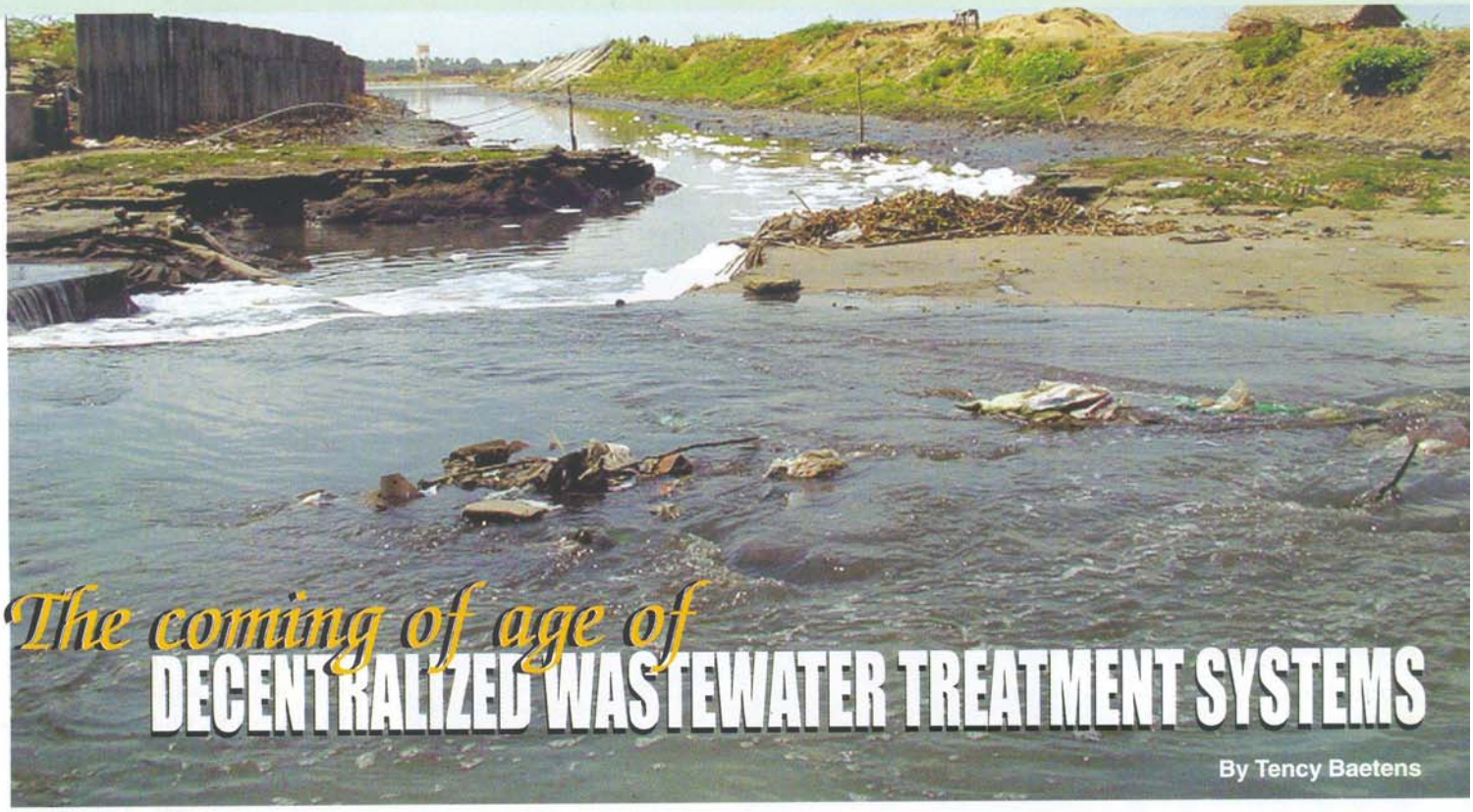


The coming of age of DECENTRALIZED WASTEWATER TREATMENT SYSTEMS

By Tency Baetens

Strategies for disposal of untreated sewage in India have focused mainly on implementation of energy intensive conventional treatment technologies. Such centralized treatment plants require high capital investment, continuous power supply, have high maintenance costs and need skilled operators. Very few centralized treatment plants have a successful operating track record.

