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Ecological sanitation in urban medium density mixed housing

Gertrude Matsebe, CSIR, South Africa

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Ecological sanitation (referred to in some countries as Ecosan) has been successfully implemented in both developed and developing countries such as Sweden, Germany, China, El Salvador, Mexico, Uganda and South Africa. Among others, three factors are unique to the use of Ecosan in urban Medium-Density Mixed-Housing (MDMH). Firstly, decision-making is more complex because consensus needs to be reached among a diverse group of people with a varied level of understanding of ecological and sustainable concepts. Secondly, the technological challenge is more complex in MDMH due to the more intricate physical connections of a shared Ecosan system Thirdly, the challenge of management is more complex as responsibility for maintenance and emptying of bins is shared among groups of families or units. This paper presents findings of a literature review carried out to investigate the use of ecological sanitation in urban multi-family housing and concludes by confirming the viability of these technologies globally with particular applicability in South African urban contexts.

Introduction

1.Background

Ecological sanitation has the following main considerations in its implementation: health and hygiene, environment and natural resources, technology and operation, financial and economic issues, socio-cultural and institutional aspects, climate, as well as population density and settlement pattern (OtterWasser GmbH, 2009; Ulrich, 2009; Rauschning *et al*, 2009; Winblad and Simpson-Hébert, 2004). This paper presents findings of a literature review on the use of Ecosan technologies in Medium Density Mixed Housing in urban areas and the related unique challenges in terms of decision-making, technological and management considerations.

However, in South Africa, there are also challenges in terms of co-ordination of services among government departments (budgets and functions). By the restructuring of the Department of Human Settlements, which now includes the sanitation portfolio, there is a real challenge in the implementation of localized, sustainable and decentralized sanitation systems. High-tech technologies without proper budgets, skills or plans are promised. In some cases, location and topography complications coupled with limited budgets means that informal settlements upgrading or the building of new housing for the poor are greatly delayed as these settlements cannot be easily or cheaply connected to the existing sewer lines. While there is a perception of waterborne systems being the superior technology, government makes (sometimes unrealistic) promises of conventional service delivery, further stigmatizing alternative, decentralized technologies.

2.Definitions

Ecosan contains and sanitizes human excreta through dehydration (e.g. urine diversion toilet) and decomposition (e.g. composting toilet). Composting toilets, vacuum toilets and urine diversion (UD) toilets (both dry and flush) are some examples of Ecosan technologies *(*Winblad and Simpson-Hébert, 2004). It is a closed-loop or cycle system that treats human excreta as a resource (*ibid*).

Medium Density Mixed Housing (MDMH) refers to housing developments with a minimum of 50 dwelling units per hectare (du/ha) and a maximum of 125 du/ha (Landman *et al.*, 2007; Osman, 2010). This housing typology is characterised by ground level entry, private external space for each dwelling unit, and close proximity to secure parking, with such developments ranging from single to four storeys structures (*ibid*).

Review of case studies

Ecosan technologies have been implemented in urban medium- and high- density housing. Some examples are presented below:

Germany

A range of Ecosan technologies have been implemented in various locations around Germany. In *Allermöhe, Hamburg*, composting toilets were installed in over 3000 households (less than 4 storeys) with composting containers located at the basement for the treatment of human excreta, toilet paper and organic kitchen waste. A vision of sustainable lifestyle was instilled among the residents who were all home-owners (Rauschning *et. al*, 2009). Residents participated intensively in the planning, design, implementation and maintenance processes perceived to have increased commitment towards operation and maintenance activities (*ibid)*. Family houses, multi-storey houses and a public Kindergarten in the ecological settlement of *Bielefeld-Quelle* were also installed with about 500 composting toilet (Berger, 2004). In a mixed-use building conversion, dry toilets were installed and connected to four composting containers. The sanitation solution was to combine a 4-litre water saving flush toilet together with a separating device that separates the flushed water from the excreta in order to lead the solid parts to the composting container (*ibid*).

Austria

Urine diversion flush toilets were installed at a primary school and residential buildings, consisting of single houses and flats, in Linz (Ulrich, 2009). Ceramic waterless urinals were used in the school building and day nursery. Urine is directed into six double wall fibreglass tanks, situated in the housing areas, and 2 storage tanks, situated in the basement at the school. Current legislation limited the use or urine for agricultural purposes, so the collected urine is released into the sewer system. An external company (LINZ AG) is responsible for the maintenance of the Ecosan system. While the operation of urine-diversion flush and the conventional toilets are the same, however, the cleaning of the UD toilet is more complicated. Furthermore, users face challenges of accepting the UD toilets due to operation shortcomings such as odour (from wrong deposition of faeces in the urine receptacle) and inadequate water flush volumes to carry away faeces and/or toilet paper. The incorrect use or the design of the UD toilet itself (causing splashing of flush-water onto toilet seats) and neglected maintenance also adds to these problems (*ibid).*At the school, the size of the toilet proved to be too big for small children (Ulrich, 2009). This ultimately resulted on the conversion of UD toilets into flush toilets. However, the waterless urinals are functioning well due to regular operation and maintenance (*ibid*).

