25th WEDC Conference Addis Ababa, Ethiopia, 1999

INTEGRATED DEVELOPMENT FOR WATER SUPPLY AND SANITATION

Environmentally-friendly hygienic dry sanitation technology

Malcolm Farley and Steve Kilbey, UK

THE DIFFICULTIES IN providing safe, hygienic, and disease free sanitation for the global population are widely acknowledged. Hazards from inadequate and poorly designed sanitation systems include damage to the environment, health risks to the population, disease epidemics and death. The Water Supply and Sanitation Collaborative Council (WSSCC) acknowledges sanitation as being undervalued and under-resourced on a global scale. The increased coverage of sanitation facilities, and the development of better appropriate technology for the disposal of human waste, is viewed by WSSCC as a priority issue.

This is reflected in the work being carried out by the World Health Organisation's Operation & Maintenance Working Group. This Group is mandated by the WSSCC to improve the effectiveness and efficiency of water supply and sanitation systems. The Group's aims are to promote the improvement of O&M and to raise the level of awareness of its benefits. Its scope of work includes raising the profile of O&M through presentations, conferences and workshops, and by promotional literature. The Group has been active in consolidating the available guidelines, manuals and training packages, and in developing and applying new ones. It also aims to encourage exchange of information within a network of key players, led by members of the Group, and to guide water sector practitioners in the practical application of the tools.

One of the main factors identified by the Group in preventing good O&M practice is poor design and inadequate management. One of the Group's tools is a manual for linking technology choice to O&M (ref. 1) including a review of sanitation technologies. The review includes a series of fact-sheets for each of a range of low-cost sanitation technologies. Each fact sheet assesses the strengths and weaknesses, and the O&M requirements, of the technology. For the latrine technologies the review distinguishes between systems which do not need water for functioning (dry systems) and those which do (wet systems). The latrine technologies include;

- basic improved traditional latrine
- ventilated improved pit latrine (VIP)
- double vault compost latrine
- bored hole latrine
- pour-flush latrine with leaching pit

The initial cost of each technology varies with the degree of sophistication. The VIP is the most expensive, with a cost range for a single pit VIP of US$ 70-400. The pour flush single pit latrine costs from US$ 30-100. However each design requires considerable O&M activity.

The double vault compost latrine needs to have vaults which are large enough to store faeces for at least a year, to ensure they become pathogen-free. While being more environmentally friendly than the non-composting latrines, the technology requires a full understanding of the anaerobic composting concept. This is frequently lacking and the contents often become wet and malodorous. Also, in the eagerness to use the contents as fertiliser, they are not always pathogen-free.

It is in the context of the WHO guidelines, and the need to pursue more environmentally-friendly, low-cost, low O&M sanitation facilities, that the authors are investigating the concept and the benefits of the relatively new technology of aerobic composting.

The argument against waterborne sanitation

Waterborne sanitation systems are the traditional technologies used in urban developments. However these are not sustainable in water-scarce situations. The annual volume of water (almost invariably potable water) needed to flush away the 550 litres of waste produced annually per person is 15000 litres. Water-scarce communities cannot afford such luxury. Even communities with sewerage systems frequently do not have a sewage treatment capacity, or one which only serves part of the city – the World Resources Institute claims that 95 per cent of sewage in the Third World is discharged untreated.

Environmentally and economically, there is a clear case in favour of composting latrines, if they can reduce pollution, reduce health risks, and still enable the user to perform his or her functions hygienically and with dignity.

The benefits of aerobic composting

The traditional sanitation methods like pit latrines, VIP latrines, anaerobic composting latrines, and pour-flush latrines, suffer from a multitude of problems, including odours, flies and other insects, risk of disease, and pollution of water sources.

Dry sanitation and composting technologies are increasingly viewed as alternative, environmentally-friendly technologies for reducing health risks in water-scarce communities. An individual produces approximately 500 litres of urine and 50 litres of faeces per year. 50 litres of faeces can be managed relatively easily, and, when dehydrated,

amounts to no more than a bucketful. The answer to managing waste efficiently is to eliminate the urine, either by separation to a second chamber or soakaway, or by evaporation. The latter is more environmentally friendly, as it reduces the risk of pollution of water supplies.

The South African experience

Like many developing countries South Africa faces an acute crisis in the provision of safe and hygienic sanitation services. The World Bank considers South Africa to be one of the world's 'water crisis' countries, in a near permanent state of drought. Because it is a water-scarce country with low financial resources, waterborne sewerage systems are not an option.

