefore limited to monitoring the implementation of the different projects and programmes funded by UNHCR.

One of the biggest problems for UNHCR is to obtain sufficient land from the host country on which to settle refugees. Naturally, the host country cannot allow the refugees to settle on productive farmland, so in most refugee operations UNHCR has to accept land which cannot be used for anything else. Not surprisingly, soil conditions are poor, and water resources are scarce on land used for camps.

Phanat Nikhom Camp is not a low-density area in terms of population. Normally the density is around 400 people per hectare, but at the peak of the refugee influx it was 525 people/ha.

In Phanat Nikhom Camp the soil is not suitable for on-site disposal and moreover there is insufficient space for adequate drain-fields due to the high population density. From the very beginning it has been obvious that the seepage pits would not be able to function adequately and that most of the sewage would have to be transported to the waste stabilization ponds by vacuum trucks.

From an overall point of view the sanitation system adopted in Phanat Nikhom Camp has been shown to be socially acceptable to the Indo-Chinese refugees. It has shown itself to be technically, economically and environmentally appropriate. After all it has served more than half a million refugees, who have since been processed for resettlement in third countries, during the eight and a half years the camp has been in operation.

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