In recent years, decentralized wastewater treatment systems have emerged as a cost- effective, high-performing treatment technology in many countries. There is a growing interest in developing and adopting this technology for water pollution control also in India.

The advantages of decentralized wastewater treatment systems include dramatic cost reduction on sewage collection, less maintenance of sewerage systems, cost-effective treatment technology, and reliability and affordability. There is also the possibility of community involvement through the developers/builders/citizens in the wastewater management cycle, with the option of utilizing the recycled wastewater.

Auroville, near the city of Pondicherry, has been experimenting and developing decentralized wastewater treatment systems for the last 20 years. The community operates at present more than 45 decentralized treatment systems of different capacity and designs.

The limitation of being situated on a plateau, with no access to rivers or natural lakes for the supply of freshwater, was turned into a challenge. During Aurovilles' 35 years of existence several environmental programs were initiated which ultimately resulted into the reforestation and planting of 3 million trees. Other measures to ensure a near-zero rainwater run-off in the area included projects for the rehabilitation of the neighbouring village water tanks, the damming of the canyons and rainwater harvesting techniques.

Early attempts towards decentralized treatment of sewage

The effort of treating wastewater through decentralized natural methods is an integral part of the overall effort to ensure a sustainable water management policy for the whole project. During many years of trial and error we were able to learn first hand which methods and systems worked, what were the major difficulties and which design features could be improved upon.

For many years a natural treatment method called the 'rootzone treatment method' was the main focus of our attention and effort. The method originated in the seventies in Germany. Sewage is passed through a constructed basin filled with a filter material in which semi-aquatic plants are growing. When sand is used as the main filter material, it was observed that the fine filter material has the tendency to clog when the pretreatment is not sufficient. Sand filters also need large surface area.

After implementing several larger systems, it became clear that the design of a pretreatment device, followed by a planted filter as the main treatment phase and a polishing tank, was functioning satisfactorily in terms of biological sewage treatment, but proved to be difficult to implement in urban or semi-urban situations due to large space requirements. These

are calculated at 4 m² for temperate zones and 2 m² per person for tropical zones.

The natural process happening in a rootzone treatment plant or a planted gravel filter is mainly aerobic and very suitable for temperate climate zones. On the other hand, anaerobic processes – which take place without supply of oxygen – occur naturally in subtropical and tropical climate zones with temperatures from 15 to 40º C. The anaerobic process only needs sufficient heat to start and continue.

With this information we are able to build and operate treatment systems which fulfill the need of reliability, which are economically affordable, omit no foul smell, produce effluent characteristics at par or lower than the stipulated standards, have a low maintenance cycle, can be aesthetically integrated in the landscape and be situated near households, apartment blocks or within cities green spaces.

Dewats principles

Natural sewage treatment processes are achieved by using methods that utilize the natural occurring physical principles combined with biological activities of microorganisms. Microbes used in the treatment facility are generated from microbial populations that occur and grow naturally in the wastewater itself.

