

Mulch Filter and Resorption Trench for Onsite Greywater Managment

Report from a demo-facility built in
Kimberly, South Africa.



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SUMMARY

Finding a robust, simple and affordable solution for onsite greywater treatment is a challenge for Ecosan in the world. Within the Ecosanres pilot project in Kimberly, South Africa, where the first ecosan system was installed in 2002, problems with greywater handling was identified as the major focus area for improvement in beginning of 2005. Due to the frustration from malfunctioning greywater systems, Sol Plaatje Municipality started planning for a centralised system. Thus need to find functioning methods for onsite greywater management was urgent and the SEI team called for expert support.

The objective for the task given was to, in short time, come up with a credible idea for onsite handling of greywater in Hull Street by implementing and testing a demonstration facility. The solution proposed was based on ideas developed within the Ecosanres pilot project in East London, but also from long experiences from using artificial media's for soil infiltration in Sweden.

The design of the treatment process involves three units:

1. Prefilter (Mulch filter). Straining of particles (e.g. food residuals, grease, oil, fibres etc). Digesting of the carbohydrates by macro- and micro fauna. Rapid drainage of water.
2. Artificial media (InFiltrate®). Distributing water uniform by so called controlled clogging. Mineralisation of BOD by bacteria.
3. Resorption trench. Buffering and end use of water by infiltration (ground water recharge) and transpiration (irrigation).

The demo unit in Kimberley was tested for more than 10 months and regularly monitored by a team led by Shelly van der Molen. During this whole period the unit performed very well, and this in spite of the spring rainfall in 2006, exceeding all previous records. Storm water was standing all over the Hull Street residential area, but not in the garden with the demo facility.

The three-step process solution (particle and BOD removal in mulch filter, secondary treatment for high degree of BOD removal in an artificial media and final treatment of the water in an improved resorption ditch) has proven to be a viable solution for on site treatment and reuse of greywater. The technique has proved to be robust and efficient since all water was resorbed by the impermeable soil despite heavy rainfall, no transpiration and minimum of maintenance.

The pre-treatment in a the mulch filter seems far better than a septic tank, since it promises to be cheaper, aerobic (no odour), more volume efficient and easier to maintain.

The secondary treatment in artificial media seems reliable and efficient in terms of BOD removal. The filter is simple to construct from materials available on local market and secures resorption capacity also in very impermeable soils.

The on site greywater concept developed promises to fulfil the objective to be a simple, cheap, robust, compact and adaptable on-site treatment of source-separated greywater. More tests and validation of the concept is however needed. Research should be allocated in process optimising and appropriate design for different applications. Further R&D is extremely important to make this interesting technique available to local markets.

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PREFACE

Ecological sanitation (Ecosan) means separate handling of human excreta from the greywater fraction. This principle has the potential to supply people with functional, safe and affordable toilets. Also pathogen control and reuse of water and nutrients are achievable by ecosan. The ecosan principle is a promising track to reach sustainable sanitation for billions of people around the world.

So far developing ecosan has focused on toilets and handling of excreta while the greywater fraction has been very much neglected. The need to improve knowledge and techniques in greywater handling is especially relevant when ecosan goes urban.

This project was initiated and financed by the pilot projects in Kimberley within the EcoSanRes. Liaison person for the pilot project was Jan Olof Drangert. In Kimberly two new settlements (Eco village and Hull Street) have been built with ecological sanitation. These settlements are the result of the co-operation between SIDA and the Sol Plaatje Municipality.

During the first years of operation of the sanitation system, great efforts were made to develop them. Different measures were tested for greywater management but all trials ended up in the same; bad smelling water on ground. In beginning of 2005, due to the malfunctioning greywater systems, Sol Plaatje Municipality started planning for centralised system. Thus need to find functioning methods for onsite greywater management was urgent and the SEI team called for expert support.

The report describes the experiences from building and operating a demo facility in Hull Street. The system that treated greywater from one family was successfully operated in 10 month. The technique used is innovative and involves mulch filtering and improvement of resorption by controlled clogging by artificial media. The mulch filter idea is developed within the Ecosanres pilot project in East London.

Peter Ridderstolpe, WRS has been responsible for planning, design and building the demo-facility and writing the report. Michelle van der Molen During local SEI consultant has been closely involved in all parts of the project. Håkan Jönsson, SLU has been the main reference person in monitoring and writing the report.

INTRODUCTION

Background and challenges

Kimberly is situated in the province of Northern Cape and is one three cities in South Africa that has been supported for many years by the Swedish International Development Cooperation Agency (SIDA). The planning and implementation of the new settlements in EcoVillage (Mosoeshoe village) and Hull Street Housing program is a result from the co-operation between SIDA and the Sol Plaatje Municipality (former Kimberly Municipality). A strong vision for these settlements is that it has to create a non-racial, integrated and ecologically sustainable society. (See the Municipal Integrated Development Plan). A part of this vision is to build ecological solutions for sanitation (Källarfelt& Nordberg 2004, The Hull Street Integrated Housing Program, a poster and a brochure edited by Sol Plaatje Municipip).

Both Ecovillage and Hull Street has sanitation based on urine diversion dry toilet systems. Each flat has one toilet and one urinal. Greywater from kitchen and bathroom is collected and led to onsite treatment.

