Bench Scale Gray Water Treatment System

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EXTENDED ABSTRACT

The purpose of this design project was to model the treatment of gray water using four different treatment systems. Gray water is wastewater generated from domestic activities such as laundry, dishwashing and bathing, which has the potential to be reused on-site for irrigation and/or toilet flushing. The goal of the study was to determine the operational characteristics of a gray water treatment system.

The bench scale model that was used had several components. Influent was held in a chilled 25-L container. Chilling was accomplished by partially submerging the container in an ice bath. A mechanical stirrer was used to keep solids in suspension. Influent was pumped from this tank to the treatment system using a bilge pump. The treatment system can be used to model up to four unique processes. Primary treatment is applied in one of two 10-L vessels. This treatment is followed by secondary treatment in one of four 4-L vessels. All vessels are covered to prevent algal growth. Effluent from the 4-L vessels discharges into beakers for sample collection and flow analysis. Residence time of the system is an important design parameter and was evaluated via a tracer study. This was done by using a feed solution with a known concentration of P-nitrophenol and then monitoring the flow rates and P-nitrophenol concentrations throughout the system. The concentrations measured were compared to mass-balance predictions.

Four different treatment techniques were modeling in a 2-week study of the system. The treatment techniques modeled were detention time, detention time with UV-C radiation, detention time with aeration and detention time with aeration and UV-C radiation. The aeration treatment trains use microbial growth to treat the gray water while the detention treatment trains rely primarily on settling for treatment. The UV system works by using special arc lamps that sterilize bacteria and prevent them from reproducing. The effectiveness of these treatment processes was analyzed by performing 5-day biochemical oxygen demand, chemical oxygen demand, total solids and suspended solids tests. Through comparison of the experimental results, the effectiveness of each treatment process can be determined.

Key findings of this study include the effect that UV-C radiation has on disinfecting the gray water. In both the un-aerated and aerated trains, the treatment with radiation showed the largest reduction in bacterial levels. Results also suggest that the composition of the gray water, low substrate concentration, does not support the aerobic growth of microorganisms that would normally be used to treat wastewater.