RESEARCH SUMMARY

Effluent Treatment by Aggregate in a Conventional Onsite Wastewater System

February 2006

Treatment of Effluent by Aggregate in a Conventional Onsite Wastewater System.

The aggregate in an onsite wastewater system (OWS) does not provide treatment of septic tank effluent. The 2002 US EPA Design Manual clearly states that the primary function of aggregate in a septic trench or bed is to:

- Support the pipe and spread localized flow
- Help maintain the structure of the excavation
- Expose the applied wastewater to the infiltrative surface
- Provide peak storage for wastewater during peak flows

The aggregate in an OWS was never intended to act as a filter to pre-treat the wastewater nor is it capable of providing significant pretreatment to the wastewater that flows into the system (Otis 1991).

Additional support can be found in a wastewater hydraulic & purification study performed by the Environmental Science and Engineering Department of the Colorado School of Mines (CSM). In this study, four three-dimensional lysimeters ***(Figure 1)*** were built and filled with the same medium sand media. Two were representative of aggregate free (AF) chamber systems, and two for 12" deep aggregate laden (AL) systems. During a 48-week test cycle, each lysimeter was dosed four times daily with septic tank effluent at 5 cm/day for AL systems and 8.4 cm/day (68% more) for AF systems (Van Cuyk et al., 2001).

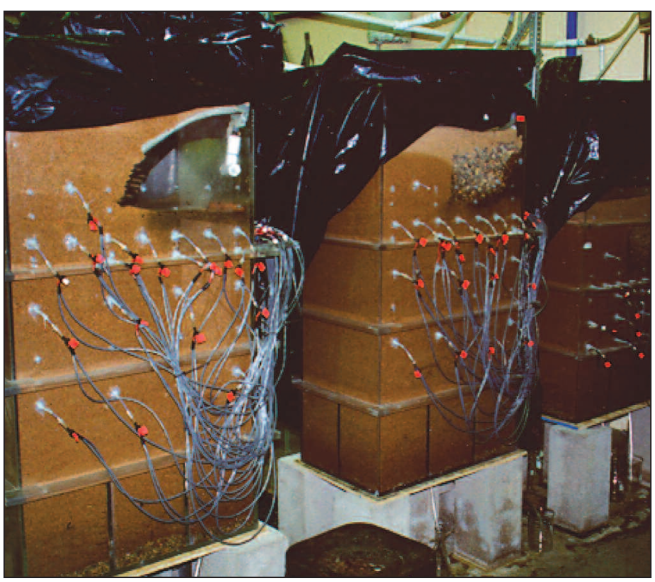

Figure 1*: The 3-D soil lysimeter facilities in the pilot laboratory at CSM. (Only lysimeters L2, L3 & L4 shown.)*

The observations made during this 48-week period concluded that all four lysimeters performed similarly. This demonstrates that under the studied conditions, there was no measurable difference in hydraulic and purification performance between the aggregate free and aggregate laden cells. In other words, the presence of aggregate did not enhance the purification process (***Figure 2***).

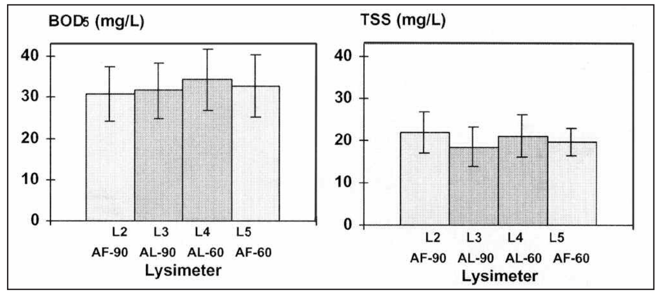

Figure 2*: Percolate composition for alkalinity BOD and TSS during weeks 20-42 of operation.*

Does aggregate provide effluent treatment similar to a "trickling filter"?

Comparing the aggregate in an OWS to the media within a trickling filter system would be inappropriate since both systems operate on different principles.

Trickling Filter System

In a "trickling filter", the filter process is an attached growth process in which wastewater that has undergone primary clarification is distributed periodically over an inert media such as rock or plastic (US EPA 1992). Collected wastewater is usually re-circulated through the media several times to dilute incoming wastewater and provide additional treatment (***Figure 3*** on back).

The wastewater in a trickling filter requires two basic conditions for treatment to take place. First, the active biomass performing the treatment must be well mixed with the wastewater. Second, sufficient oxygen must be supplied to meet the oxygen demand of the biomass in biodegrading the wastewater (Otis 1991). Aggregate alone in an OWS does not provide either of these.