The ecosan system has not operated without problems. From start different problems occurred and a lot of effort has been spent to make the system work without smell and other nuisance. After addressing the toilet component of the project in 2005, and working together with the Hull Street community, the technology was accepted by local residents. In the end of 2005 the greywater problem was identified as the major focus area for improvement. All previously installed greywater systems built showed clear signs of malfunctions and all efforts to improve them ended up in the same result; smelly water on the ground.

The experiences from the greywater trials and errors in Ecovillage and Hull Street are educating and from the lessons learnt there was a need to allocate much more attention to the greywater fraction in planning and building ecosan system.

A short description of the greywater system built and experiences from operation are given below.

Greywater trials in Eco- Village

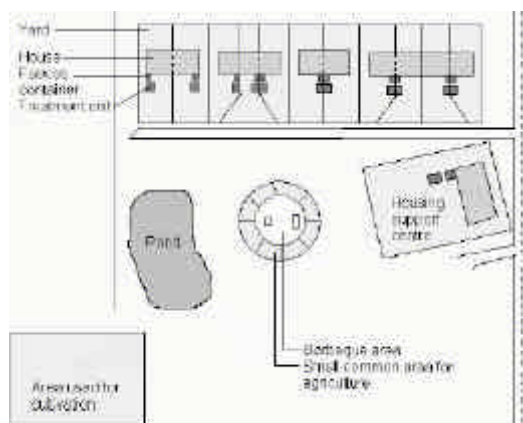
The village was constructed in 1999 and people moved in 2000. All together there are 11 houses/apartments in the village. Greywater (from sink and showers) is collected and led through a 50-mm plastic pipe system to a treatment unit outside each house.

From the treatment units water is collected and conducted by gravity a 100-mm pipe to a storage pond where all storm water from the surrounding area is led (Figure 1). The idea behind the system design is that treated greywater and local stormwater should be reclaimed by irrigation of a nearby field

Design

The treatment unit is a brick and mortar cement block construction covered with a lid of steel sheet lid. It consists of 4 serial small compartments for grease trapping and a larger compartment with a sand filter. Water is led to a sand filter by a horizontal pipe on the surface.

Figure 1. Map over Moshoeshoe Eco village (Drawing from Källarfelt&Nordberg 2004)



The arrangement of the outlet pipe resulted in the whole system being saturated with water. The sand filter became anaerobic, instead of aerobic as planned. The size of the whole treatment unit is 1,95 m x 1,3 m x 0,84 m corresponding a volume of about 2,2 m³ (figure 2 and 3).

Experiences

Residents were very satisfied with the system, initially. Interviews conducted by the MFS-students showed that:

- Residents wanted to save money by reusing the water for irrigation; however,
- they didn't want to use the water as it smelled and to them seemed unhealthy.

Residents found that rice and other particles cause stopping in the filter and that stagnant water started to smell. All units were blocked several times and some units became more or less constantly blocked with dirty and smelly water overflowing out in the yard. Investigation of the filters and measuring water quality revealed no treatment capacity and sand filters completely clogged with slimy anaerobic biofilm (Källarfelt&Nordberg 2004).

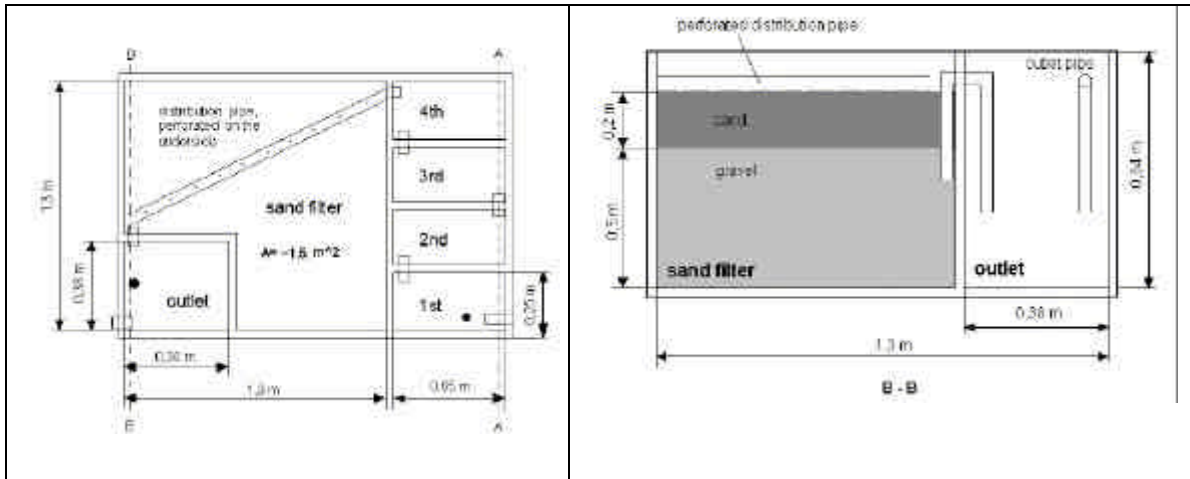


Figure 2 and 3. Plan and section of treatment unit. Water is flowing by a serial of small chambers the last one filled with sand and gravel. As seen from the section water outlet is near ground making all the volumes to be saturated with water (drawing from Källarfelt&Nordberg 2004)

The problem was addressed temporarily by bypassing the first 4 fat trap compartments and the filter, piping the untreated water into the pond. This however only resulted in moving the problem off the site and into the collection pond a few metres away



Figure 4. Treatment unit with rusty lid and pounded, May 2006



Figure 5. Pond enriched with nutrient from earlier collected greywater, May 2006

During visit in May 2006 it was obvious that system had further failed. Blockage in pipes and in filters stopped any grey water being treated or collected in the pond. Instead greywater had to be removed from treatment units by pumping and trucking to the municipal treatment plant. This routine took place once a week. Picture below (figure cc) shows a pounded unit before emptying. As seen from the picture the lid

covering the treatment units is weathered and partly cracked. (Also the lid of the big urine tank was rusty and had turned to deadly trap for children and animals. The pond was also found to be very dangerous for drowning since it was deep and constructed with very steep sides. In the picture below the nutrient enriched grey- and storm water in the pond is seen.

