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INTEGRATED DECENTRALISED WASTE WATER TREATMENT SYSTEMS

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1 INTRODUCTION

Integrated Decentralized Waste Water Treatment Systems are based on several natural physical treatment techniques, put together in different combinations according to the needs and the financial budgets of users. The different devices cover primary, secondary and tertiary treatment stages.

The treatment applications are based on the principle of minimal maintenance, the critical parts of the treatment system work continuously and uninterrupted with low energy inputs. The technology provides treatment for domestic and industrial (non-toxic) sources. It can treat effluent flows from 1 up to 1000 m³ per day. The technology is tolerant towards inflow fluctuation (i.e. university campuses) and does not require complex maintenance practices.

2 BIOLOGICAL PRINCIPLES OF EFFLUENT TREATMENT

Natural effluent treatment processes are achieved through methods that make use of physical principles combined with biological activities of microorganisms. Bacteria colonies in the treatment devices are generated from microbial populations that occur naturally in the wastewater.

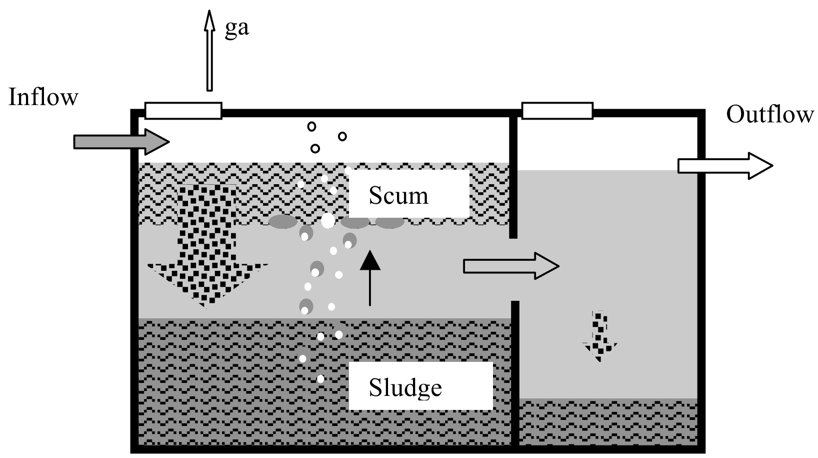
3 DEWATS PRINCIPLES AND DEVICES

3.1 Pre-treatment cycle: the settler

A pre-treatment device is used for the sedimentation process to take place, in which the liquid part is separated from the solid matter. A device called **a settler** is used for this phase. If needed, a screening device, for preventing unwanted large materials to enter the system can also be installed. It is useful to install near the kitchen outlet a grease trap, a device designed to intercept most greases and solids before they enter the wastewater disposal system. This device needs very regular cleaning and a special place for the disposal of the removed scum layer.

The settler is an underground constructed tank with **one partition wall**. Within the settler two main treatment processes take place, first a sedimentation and second a stabilization and digestion of the settled sludge through biological treatment. Storage volume is provided for 18 upto 36 months, this parameter defines the necessary desludging period.

Typical Section of a Settler

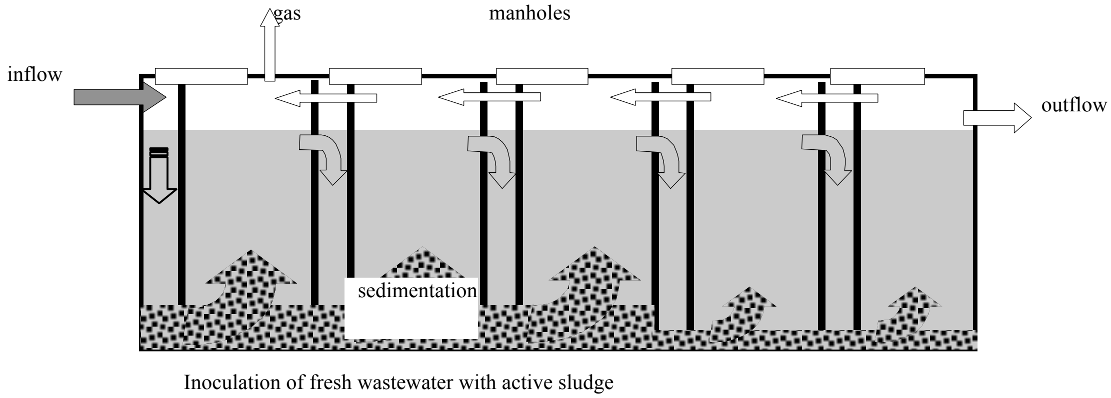


Desludging is the process of emptying the sludge at regular intervals from the first and second chamber, which is an absolute necessity. Sludge is composed of helpful bacteria, it is useful to ensure a left over portion in the bottom, in order to provide fresh inoculation material for restarting the process after the regular (2 to 2½ year interval) cleaning period.
The settler can be a separate device or can also be incorporated as the first section of the baffled tank.