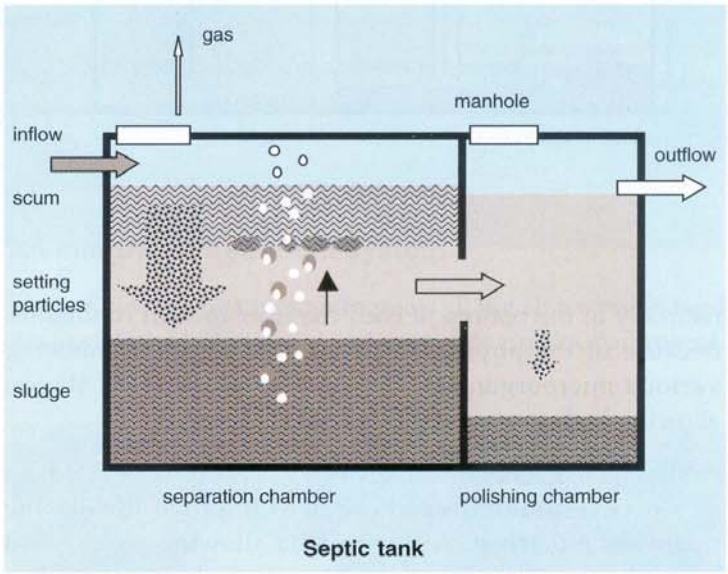
Decentralized wastewater treatment systems (Dewats) are based on different natural treatment techniques, put together in different combinations according to the needs, the possibilities, the challenges and the financial implications.

The different components cover the primary, secondary and tertiary treatment of wastewater.

Primary treatment

Pre-treatment is used for screening and sedimentation process, in which the liquid part is separated from the solid matter. A device called a **Septic tank** is used for this phase.

The septic tank is the most common, small-scale and decentralized treatment plant. It is basically a sedimentation tank in which settled sludge is stabilized by anaerobic digestion. Dissolved and suspended matter leaves the tank



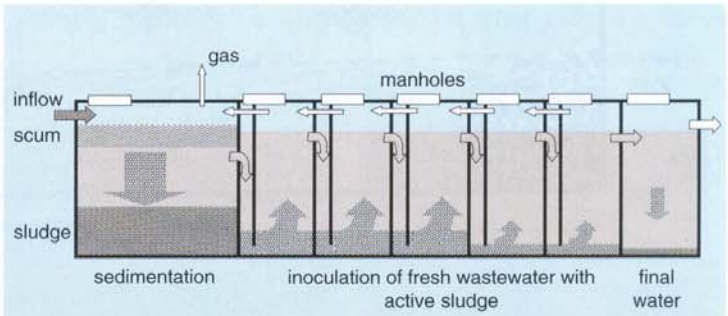
Septic tank

more or less untreated. The treatment efficiency of a septic tank is in the range of 30% COD removal. Desludging at regular intervals is absolutely necessary. A septic tank can also be incorporated into an anaerobic baffled tank as the first section as a **Settler** device.

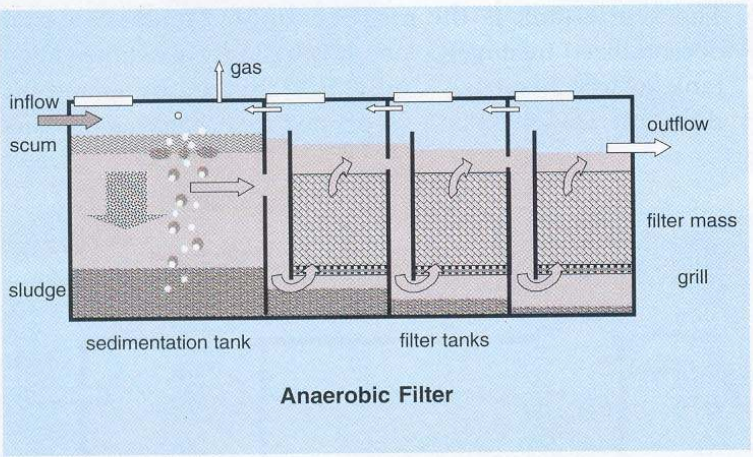
Secondary treatment

In the secondary treatment phase, biological and natural chemical processes are used to digest and remove most of the organic matter.