Assessment

A submerged sand/gravel filter, as the one constructed in Eco-village function as an anaerobic biological reactor. As such, both straining and capacity for biological treatment is expected to be low. Design of a limited volume, where the large part was filled with grease, oil, sand and gravel make volume for treatment and the retention time minimal. Under these circumstances, smelling water and very little removal of BOD removal is to be expected. Lack of maintenance (removal of sludge) and a load of BOD far exceeding capacity for mineralisation made clogging unavoidable.

The intention it seems is that the sand filter was meant to work as a vertical filter (i.e. with unsaturated flow), but the arrangement of the outlet pipe resulted in a drowned system. Another obvious technical weakness was the use of steel sheets, sensitive to rust, as lid.

Greywater trials Hull Street

Hull Street is a large project including planning for 2500 houses. The first phase of building (114 flats) was finished 2002 and people moved in. Houses with small private plots are arranged around a common yard, Figures 6 and 7.

The house is built on land formally belonging to a diamond mine. Thus parts of the original soil (have been removed and residuals from mining has been filled back. A thin top layer of soil (0,3- 1,5 m) on hard rock builds up soil profile. The soil is rich in calcareous and weathered, thus very impermeable for infiltration. Landscape is extremely flat.

In Hull Street a very simple solution for greywater (and urine) management was chosen. As seen in pictures below, the greywater (and the urine) was simply led to soakaway , about 1 m³ in size outside houses (figure cc). This solution was said to be temporary until better options had been found (Källarfelt & Nordberg 2004).

Experiences

Soon after taking the systems into operation, the soakaway pits started to fill with water. In April 2004, it was concluded that some pits where filled with water and the infiltration capacity seemed to be reduced by a biomat (Källarfelt & Nordberg, 2004). In January 2006, infiltration capacity had been reduced to the extent that no or very little water was infiltrated. Instead one had been forced to empty greywater by a pump. The water was carried in container by wheel barrel and used for irrigating young trees that were planted in the yard (Figures 8 and 9).

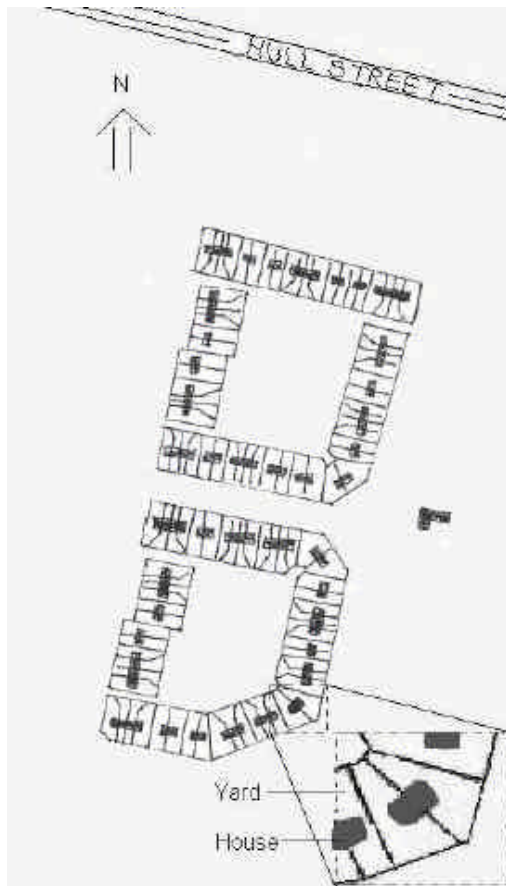


Figure 6. Houses with private plots are arranged around a common yard in the middle (Källarfelt&Nordberg 2004)



Figure 7. Greywater (and the urine) discharged in soakaway pits outside houses (Källarfelt& Nordberg 2004)



Figure 8 and 9. Greywater sucked from soakaway pits and



.... used for irrigation to trees planted in the yard (Jan 2006) .

Further temporary solutions were implemented and included, infiltration trenches for greywater disposal and reuse. Shallow trenches were dug along the fence between houses and filled with gravel and small stones. A plastic liner was used to protect gravel from refilled soil. Greywater from kitchen and bathroom was led to the trench by a pipe ended up in gravel in the beginning of the trench, Figures 10 and 11.

In some houses with pounded soakaway pits, grease traps were installed for kitchen water, figure 12. The idea was that these traps should protect soil from clogging. The grease traps were filled with plastic materials for carrying bio film and several so-called biocultures were tested to improve degradation of the trapped sludge.



Figure 10 and 11. Infiltration trenches for greywater disposal and reuse was also tested but after some month soil start to clog.