3.2 First treatment cycle: the anaerobic baffled tank

In the first 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** is used for this phase. Several tanks are constructed in series to digest degradable substances. Baffle walls or down-flow PVC pipes direct the waste water stream between the chambers from top to bottom and up again. During this process the fresh influent is mixed and inoculated for digestion with the active blanket deposit of suspended particles (floating bacteria media) and microorganisms occurring naturally at the bottom of each chamber. Because of the

physical separation (multiple chambers), various microorganisms are present at different stages, allowing a high treatment efficiency.



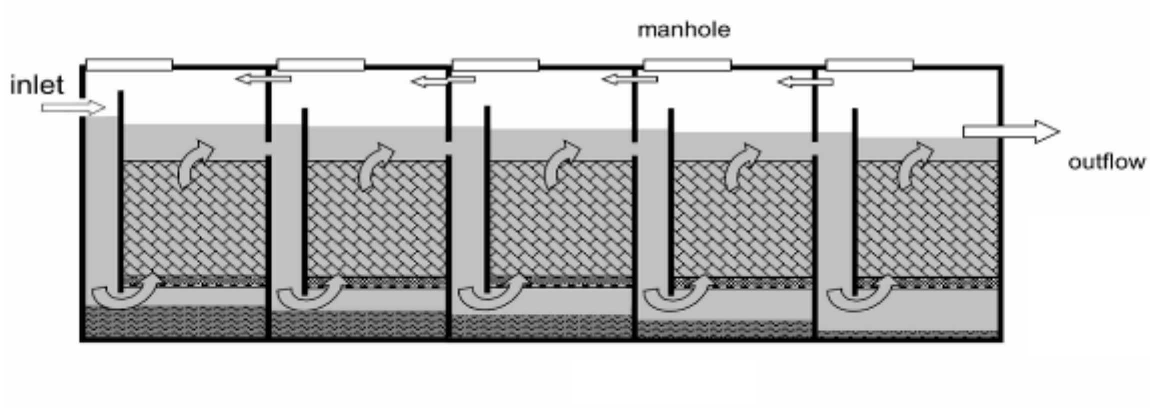
Typical section of an Anaerobic Baffled Tank

3.3 Second treatment cycle: anaerobic filter

At the end of the last chamber of the baffled tank reactor one or more chambers can be fitted out as an **anaerobic filter** in order to improve further the treatment efficiency. A filter media allowing widespread contact with the effluent 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 that occurred already in the baffled tank treatment. The process works with fixed bacteria media.

The pre-treatment (settler), first treatment (baffled tank) and second treatment (anaerobic filter) are constructed below ground level. The different phases can be built together, or as a separate set-up. The effluent passing out of the anaerobic filters will have a 90% of the original pollution load removal. The Central Pollution Control Board's (CPCB) standards are met and the wastewater can be, if required, safely used for infiltration into the soil and subsequently recharge the ground water table.