A device called an **Anaerobic Baffled Tank Reactor** is used for this phase. Several tanks (up-flow chambers) are constructed in series to digest degradable substances. Baffle walls direct the water stream between the chambers from top to bottom and up again. During the process the fresh influent is mixed and inoculated for digestion with the active blanket deposit of suspended particles and microorganisms occurring



Anaerobic Baffled Reactor



Anaerobic Filter

naturally at the bottom of each chamber in such conditions. Because of the physical separation (multiple chambers), various microorganisms are present at different stages, allowing high treatment efficiency.

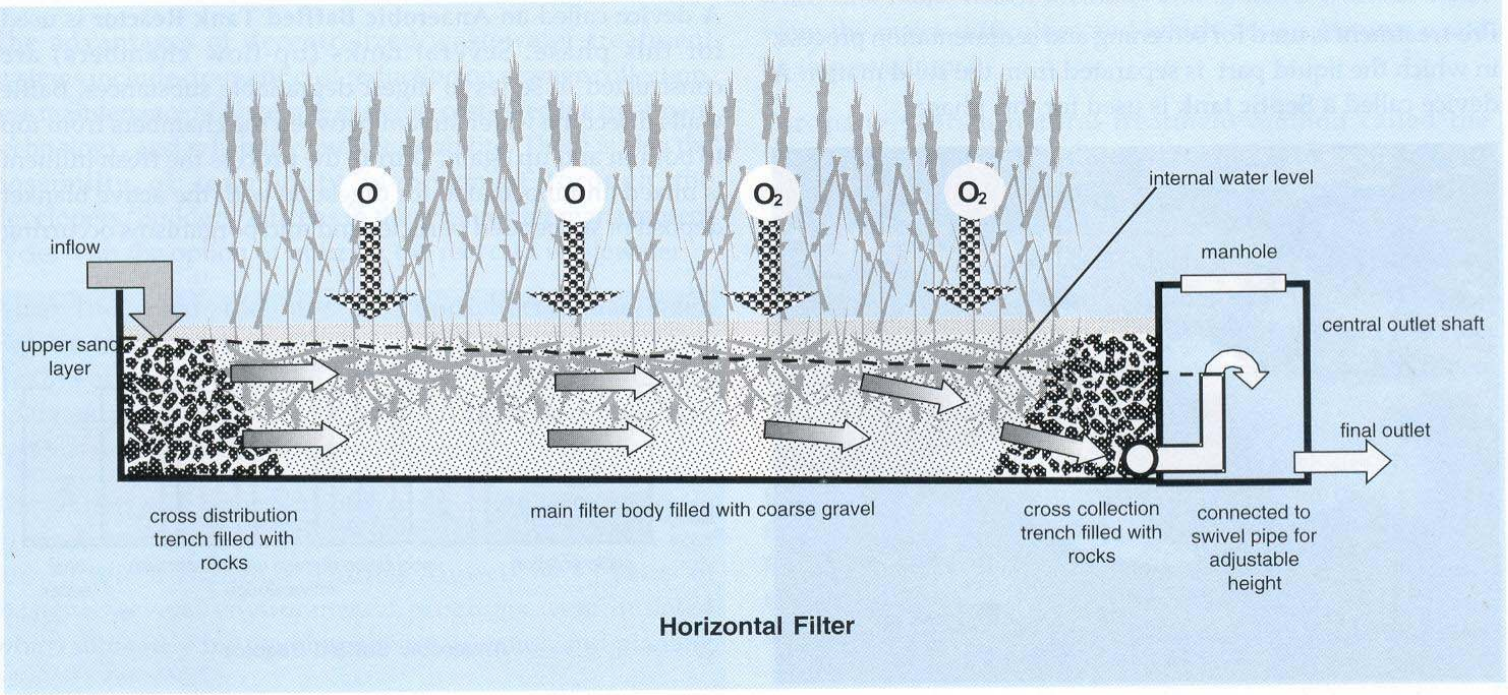
At the end of the treatment device a chamber can be fitted out as an **Anaerobic Filter** in order to improve further the treatment efficiency. A filter media allowing widespread contact with the sewage stream is used which is very efficient in retaining and digesting the left over pollutants. The problem of encountering clogging is minimized due to the digestion and treatment in the baffled reactor.