Figure 12. In some houses grease traps was installed for kitchen water. The grease traps was filled with plastic materials for carrying bio film and several so-called bio cultures was tested to improve degradation of trapped sludge.



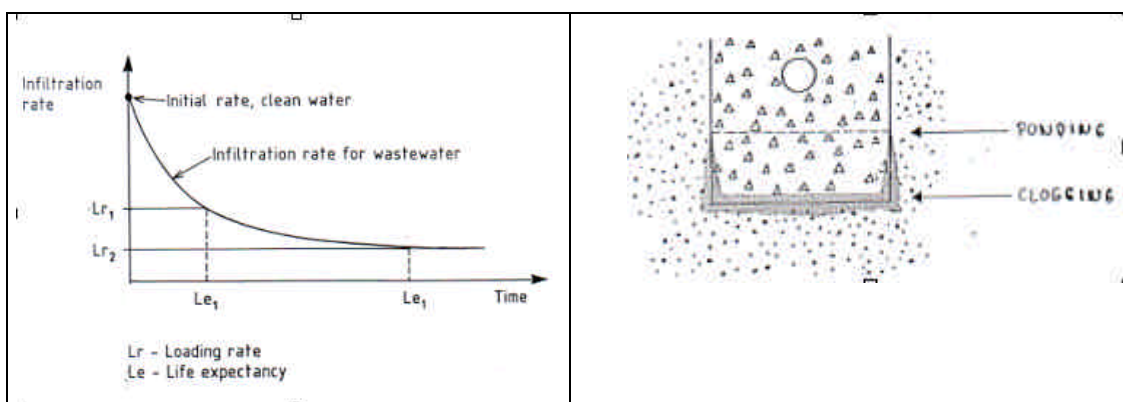
Assessment

No measurements of infiltration capacity were worked out in Hull Street but from a soil ocular characterisation Jan 2006, it was concluded that the soil contains a lot of clay. Also it was found that soil was swelling when wetted. These observations indicate that capacity for infiltration is poor.

It is well documented that the natural infiltration rate in an infiltration system decreases when loaded with wastewater. This is a consequence of the development of

a biofilm at the infiltration surface. This partly fills up and clogs the pores of the surface. Figures 13 and 14 illustrate the change in infiltration rate when a soakaway start to be loaded with wastewater. Sandy or sandy loamy soil fed by normal waste water septic tank effluent usually reaches a long term infiltration rate of about 15 to 20 mm per day. A clayish soil, like the ones in Hull Street, reaches no steady state. A slimy anaerobic biofilm develops and soon or later the infiltration surface is totally blocked and infiltration capacity is for practical purposes zero. Therefore it was logical that the trials with soakaway pits and infiltration trenches has not been successful.

Reliable and long-term soil based system constructed where soils have limited infiltration capacity must be build on the principle to remove BOD before applying the water to the natural soil. Also pre-treatment is imperative. Appropriate pre treatment include removal of particles, like residuals from cooking (e.g. particles of vegetables, meat, grease etc) or fibres from hairs, clothes etc. If not removed, these will cause blockages in the technical system or in the soil.



Figur 13. Diagrams showing that bacteria's grow in the upper layer of soil when soil is loaded with wastewater. Due to the clogging effect infiltration capacity decrease by time. In fine texture soils (like loam and clay) infiltration rate for wastewater are near zero (after Jenssen & Siegrist 1990)

Sand filters is one option for BOD control (secondary treatment) where the natural soil does not allow infiltration. The biological treatment will then take place in the sand profile liberating capacity for percolation in the soil beneath.

Sand filters require efficient pre-treatment a prerequisite that might be difficult to secure. In gravity systems its also it's difficult to distribute water uniform over surface. One possible way to overcome this problem improve is to use artificial media's, that use the principle of controlled clogging for distributing water horizontally. Such media's can be constructed quite easily and have capacity to increase treatment efficiency, robustness and economy significantly (Ridderstolpe 2004).

Mulch Filter and Resorption Trench for Onsite Greywater Managment – a report from the demo-facility built in Kimberly, South Africa. Peter Ridderstolpe, WRS 2007-02-12

In end of November 2005 Peter Ridderstolpe was engaged to support the local SEI team in finding a functioning solution for the greywater problems in Hull Street. One major challenge was to come up with a system that could ensured to be well functioning in a very short time. Residents had become quite frustrated with earlier efforts and the Manager of the Housing Company was already looking for a centralised solution.

Objectives for project

The objective for the task was to come up with a credible idea for onsite handling greywater in Hull Street by implementing and testing a demo-facility