An important mechanism of a trickling filter is the supplied air source. The filter is typically provided with oxygen via air pumps to maintain an aerobic environment. In an aggregate system gravel is not vented. Even when vents are installed, they are passive and do not provide enough oxygen evenly across the base of the

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system. Without sufficient oxygen, treatment is inefficient and incomplete (Otis 1991).

Another major drawback/characteristic of trickling filter systems is the biological sludge that is produced during the treatment of the effluent. This sludge must be removed periodically in order for the system to perform properly. Neglecting this step will cause the filter to clog and the system to fail.

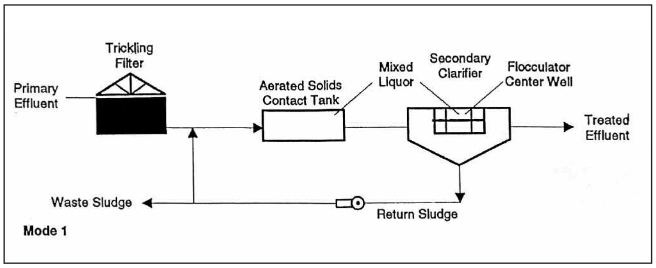

Figure 3: *Schematics of trickling filter-solids contact processes.*

Conventional Aggregate System

In a conventional aggregate and pipe system ***(Figure 4)***, the purification performance of the system relies primarily on treatment of the wastewater effluent in the un-saturated soil horizon below the dispersal and infiltration components of the OWS (US EPA 2002). The soil's surface provides sufficient area for the biomat to grow. The growth of the biomat allows wastewater to evenly permeate through the soil column while allowing the diffusion of air into the empty soil pores (Otis 1991).

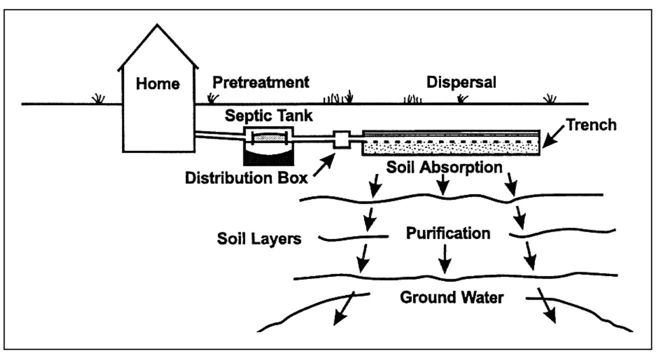

Figure 4: *Lateral view of conventional OWS-based system.*

Does the aggregate in a conventional onsite wastewater system provide treatment of effluent?

There is no evidence that the stone in a conventional onsite wastewater system provides any treatment. The biomat, not the stone, is the mitigating factor for the treatment of effluent in a conventional system.

If the stone does not provide treatment why is it there?

- Support the pipe and spread localized flow
- Help maintain the structure of the excavation
- Expose the applied wastewater to the infiltrative surface
- Provide peak storage for wastewater during peak flows

If aggregate does not provide treatment, how does treatment occur?

The wastewater effluent will travel downward through the aggregate until it meets the soil interface below the stone. As wastewater infiltrates and percolates through the permeable unsaturated soil it is treated through a variety of physical, chemical, and biochemical processes and reactions. The most active zone of treatment is called the infiltration zone. This zone is responsible for the formation of the dark treatment layer known as the "biomat".

Why does a chamber system out-perform aggregate systems?

As demonstrated by the Van Cuyk study, chamber systems, even when sized smaller than an aggregate system, provide a greater interface area for the "biomat" to form. Chambers provide a larger and more effective treatment area.

References:

Otis, Richard J., P.E., Owen Ayres & Associates. (July 24, 1991). [Correspondence with Judd Efinger, Infiltrator Systems Sales Associate].

United States Department of Environmental Protection. (September 1992). Wastewater Treatment/ Disposal for Small Communities Manual, p. 91.

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Van Cuyk, S., Seigrist, R., Logan, A., Masson, S., Fischer, E., & Figueroa, L. (2001). Hydraulic and Purification Behaviors and Their Interactions During Wastewater Treatment in Soil Infiltration Systems, Dept of Environmental Science & Engineering, Colorado School of Mines, Golden, CO. Water Resources, 35 (4), pp. 953-964.

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