Primary and secondary treatment systems are constructed below ground level. They are built together as a single and compact set-up. Nearly 90% of the original pollution load will be removed at this stage.

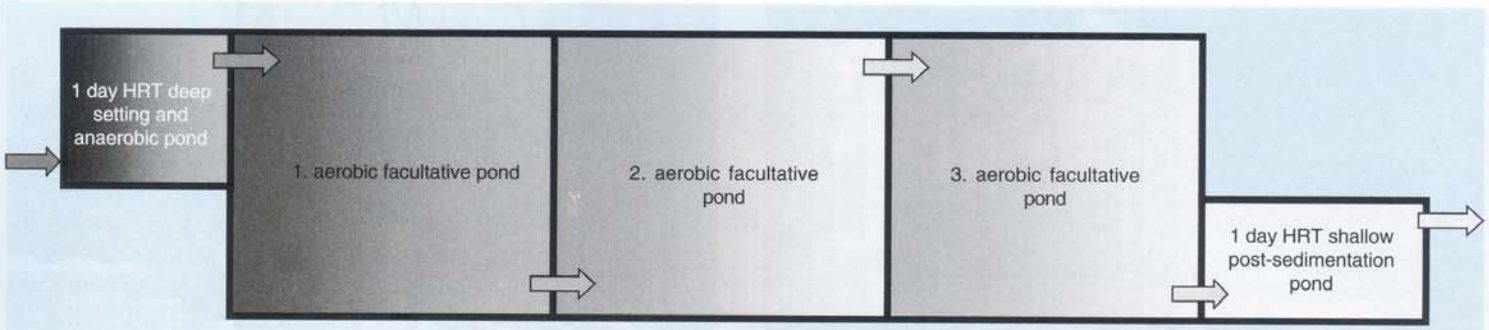
Since the system works in a closed environment without oxygen supply the effluent will continue to smell despite the fact that a substantial treatment has occurred already. For this reason an additional treatment, a planted gravel filter, is included in the design lay out.

Tertiary treatment

A **Horizontal Planted Gravel Filter** (also called root-zone system or constructed wetlands) act through the combined effect of the filter material - we stopped using sand as the main filter material and moved towards pebbles and granite stones - the plants and their roots growing in the filter media. The wastewater is re-supplied with oxygen while passing through the planted gravel filter; the effluents are odor and smell-free. Since the planted filter becomes less prominent in the overall design due to the excellent treatment taking place in the baffled tank reactor, this downgrading of the planted filter results in drastic cost reduction, less needed space above ground and with an additional benefit of having available larger amounts of reusable treated waste water, due to the decrease in the high rate of evapotranspiration normally occurring in large planted filters.



Horizontal Filter



Polishing Pond

Optional phase

The treated sewage becomes "living water again" by undergoing further biological treatment, through natural UV (ultraviolet) exposure and flowing through an open water body, a **Polishing Pond.** In order to function properly the pond is fitted with fish who control the mosquito larvae together with frogs and dragonflies. Different aquatic plants, water hyacinths, water lilies, lotuses, add to the overall beauty and pleasing view.

While the E. coli count (the contamination due to human excreta) at the outflow of a planted filter is often around 2000, the count at the outflow of a polishing pond can be well below 20.

At this stage the recycled wastewater can be reused without posing any threat to humans. It is valuable for irrigation; the water is high in nutrient contents and beneficial to plant growth.

Effective Microorganism (EM)

Microorganisms occurring naturally in the sewage may not necessarily be the most effective and efficient microbial communities to act on the sewage during the treatment process.