DESCRIPTION OF THE MULCH FILTER AND RESORPTION TECHNIQUE

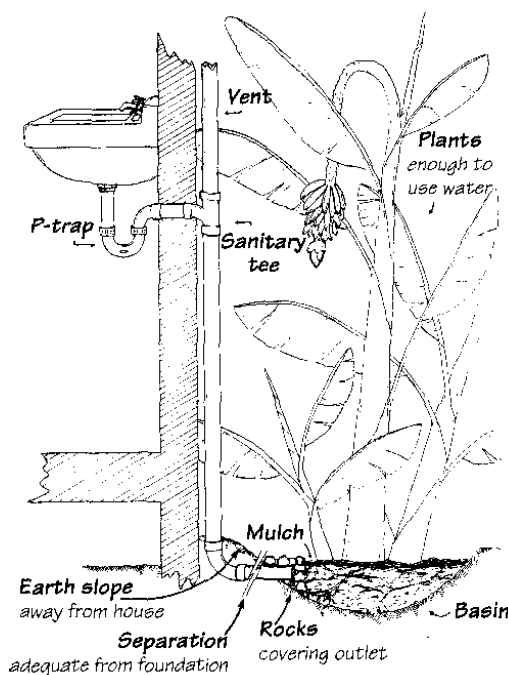
The process idea

As described above, blockages are to be expected if wastewater (grey water) is led to infiltration without being sufficient pre-treated in terms of SS and BOD. In cold climates pre-treatment is normally achieved by flotation and sedimentation in septic tanks and the BOD removal by micro-organisms attached to media (eg sand) located under ground. In warm climates, where freezing is not a problem, the biofilter can be constructed on ground. This has many advantages. One is that beside micro-organisms also macro- fauna like earthworm can contribute in the digesting and mineralisation process. Also water and nutrient from wastewater are more easily available for plant uptake in such systems.

Figure 14. Direct use means that that the greywater is led wherefore it is produced directly to a living soil, where pollutants are be converted by micro- and macrofauna and water and nutrients are used for plant growth (Art Ludwig 2004)

The treatment process involves:

- 1. Removal of suspended solids (SS) by straining in mulch*
- 2. Degradation of organic,s (BOD) by soil fauna (earthworms and bacteria's). Fats, oil, proteins, carbohydrates transformed to humic,s (mulch)*
- 3. Water removal by infiltration and transpiration (resorption)*



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Direct reuse of greywater is maybe the most natural way to handle greywater. This means that the greywater is led directly to a living soil, where pollutants can be converted by micro- and macrofauna and the water and nutrients can be used for plant growth (Art Ludwig, 2004).

The weakness of the classical (but simple) design of direct reuse is its sensitiveness for overloading. In planning greywater management within the BCM pilot project a developed version of direct reuse was proposed. This developed principle relies in separating the unit for straining and mineralisation from the unit for water resorption. The idea to separate the processes in different units and criteria for dimensioning and design is described in the document, "Grey water management in BCM, SA- summing up views and dimensioning criteria for Greywater solution in Scenery Park, East London", Ridderstolpe, 2005. This PM was written as a base for planning greywater treatment for the pilot project in BCM. In this planning group (the core team) participated Peter Ridderstolpe, WRS, Kevin Whittington-Jones, Rhodes University, and Håkan Jönsson, SLU.

Design and dimensioning

For the Hull Street application the demand on robust efficiency of the mulch filter resorption system was extremely high. All water must be resorbed since topography does not allow for surface discharge and as described above soil is shallow and impermeable. Also the condition that the houses and the pipe systems for greywater were already built made planning difficult. Very little altitude was available for filtering by gravity flow. Especially the water from the shower caused problems since the pipe from bathroom left the house under ground.

The solution suggested was to build the mulch filter unit with the main objective to perform only the pre-treatment processes (mechanical straining of solids in mulch media and digestion of the organic by invertebrates (e.g. earth worms). The main part of the biological treatment (mineralisation) was suggested to be carried out in a biofilm in an artificial media after the mulch filter. The artificial media was suggested to be constructed according the Infiltra concept (Ridderstolpe 2004). Below the principle for handling system is outlined, Figure 15

The design was based on the capability to handle all the greywater in the system, except the water from washing machines. Dimensioning was estimated from a worst case scenario with the following loads, table 1:

Table: 1. Dimensioning Criteria, flow per household

Q = 180 l/d (Max short periods 300 l/d)

qdim = 20 l/h (10 l/min) (peak flows)

TS = 350 g/d

COD = 300 g/d

BOD = 70 g/d

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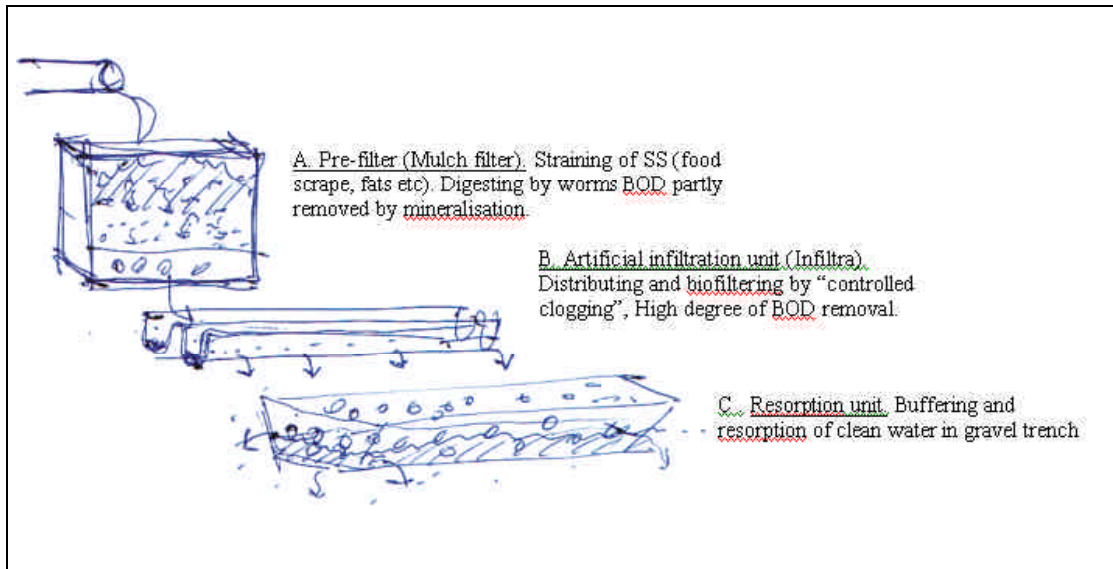


Figure 15. The three treatment units suggested for on site greywater handling in Hull Street.

