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TREATING HIGHER-STRENGTH COMMERCIAL SEWAGE FOR DISPOSAL OR RE-USE

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ABSTRACT

Commercial high-strength sewage may have high organics and nitrogen, variable diurnal and seasonal flows, use of disinfectants and grease-strippers, and fast-food type employees. A 'pre-engineered' treatment process developed to counter these challenges results in a more consistent effluent quality. Consistency is important for nitrogen removal, for difficult disposal sites, and for irrigation or toilet re-use.

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more chemical use “for health and sanitation purposes” the wastewater becomes more and more difficult to predict, and this is a problem for the designer, regulator, and operator. Basically you never know what you are going to get, or when.

This paper describes a treatment process that is ‘pre-engineered’ to counterbalance these surprises and variability of sewage flows. The process can be designed initially or added as a retrofit. The dampened flow and organic peaks al Ts 100 TCn2

Figure 2. Waterloo Biofilter SC-20 shipping container at a truck stop, capable of treating 15-20 m^3/day wastewater. Buried pump and septic tanks are in background.

The grease traps collect kitchen wastewater and discharge to the septic tanks, whereas the toilet and other wastewater discharges directly into the septic tank. Effluent filters on the grease traps are commercially sized Zabel filters, and have an access riser to surface for regular servicing. Septic tanks are set in series and are preferably double-compartment tanks, again with risers to surface to service the effluent filters.

The presence of a grease trap does not guarantee success if deep friers are emptied into the drains, or if excessive disinfectants are used in the facility. Used grease strippers for cleaning fume hoods cannot be disposed of in the grease trap or septic tank, or it will mobilize the grease into the treatment unit, and cause problems.

Closed-Loop Variant

The key component for pre-engineering the sewage variability is a separate, closed-loop BIOFILTER module with 100% return to the surge-pump tank. This BIOFILTER is on its own timed

For tight soils, the basal contact area is sized for a hydraulic loading rate of 15-20 L/m^2/day based on the peak design flow Q. The bed is prepared by scarifying (only on a dry day on heavy clay soil), and by constructing a preferred direction of flow if desired. The mantle is the native topsoil lateral to the sand bed into which excess water infiltrates.

To distribute the effluent, a stone and pipe layer, again 25-30 cm thick, is laid on the sand bed, and sized for a loading rate of 50 L/m^2/day for larger commercial sites, or a smaller 75 L/m^2/day for residential sites.

On flat terrain with heavy clay soil, the Area Bed should be elongated 2:1 or 3:1 and the stone-pipe bed centred on the sand in the same orientation. On sloping terrain, the stone-pipe bed is elongated across the flow direction, and is set toward the uphill side of the sand bed. In sandy soil, a more equant bed is possible because of the greater vertical permeability.

Because they are elongated across flow direction, the lateral loading rate into the adjacent soil mantle is minimized and hydraulically more sustainable (e.g., Tyler, 2001), similar to the 'contour' trenches in Nova Scotia (NSDHF, 1988). Clay soil underlying an Area Bed retains its blocky, topsoil-like structure because it receives oxygenated wastewater in which earthworms can thrive, and is not smothered by a thick pile of sand or soil. Its lateral permeability is retained to remove treated effluent away from the disposal area, and to remove residual pathogens in a free-draining environment.

Shallow-rooted vegetation such as cedars may be planted to remove water from the mantle area. Care must be made in grading to direct surface water runoff away from the bed, a common cause of disposal bed failure. Set-back distances to wells and property lines are dependent on local codes.

Fecal Removal in 'Area Bed'