The introduction of specific microbial cultures as a method for optimizing the treatment in order to increase the efficiency and effectiveness of the process is the basis for introducing EM technology in wastewater treatment facilities. Stock solutions are cheap, have to be diluted before being used in the process and are available in India.

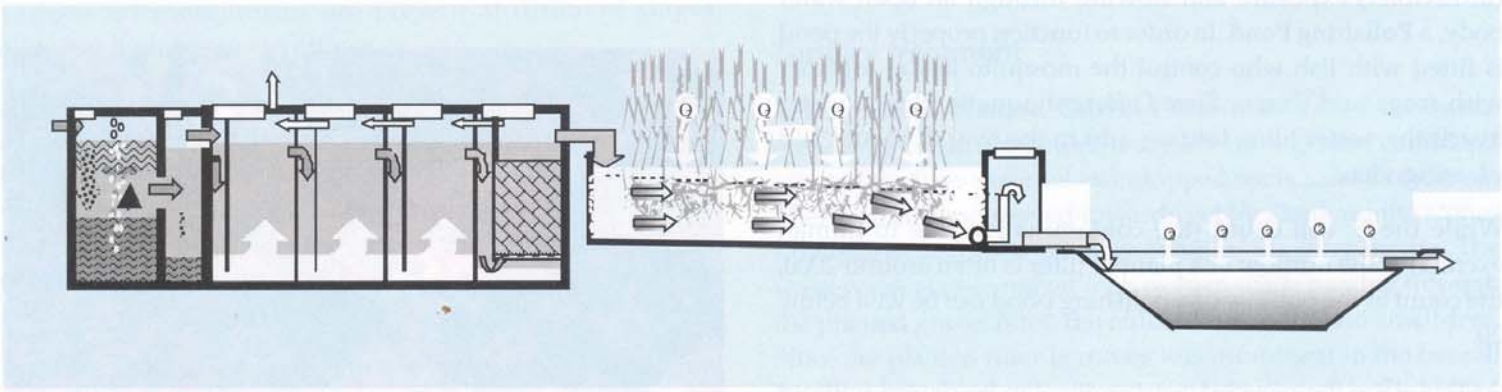
An integrated treatment system

Natural sewage treatment integrates all the above mentioned devices. Both black (toilets) and grey water (sinks, bathrooms,

kitchens) is used for the treatment process. Separating the different generated wastewater streams is a more sophisticated way and is being practiced by industrial users.

A settler, a baffled tank reactor and an anaerobic filter are integrated into a single structure, build underground. The device takes care of the primary and secondary treatment phase. The treatment efficiency is 90%. The pollution Control Board's standards are met and the wastewater can be safely used for percolation into the soil, if required. Due to the anaerobic process the wastewater still smells when it flows



out of the baffled tank reactor and anaerobic filter. If the effluent is reused, a planted filter is added which will take the odour away. With an efficient pretreatment, the size of the planted filter can be reduced to 0.30 m^2 per person. Granite stones can be used as filter material and even plant species like canans (Cana Indica) are able to grow in planted filters.

The polishing tank is the most visible feature of the design outlay; the treated water can be pumped out and brought back into the cycle without any harm.

The joy generated from having a system operating next to the house, treating every drop of your families' wastewater and having the pleasure of reusing the treated water again is indeed very special. It's worthwhile trying as success has now been made easy.

REFERENCE

Dewats, Decentralised Wastewater Treatment in Developing Countries
Ludwig Sasse, 1998

BORDA, Bremen Overseas Research and Development Association, Germany

Partner contacts:

Auroville Centre for Scientific Research (CSR), Auroshilpam, Auroville 605101
csr@auroville.org.in

Fedina-Borda, Dewats Coordination, Bangalore
borda.india@vsnl.com

Inspiration, Kochi • inspire@vsnl.com

Hunnar Shaala, Bhuj, Kutch
buj_hunnar@sancharnet.in

ABOUT THE AUTHOR

Tency Baetens, Auroville Centre for Scientific Research (CSR)