Mulch filter unit

This unit must have high capacity for drainage but at the same time allow for efficient straining and environment for micro- and macro fauna. For design and dimensioning various informations from literature was used. Experiences from full-scale applications of mulch filters (vermi-composting filters) in similar climate areas indicate that systems have capacity to deal with a load of wastewater over 1000 mm per day and at to mineralise more than 100 g BOD/m² and day (Ridderstolpe2005).

Infiltra unit

The design of this unit is mainly based on own experiences (Ridderstolpe 2004, InFiltrate © is sold as a commercial product in Sweden since 1993). Dimensioning of total surface area was calculated from a situation with no or very little BOD removal take place in the mulch filter unit. Total Infiltra layer (surface for biofilm) was about 6 m².

Resorption unit

The design of this unit was based on the idea to spread water over a long but narrow trench to get a large mantel area (bottom and walls). The pore volume in the gravel under the Infiltra layer was dimensioned to allow about 1 m³ storage (corresponding 4-5 days worst case load). Resorption rate on site for treated water was assessed to be around 40- 50 mm per day. One three or bushes established along trench should be expected to contribute for most of necessary water removal by transpiration.

IMPLEMENTATION

Planning and preparation for building a demo facility was performed in December 2005. Construction took place during three days in beginning of Jan 2006 (6/1 till 10/1). The facility was followed up during its time of operation till 2006-11-23 when it was deconstructed. During all parts of the project local SEI consultant Michelle van der Molen worked closely with the technical specialist on the demo facility.

During the first day in Kimberly January 2006 decisions were made in design details and location of facility. It was decided to build the demo facility at the house 34151 since the house owner Mr Van WYK plays an important role as a leader for the tenants in the area. Mr van Wyk who represents the community on the Housing Company Trust supports the Ecosan idea and had shown great interest in using greywater for gardening, see picture below (Figure 16).



Figure 16. The house owner Mr Van WYK is passionate about gardening and uses water from his shower and washing machine for irrigation

Building the demo facility

Material used

Material for building was bought at local shops during first day of the visit. Geotextile is available in SA but was brought from Sweden.

Table 2. Material used for building the demo facility

Corrugated plastic sheets	16 m	sawed by shop in 25 cm ribbons
Plastic mesh (32 mm mesh size).	16 m	Mesh cut by hand in 30 cm ribbons
Stones from hard rock (20-40 mm)	2 m ³	
Gravel from hard rock (4 x25 mm)	1 m ³	Fine texture washed off by hand on site

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Plastic pipes (45 mm), bends and glue	3-5 m	
Inspection pipes with lids		Made from plastic pipes (45 mm and 110 mm)
Inspection chamber in plastic (inlet for shower)	1	Made from a WC water container
Plastic containers (45 x45x 50 cm) with lid.	2	Bought in super market
Net plastic basket (Diam 45-cm.)	2	
Mulch (wood chips etc		Wood
Screws, stripes etc		
geotextil (PF 30)		Brought from Sweden

Construction

Building process was well planned and worked well. Plans were change and adapted to site and material available. Building work was done in less than tree day. Photos below give a picture of building process



Preparing Infiltra.



Digging and rearranging pipes.



Filling the Resorption trench.



Urine pipe was led to resorption trench



Filling gravel in the Infiltra



Monitoring pipes



Drilling holes in containers for drainage and aerating filter



Holes in container wall to let filter communicate with soil



Arranging the the prefilters



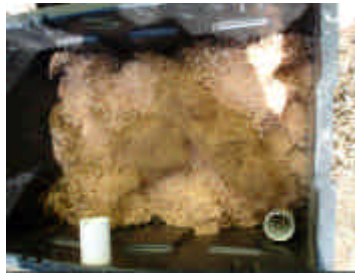
Refilling trench



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Drainage layer in filter



Inspection pipes in mulch



Commission completed

EXPERIENCES FROM 10 MONTH OF OPERATION

Methods for following up

The facility was taken into operation immediately after finishing construction (9/1) and was running for a period of more than 10 months. During the period plans for centralised greywater system for Hull Street was implemented and the 23/11 the demo facility had to be removed.

The local SEI team checked the facility regularly (each once a week to second week) and observations were filled in a special prepared protocol (see Appendix 1). Points of observations illustrated in figure below. The observations from field were discussed with the Swedish R&D team (Skype meetings between Shelly van der Molen, Håkan Jönsson, Peter Ridderstolpe, Jan Olof Drangert and Björn Vinnerås).