Until the beginning of the decade, the traditional alternative to waterborne sanitation in South Africa has been pit latrine, bucket toilet, chemical toilet or 'Aqua Privy'. While these are of simple design and relatively low cost, they have a number of limitations;

- obnoxious odours
- fly breeding
- risk of pit collapse (and children drowning in pits)
- health risks from exposure to untreated sewage
- contamination of underlying groundwater
- short life-span
- high operation and maintenance costs

Pit latrines require continual dosing with enzymes to aid the decomposition process and to try and eradicate odours. New pits have to be dug continually, which is difficult on crowded sites. On certain sites, e.g. rocky ground, in flood areas, above a groundwater source etc., pits cannot be dug at all. Such basic guidelines have, however, largely been ignored, and South Africa is witnessing the effects of inadequate sanitation and associated diseases. The South African Water Research Commission (WRC) notes that 46 per cent of groundwater resources are contaminated above the internationally acceptable level. Pit latrines and other sanitation systems which rely on seepage into the surrounding soil are a contributing factor. Surface water sources and living environments are contaminated by spillage from bucket toilets into streets and storm water drains, and by pit latrines which flood. Residents, especially children, are exposed to untreated sewage, and this has led to an increase in sanitation-related diseases like gastroenteritis, diarrhoea, typhoid and cholera. At least 650 South Africans, most of them children, die from diarrhoea every day. In KwaZulu Natal an epidemic of Shigella dysentriae occurred for the first time this century. 400 cases are being treated every month in Greater Durban hospitals, with an estimated 30 unreported cases for every patient treated. Warnings of possible cholera outbreaks have been made in Johannesburg following outbreaks in Maputo (Mozambique) and Mpumulanga. Typhoid occurs regularly in rural communities.

The aerobic composting latrine

Each of the problems of conventional sanitation technologies, and the accompanying risks to the population and the environment, has been addressed by a South African company, Enviro Options (Pty) Ltd. in the development of the Enviro-Loo aerobic composting dry sanitation system. The system has been developed with the care of the environment and the elimination of health risks in mind. The system is sealed - it cannot leak and storm water cannot enter. It operates without electricity, but a power source can be added to accelerate the process if required. This makes the unit different from other composting toilets on the market, which are mainly designed for developed countries, and which require a power supply for electric motors to turn the waste. Also, there is no need to dig a deep pit – particularly useful in hard ground and rocky areas. The system is a one-off installation which does not need to be continually moved.

Urine passes through a perforated plate into the collection chamber where it evaporates, assisted by air flow through the chamber. Faeces are 'flushed' by a mechanical paddle off the plate into the container, where they are dried and partially composted, utilising natural radiant heat, ventilation, bacteria, and prolonged retention. The result is a harmless, partially composted, odourless residue that is a fraction of the weight of the original volume. Laboratory analysis of samples of waste show that moisture content is from 12.5 – 16.0 per cent, and E.coli, Coliforms and Salmonella are absent in most cases. This means that the dried waste can be further composted with household waste to produce a soil fertiliser. O&M requirements are minimal, as the system requires only occasional bagging-up of material to finish the composting cycle.

The initial cost of the Enviro-Loo is around US$ 400, comparable with the VIP latrine. Two sizes are available, 10-15 uses per day for individual families, and 30-45 uses per day for communities. For larger communities, schools, and other institutions, multi-units can be installed. O&M requirements are minimal, and require only simple tools – a brush for toilet bowl cleaning, with either water or an enzyme toilet cleaner supplied by the company. Waste removal is also simple, requiring a shovel and rake, and a container for removal to a composting site.

Over 8000 units are being successfully used throughout Africa and other countries, including Australia, USA, Greece and Israel.

Conclusions

The Enviro-Loo appears to fill a much-needed gap in the commercial latrine market. It addresses the risks to health and the environment posed by other latrine systems. Its design and appearance is user friendly, preserving basic comfort and dignity for the user. Its O&M requirements are minimal and simple. In water-scarce communities the dry composting concept is an additional advantage. The benefits of the latrine, which have been demonstrated

throughout Africa, would apply equally to water-scarce countries and emergency situations throughout the developing world.

References

Linking Technology Choice with Operation and Maintenance for Low Cost Water Supply and Sanitation. World Health Organisation/IRC International Water and Sanitation Centre, 1997.

MALCOLM FARLEY, Principal Consultant, Malcolm Farley Associates.
STEVE KILBEY, Director, SK Consultancy International Ltd.
