Sewerage and sewage treatement

Sewerage is the removal of excreta, flushing water from toilets and household sullage through a pipe or sewer network to a treatment works or disposal point, as shown in Figure 1. When this is operated correctly and the waste is treated, sewerage is an effective method of excreta disposal. In many areas of the world, however, sewage is allowed to flow directly into rivers untreated, representing a major public health risk.

Sewerage is a high cost technology and requires water for flushing. It is probably best employed in urban situations or where sufficient finance is available for its proper operation and maintenance. Lower cost sewerage technologies, such as small-bore and shallow sewerage, do however exist. These provide the benefits of water-borne excreta disposal but offer greater potential for community management, as well as having a lower water requirement and thus lower costs.

Sewage should always be treated prior to discharge into any surface water body or disposal onto land. After treatment, sewage can be used for agriculture and aquaculture.

The advantages of sewerage are that it can remove large amounts of wastewater and it provides great user convenience. The main disadvantages are the high capital and operating costs, and the fact that the effluent still contains large numbers of germs. Sewage can be treated in lagoons, and this is generally an appropriate method. The reuse of treated wastewater is covered in Fact Sheet 3.13.

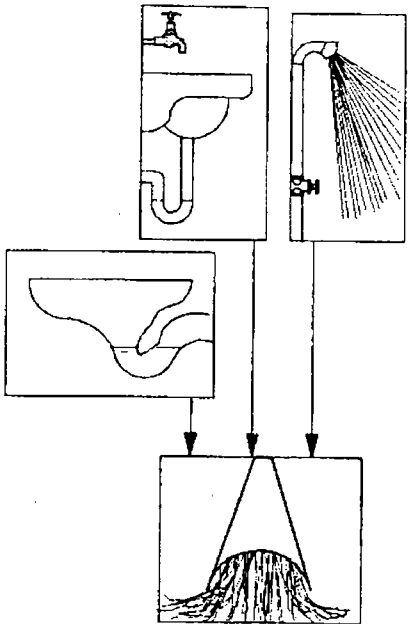

Figure 1. Disposal of excreta by sewerage

Modified sewerage

There are two types of modified sewerage - shallow sewerage and small-bore sewerage - which work on similar principles to conventional sewerage.

Shallow sewers are laid at shallower depths and gradients than conventional sewers, and are generally of smaller diameter. Unlike conventional sewerage which aims to keep solids in permanent suspension, shallow sewers allow solids to move down the pipe in a series of movements. Each time a blockage occurs, water pools behind the solids until the pressure is sufficient to re-suspend them and move them further down the sewer. Shallow sewers are easier to maintain and cheaper to build than conventional sewers, and the potential for community participation in management is much higher. Sewage from shallow sewers still require treatment, and the cost of this must be considered when installing shallow sewerage.

Small-bore sewers use only short lengths of large diameter sewers to take sewage to an interceptor tank close to the household or main discharge point of a block which collects the solids. Beyond the interceptor tank, only the effluent is carried in small diameter sewers. The interceptor tanks are generally small and require regular emptying, usually by vacuum suction pump. The interceptor tank should *never* be emptied by hand, as it will contain raw excreta and be a significant public health risk. The frequent emptying raises recurrent costs, but as the main sewer is of small diameter and laid at shallow depths and gradient, and the interceptor tanks are small, this greatly reduces the capital costs of sewer installation.

Conventional sewage treatment

Sewage can be treated in a conventional sewage treatment plant to remove the solid material in the sewage and also to make the liquid part of the sewage less harmful to humans and fish when it is passed into a river or the sea.

After treatment, the solid part of the sewage (the sewage sludge) can be used as a fertilizer for crops. The liquid part of the sewage (the sewage effluent) can be used for the irrigation of crops.

Conventional sewage treatment employs physical treatment, such as screening, sedimentation, filtration, aeration and drying ; and biological treatment using biofilters (for example, trickling filters and rotating biological contractors), activated sludge, oxidation ponds or lagoons, and aerobic and anaerobic digestion. The sewage sludge is usually treated using anaerobic digesters and thickeners, followed by drying beds.

The main drawback with using conventional sewage treatment is that the sewage effluent may still contain a very large number of pathogenic organisms after it has passed through the treatment plant.

Chlorination of sewage effluent before discharge to inactivate pathogens is not recommended, even if there is a serious epidemic in progress. It is expensive, rarely effective and furthermore may have a severe negative impact on health and environment.

The advantages of a conventional sewage treatment plant are :

- Can treat large amounts of sewage quickly.
- Uses a relatively small area of land.

The disadvantages of conventional sewage treatment include :

- The treatment plant is expensive to build and maintain.
- Sewage effluent may still contain large numbers of pathogens when it leaves the treatment plant.

Lagoons or oxidation ponds

Lagoons are often considered as the cheapest and most effective way of treating sewage. The sewage flows into a series of large ponds which allow the solid part of the sewage to settle out and to break down.

The liquid part of the sewage flows into ponds where air and sunlight kill many of the harmful germs in the sewage and make the liquid less dangerous to plants and fish.

A lagoon system has all or some of the following parts :

- Anaerobic pond - a deep pond where most of the solid part of the sewage settles out to the bottom. As oxygen cannot reach down into the pond, the sludge breaks down without it or anaerobically.
- Facultative pond - a shallower but bigger pond which lets the remaining solid part of the sewage settle out, and also allows air and sunlight to kill harmful germs and to make the liquid part of the sewage less dangerous to plants and fish.
- Maturation (final) ponds - usually two or three ponds in a line which allow oxygen and sunlight to kill more harmful germs and to make the liquid safe for passing into a river or for irrigation of crops. Often the maturation ponds are used to breed fish. The more maturation ponds that are used, the cleaner the effluent becomes.

Lagoon systems are usually built in pairs (or in parallel) so that the anaerobic and facultative ponds can be drained down and the sludge dug out every few years. The sludge may be used as a fertilizer or soil conditioner.

The main advantages of lagoons are as follows :

- Can be built and maintained with local materials and labour.
- Do not need expensive or imported equipment such as pumps.
- Can be used to breed fish.
- Sludge can be used as a soil conditioner and effluent can be used for irrigation (see Fact Sheet 3.13).

The disadvantages of lagoons are :

- Need large areas of land
- Need careful but not extensive maintenance, for example grass and plants have to be cut regularly from the edges of the lagoons to stop mosquitoes and snails breeding.