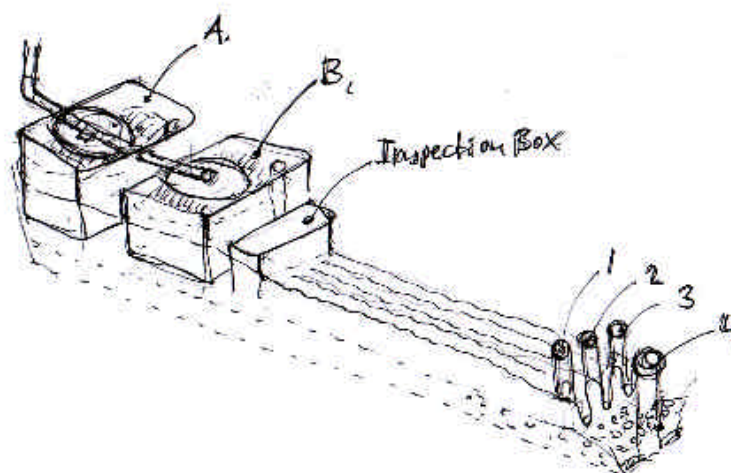


Figure 17. Monitoring points

Mulch Filter and Resorption Trench for Onsite Greywater Management – a report from the demo-facility built in Kimberly, South Africa. Peter Ridderstolpe, WRS 2007-02-12

In beginning of May (05/5-07/7) Håkan Jönsson, SLU and Peter Ridderstolpe visited Kimberly. On this occasion also Kevin Wittington Jones, Rhodes University, the local greywater specialist engaged for the BCM project participated. During this visit a careful inspection of the demo facility was performed.

A master student from Senegal (South –south cooperation) at Linköping University, Denis Fru Achu, was engaged during spring to contribute in the following up and research work. The student spent two-months (June- August) at the site but didn't succeed to take any samples or measurements and no report has been written. To this report Mr Achu have contributed with some notes from experiences and some photos (2007-02-01 unpublished)

Below is a summary of observation done during period

Loads

During the period, three adults lived in the house. No children lived in the house, but during school holidays, two teenagers also occupied the house. Water consumption in the house was measured and varied from 50 l/d up to 600 l/d. No measurements or assessments are available on greywater production. Probably greywater production is in the lower range of water consumption since the house owner uses quite a lot of water for gardening (Achu unpublished 2007).

The spring rainfall 2006 exceeded all previous records. In six months, (January till June) the total rainfall was 2000 mm, ten times the annual mean precipitation rate! Storm water was standing all over Hull Street and Kimberly.

Adjustments

In January a brick superstructure was constructed for protection of the mulch prefilter containers. A lid made from wood was placed above. Planting trees was planned but never happened.

The first two month of operation, the facility handled only water from kitchen sink. In February heavy rainfall started and the house owner could not use shower water for irrigation. Therefore by beginning of March the shower was connected to the prepared pipe connection entering into inspection box on Infiltra layer.

In March composting worms (*Esenia* sp) where introduced to the mulch. These worms where fetched from a nearby nursery. During the entire period only the second mulch container was in use. It was decided to not switch between prefilters since we wanted to test the capacity. In April, the net basket was also removed since no need for emptying it had been observed.

Observations and interpretations



Rain start in January. No signs of anaerobic conditions in prefilter. Increased water level observed in monitoring pipe in resorption. Also some smell was observed from inspection box and monitoring pipe in resorption filters (Photo 02-25 M v d Molen).



Superstructure and the contours made on facility protected it from storm water At right shower pipe entering inspection box (Photos 0302 from M v d Molen).

In middle off March, levels in resorption layer reached a maximum and standing (grey/black) water was seen in bottom of resorption ditch. Water level pounded some cm in the valleys in the Infiltra layer. At that moment, it was uncertain if water levels seen in inspection pipes were an effect of clogging or from rain that saturated the surrounding soil.

In April rainfall continued and water from rainfall, urine and grey water caused the soakaways to flood all over the Hull street residential area, but no water was standing in the garden of the demo site. The mulch filters worked well and water levels where stable in resorption bed and infiltra layers.

May 5 the demo facility was inspected carefully. At that time rainfall had faded



Curious expert keen to explore...



Basket one month without emptying



Debris in different degrees of degradation



Under basket: strained particles and light coloured slime, no smell



10 cm down in mulch: Brownish slime on mulch. First worm found



20 cm down: Still brownish well structured mulch. Eggs from worms found



Bottom of Infiltra seen by inspection box: Grey and healthy biofilm. Some maggots, no sign of anaerobic



Infiltra layer seen in inspection box. No pounding of water, some slime and residuals in bottom of valleys. Small spiders



Water from shower entering from pipe in the right valley of Infiltra, flooding from valley to valley. Red colour from flocculated iron salts



Checking the end of the valleys in Infiltra. No water found in valleys. No bacteria film nor flocks on textile.



Water is sucked from resorption trench



Water after prefilter (left) and after Infiltra (right)

Between 15 July and 7 August, Denis Fru Achu made some observation of the demo unit. Still container A was in operation, but some water also went into container B.

In his report (unpublished draft 2007-02-02) he concludes: *“Grey water loads is easily handled in mulch filter. The commonly observed residuals have been rice, potatoes, beans, maize flour, vegetables, seeds of fruits, fats and oils which showed signs of degradation. The accumulated degraded residuals were always evident during observation periods but their thickness was not usually considerable. Out of the 9 times of registered observations, 7 times had accumulated residuals ranging between 1-3cm (78%), 2 times below 1cm (22%) and none (0%) above 3cm. such thickness range was far from causing overload or overflow of greywater and it posed no significant threat to the household.*

All through the observation period, there was no recorded period with appreciable smell or black colorations indicating anaerobic conditions in the mulch media or elsewhere. Also the water level in the inspection pipes in the mulch medium A, valleys of inspection box in trench, monitoring pipes 1, 2 and 3 was not visible. This indicates probably that the infiltration is rapid and without obstacles. However, the monitoring pipe 4 had water level ranging most of the time between 3cm and 7cm. The monitoring pipe 4 receives water from the bathroom and laundry. The flow is regular and the quantity is large and therefore takes a longer time to be infiltrated. The colour of the geotextile was constantly light brown probably from surrounding dust. The yard was always dry and tidy and did not experience greywater overflowing from pits as was the case in some units that had to be drained manually.