Sweden

Sweden has been one of the pioneers of urine-diversion toilets since the nineteen century (Austin and Duncker, 2002) and has advanced, modern, high standard urine-diversion toilets, many models made with pedestals of porcelain in both dry and flushing systems. The flushing system is mainly installed in high density residential apartments or cluster housing. In these housing developments, urine is collected and stored in underground vaults, from where it is collected by farmers. Faeces are flushed into a conventional waterborne sewerage for further treatment. The front urine receptacle is flushed with a spray of about 200ml of water from a nozzle on the side of bowl (*ibid).* In Stockholm, a large number of Vietnamese double-vault dehydrating toilets are installed inside weekend houses, permanent houses, apartments, industries and institutions (Winblad and Simpson-Hébert, 2004). Urine is directed to an underground storage tank with a minimal flush of water (about 0.1 litre). Due to the smaller tank volume (0.5 cubic meters), it requires frequent maintenance. Urine is transported to a farm for use as fertilizer (*ibid).*

China

In Wucum, a town in southern China (Guangxi province), the modified version of double vault UD toilets are installed inside the house, usually on the second or third floor (Winblad and Simpson-Hébert, 2004). Urine is diverted from a specially designed squatting pan to a ground level collection point from where it is used as fertilizer in the household’s own vegetable garden. Buckets are provided for ash, another one for the disposal of toilet paper and water can for rinsing the urine bowl in the bathroom ((*ibid).*

South Africa

UD toilets are installed in two MDMH projects in Kimberley, namely, the Eco-village and Hull Street. Thirteen units in Eco village are designed with a number of ecological installations such as UD toilets, urine collection, greywater treatment, gardening and solar heating (Drangert *et al.*, 2002). Dry urine diverting (UD) toilets had vaults for dehydration of faecal matter before use in the gardens. However, there is no information provided regarding the orientation of the toilets or vault. Urine storage tank is dug into the ground in Eco-village to be used for timely spreading in the gardens. In addition, small greywater treatment units with a grease-trap and sand filters were attached to each house, and the effluent is discharged into a dam together with stormwater. The one and two-storey houses in Hull Street are fitted with piped water and local containment of greywater, urine, and faecal material. The urine diversion (UD) toilets are indoors while the vault of faeces and paper is reached from the garden. Urine is diverted to a soakaway (*ibid*). The author re-visited the Hull project in 2007 and found that toilets are still operating well. Moreover, an interview held with the manager of the social housing company revealed that the Sol Plaatjie municipality intends to convert the UD system into waterborne due to users' dissatisfaction about it, as it is associated with the old bucket system.

Unique considerations and challenges of ecosan toilets

The unique considerations in the use of ecosan in urban MDMH include the fact that decision-making is more complex as consensus needs to be reached among a diverse group of people. It is noted that the more ecologically/environmentally conscious a group is, the more the level of acceptance. Secondly, the technology challenge is more complex when compared to single family house due to the connection of several toilets to one container via shafts or special pipes. Thirdly, the challenge of management is more complex because responsibility for maintenance and emptying the bin is shared between groups of families, this perhaps being more difficult among urbanised individuals.

Management of ecosan technology in MDMH requires higher level of commitment from the users as compared to other sanitation technologies. Some handling of human excreta at household level is required which might become difficult to implement when there are a number of families involved whose excreta goes to the communal systems (urine storage tanks and bins for faecal matter). Moreover, ownership of houses as in the case of Allermohe Hamburg in Germany has some advantages (Rauschning *et al*, 2009). That is, in this eco-settlement, all operation and maintenance were performed by the residents themselves (or volunteers among the residents). Those owning the house and interested in sustainability issues are more comfortable in using the fertilisers in their gardens due to their level of interest.

In contrast, those in rental accommodation and not conscious of sustainability issues nor interested in gardening may not see the value of human excreta (fertiliser). In this regard, it is crucial to explore other alternatives such as the use of external companies or local enterprise(s) or local municipality to be responsible for maintenance function (Winblad and Simpson-Hébert, 2004). The output from ecosan is monitored, collected, further processed and sold by these institutions. Furthermore, secondary treatment may be carried out at centralized collection centres known as eco-stations. This communal management has two main advantages: it is more convenient for users and it is safer for public health.

The advantages of ecosan

The advantages of ecosan are mostly economical and environmental. The cost of a flushing toilet is estimated to be 4 EUR per cubic metre per person in Allermöhe, Hamburg, Germany. This is an equivalence savings of EUR 8,176 per annum on a composting toilet. These savings are also attributed to minimum production of greywater, which does not attract a wastewater fee and is not drained into municipal sewer (Rauschning *et al*, 2009).

By actively participating in project planning and decision making, users not only become self-reliant and independent but also have a sense of ownership and responsibility for management and maintenance of the infrastructure. Thus Ecosan provides for community independence in that it is not reliant on municipal infrastructure.

Lessons learnt from case studies

The case studies presented above confirm that Ecosan toilets have been successfully implemented and used in various housing typologies in different societies, thus demonstrating and proving that the Ecosan technologies may be suited to many countries on condition that operation and maintenance is properly done. These technologies have proven to be accepted across various cultures and income groups in the presented case studies. The level of acceptance and use of the technology is high when the residents are owners of the houses as opposed to units with rental tenure only and where residents are aware of and embrace sustainability concepts. Users who actively participate in the system contribute positively to the success of the greater system. Users of the technology develop a sense of ownership when they are actively involved in the entire process of the project. The economic benefits of operating Ecosan technologies are higher compared to the conventional system.

Conclusion and way forward

It is acknowledged that not all simple sanitation technologies could be used under all circumstances and that many factors are to be considered when implementing alternative sanitation technologies. However, decentralised sanitation is appropriate in water-scarce or relatively remote urban areas. In addition, with regards to maintenance, if something goes wrong in the smaller systems, it has a lesser impact on the greater community and environment (e.g. contaminating rivers, threats to fish or other species, and many other ecological systems). Also, the implementation costs for such localized systems are reasonable, and minimal scale systems appear to function well.

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Contact details

Gertrude Matsebe
CSIR, Built Environment Unit
P.O. Box 395, Pretoria, 0001, South Africa
Tel: +27 12 841 4380
Fax: +27 12 841 3400
Email: gnmatsebe@csir.co.za
www: www.csir.co.za