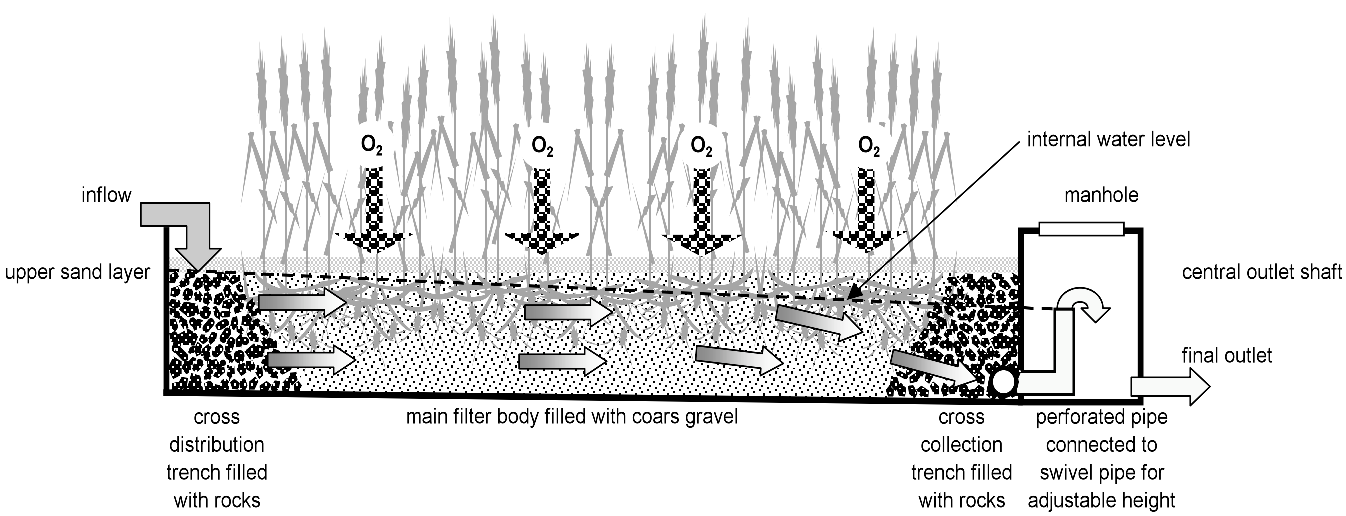
Typical section of an Anaerobic Filter



Since the system works in a closed environment without oxygen supply (anaerobic conditions) the effluent will continue to smell despite the fact that a major part of the effluent treatment has occurred already. For this reason an additional treatment is included in the design lay out, being the third treatment in the form of a planted gravel filter.

3.4 Third treatment cycle: the planted gravel filter

A horizontal **planted gravel filter** functions through the combined effects of the filter material, the plants and their roots growing in the filter media. The waste water is re-supplied with oxygen while passing through the planted gravel filter; the effluent coming out is odor free. Since the planted filter becomes less prominent in the overall design due to the excellent treatment taking place in the baffled tank reactor and anaerobic filter, the minimizing of the planted filter results in cost reduction, less needed space above ground and with an additional benefit of having reusable treated waste water. Around 80% of the original water load can be recuperated for reuse after having passed through the anaerobic and aerobic treatment phases.



Typical section of Planted Filter

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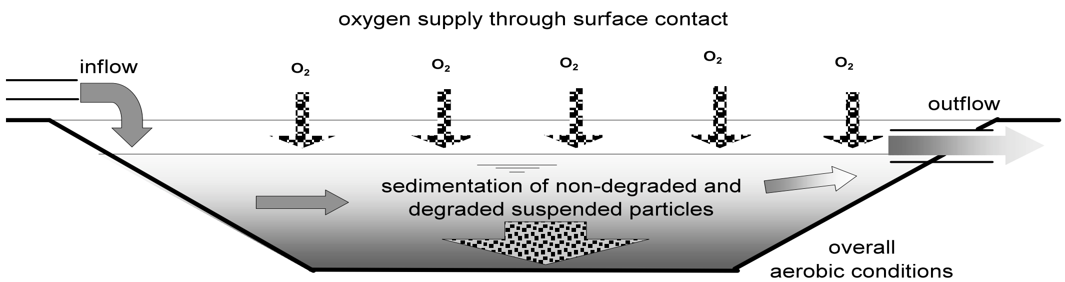
3.5 Post-treatment cycle: the polishing tank (open water body)

After passing through the different devices, with both anaerobic and aerobic treatment, the first full exposure of the treated water with air and nature is in the polishing tank, with the last cycle, the treated effluent becomes "living water again". Through natural ultraviolet (UV) exposure, it undergoes further biological treatment.

It is beneficial to have different compartments in the water body, rather than having a single water pond, so that the water can flow through the different sections of the open water body. It is a necessity to stock the polishing pond with fish for control of the mosquito larvae; frogs and dragonflies will multiply naturally, the animals, insects and the aquatic plants ensure a further extensive natural purification. Different aquatic plants like water hyacinths, water lilies, lotuses, not only add to the overall beauty, but also provide a natural shield against water evaporation during the hot weather.



Typical section of polishing pond

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

Experiments and trials are underway to eliminate the planted filter in the design, used for eliminating the odor, and replace the large device with **a vortex system**.
The vortex system has the advantage of having a tiny implementation footprint but necessitates an electrical supply during day time. Smell control with this device is completely eliminated.

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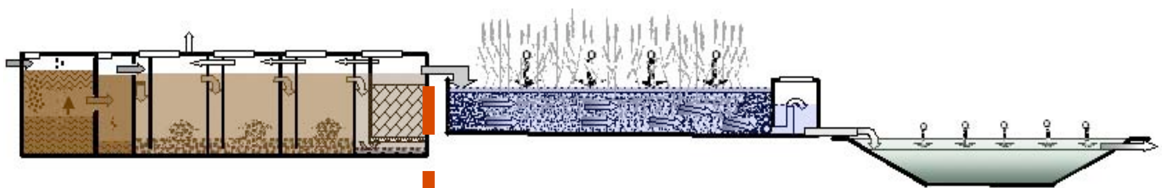
Schematic overview of a decentralised waste water treatment system:



Underground anaerobic treatment

Above ground level aerobic process

CPCB standards are met at this point, except for the smell control

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