Mulch filter in operation in August 2007 (Photo D F Achu).

The commonly observed creatures in the mulch media were worms, which do the scavenging. However, despite the reasonable positive performance recorded by this test unit, the number of worms present was not significant. The other creatures present in quite small numbers were immature cockroaches and spider eggs.

The mulch medium did not show signs of stress or overload and the worms were visibly actively helping in the decomposition of particles and leaving behind black

soil-like mass. To be noted also is that the household consumed considerable quantities of freshwater as indicated from their meter readings below. However, it was customary for the house owner to water his flowers with freshwater (he said 2 times a month) from the hose pipe though occasionally with greywater (about once a week) from the washing machine. He usually did that during the weekends when laundry is done and he is at home”.

In November before deconstructing of demo Shelly van Molen reported: *”all earthworms still alive, no smell, no serious bugs, works fabulously”* (mail 2007 02). During deconstructing she concluded; *As you can see (pictures below) the gravel in the trench was quite like when we put it in and everything was actually working perfectly.*



In end of November 2006 the facility was deconstructed



Gravel and textile looked unused



No signs of clogging beneath containers



Promising results from demo couldn't change plans for centralising system

Mulch Filter and Resorption Trench for Onsite Greywater Managment – a report from the demo-facility built in Kimberly, South Africa. Peter Ridderstolpe, WRS 2007-02-12

CONCLUSIONS

Four years of testing and developing ecosan in Kimberly 2002- 2006 have clearly demonstrated the difficulties involved in grey water handling. Finding a robust, simple and affordable solution for onsite greywater is a real challenge for Ecosan in the world.

The innovative technique suggested in this project and demonstrated by the demo facility in Hull Street indicates that Mulch Filter followed by Improved Resorption might be a viable solution for onsite greywater management. The result proves that on site treatment and reuse of greywater is possible also in areas with very low permeability of the soils and with a minimum of maintainance.

The main advantages with the new technique can be summarised:

- Pre-treatment can be performed without gravimetric sludge removal in septic tank. No need for emptying of sludge reduces nuisance in maintaining and thus risk for overloading biofilter by SS and BOD.
- Secondary treatment in artificial media improves reliability and efficiency in BOD removal compare to e.g sandfilter. Risk for clogging reduces significantly and sustainable resorption capacity is kept also in very impermeable soils.
- Simple construction and minimum of maintaining make system affordable also for poor people

The promising result from the innovative technique encourages further development and research. The focus must be to introduce the technique on the market i.g facilitate initiate local production of greywater filters. It is the author's belief that such process involves local entrepreneurs in finding commercial ideas for production of filter components.

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APPENDIX

1. Protocol for following up

Protocol to be filled in at each inspection

Day: 8 March 2008 Name of household or recorder: M van der Meulen (J. van Hylbe)
household

Rainfall since last inspection: Yes (yes) None (X)

Outdoor temperature, average: 15°C ☐ 15-25°C ☒ > 25°C ☐ < 15°C ☐

Water consumption (in scored value) no (today's value - previous value) of days

Is there a manhole in the street? A B A&B ☐

If not box A:

Observed residual - type/kind: loose black plastic and dirt

approx. thickness of residual: less than 1 cm ☒ 1-3 cm ☐ 3 cm or more ☐

Has residual degraded? nothing ☒ somewhat ☐ much ☐

Observed creatures: small insects cockroaches Other organisms: none yet

If not box A:

Residual - type: loose black plastic

approx. thickness of residual: less than 1 cm ☒ 1-3 cm ☐ 3 cm or more ☐

No smell, no black stuff some small black stuff Yes, mostly and black stuff

Has residual degraded? nothing ☒ somewhat ☐ much ☐

Observed creatures: nothing cockroaches Other organisms

Which media A:

Accumulation of residual? No, or very little nothing Yes, quite evident Yes, very much cm

Signs of anaerobic conditions? No smell, no black stuff ☒ some small black stuff Yes, lots of small black stuff

Observed creatures: nothing cockroaches ☒ Other organisms: no

Water level in inspection pipe: no water visible 1-3 cm more than 3 cm

Which media B (general):

Accumulation of residual? No, or very little nothing Yes, quite evident Yes, very much cm

Signs of anaerobic conditions? No smell, no black stuff ☒ some small black stuff Yes, lots of small black stuff

Observed creatures: nothing cockroaches other ☒ none

Water level in inspection pipe: no water visible 1-3 cm more than 3 cm

Inspection Box in trench

Water level in valleys? no visible water 1 cm or more in middle one more than 3 cm

Colour of water? clear and transparent clear with particles greyish black

Colour of biofilm on geotextile? light brownish dark brownish black and grey

Water level in monitoring pipe 1.0 cm pipe 2.0 cm pipe 3.0 cm pipe 4.0 cm

Other observations: no water absorption capacity noticeable

Left water nothing
Time 8:44 AM 7:51 PM