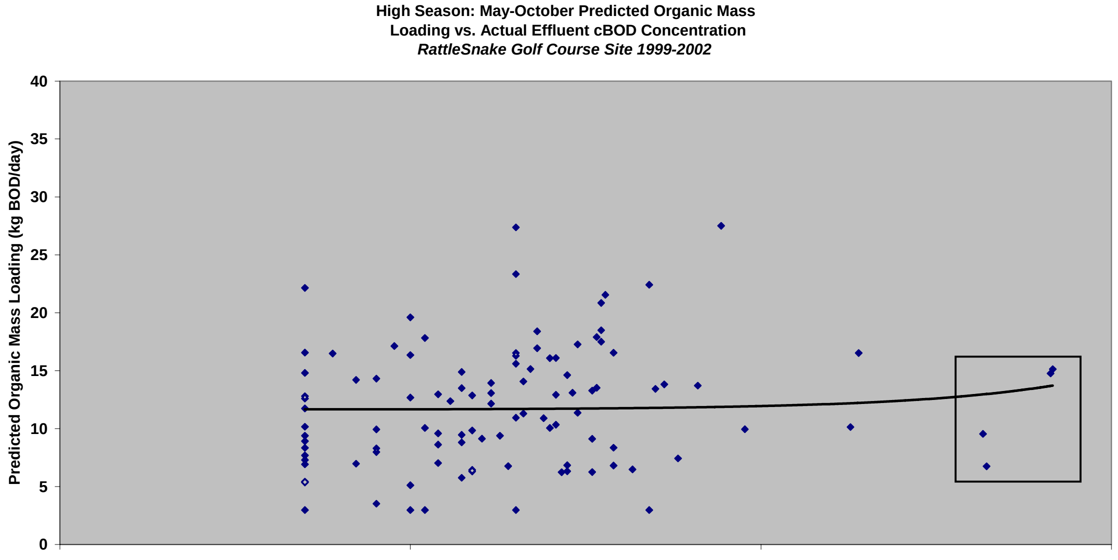
To test the efficiency of fecal removal by the Area Bed sand, a pan lysimeter were placed below 250 mm (10") of medium-fine sand ('loamy sand' with estimated T = 4-5 min/cm (10-12

Low season flows can be considered as the lag phase and the exponential growth must keep pace with the increase in organic mass loadings. Under optimal conditions, the exponential phase can result in a median doubling time of only 60 minutes (Atlas, 1988). If microbes in the Biofilter reproduce quickly enough to degrade the organics, a high quality effluent is maintained. An example of how to predict performance when hydraulic flows jump from 50 m^3/d to 400 m^3/day is described in Jowett et al. (2003).

The example used is a large golf course resort with detailed remote monitoring and wastewater analysis information over the period of 1999 to 2002. Influent samples were taken every month, effluent samples every week, and flow data taken every day. Using influent samples, the relationship between organic mass load from the facility was related to hydraulic flow rate for both low season and high season.

The slight exponential relationship indicates that when the facility is very busy, the wastewater is higher strength. However, there was no relationship between influent mass and effluent concentration in either the low or high season periods, indicating that the Biofilter was sized appropriately to handle low and high mass loadings.

Using this exponential influent mass to hydraulic flow relationship, the mass loadings for every day during the low and high seasons were predicted (Fig. 4). The resulting plots show a distinctive 'step function' jump from low to high season, depending somewhat on the weather conditions for the start of the golf season. The treatment system was designed for the prolonged high season flow with sufficient absorption and microbial attachment sites in the Biofilter medium. The microbial population was able to keep pace with the flow from the 'lag' low season to the 'stationary' high season by exploiting their 'exponential' growth abilities.



Crites, R. and G. Tchobanoglous. 1998. *Small and Decentralized Wastewater Management Systems*. Boston, MA: McGraw-Hill, 1084 p.

Heufelder, G. R. 2003. Buzzards Bay Waterloo test and pan lysimeter results. Unpublished Report for Waterloo Biofilter Systems, September 2003, 3 p.

Jowett, E. C., and M. L. McMaster. 1995. On-site wastewater treatment using unsaturated absorbent Biofilters. *Journal Environmental Quality*. 24: 86-95.

Jowett, E.C., J. M. Rogers, and S. Kirby. 2001. Four golf resorts are re-using treated sewage for irrigation. *Environmental Science Engineering*. 14: 66-68.

Jowett, E.C., H. Millar, and K. Pataky. 2003. Effect of increased flow rate on the microbial population in the Waterloo Biofilter. Unpublished Report for KEO Engineering, June 2003, 14 p.

Millham, N. P., G. Heufelder, B. Howes, and J. Costa. 2000. Performance of three alternative septic system technologies and a conventional septic system. *Environment Cape Cod*. 3: 49-58.

Nova Scotia Department of Health and Fitness. 1988. On-Site Sewage Disposal Systems; Technical Guidelines. Halifax, 78 p.

Tyler, E. J. 2001. Hydraulic wastewater loading rates to soil. In, *Proceedings, On-Site Wastewater Treatment*. 80-86, ASAE 9th