Utilization of a Fermentor to Support "Enhanced Biological Phosphorus Removal" (EBPR) with Dairy Wastewater

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Eutrophication in receiving waters is a big concern for the environment due to algae blooms consuming the dissolved oxygen available for aquatic life. Nitrogen and phosphorus are both important for eutrophication to occur; however, phosphorus is the limiting nutrient, and is therefore the key to preventing algal blooms.

Land application of wastes from dairy farms is a significant source of nutrient flow into receiving waters. If the nitrogen:phosphorus ratio in dairy waste can be increased to meet the nutrient demand of crops, then phosphorus runoff can be minimized. The ratio can be increased by removing phosphorus from wastewater. Phosphorus removal from dairy wastewater can be achieved by chemical precipitation, which is costly to the farmers. Enhanced biological phosphorus removal (EBPR) is a biological way to remove phosphorus from wastewater, and is the process considered in this study.

It is known that EBPR systems are designed to have alternating anaerobic (absence of oxygen) and aerobic (presence of oxygen) conditions. Using this strategy, EBPR is accomplished by enriching for a culture of bacteria called phosphorus-accumulating organisms (PAOs). PAOs, which grow slower than most wastewater bacteria, are able to store volatile fatty acids (VFAs) in their cytoplasms during the anaerobic phase and convert them into a storage compound called poly-β-hydroxybutyrate (PHB). This storage process allows PAOs to take up extraordinary amounts of phosphorus during the subsequent aerobic phase, thereby removing the harmful phosphorus from the wastewater effluent.[*]

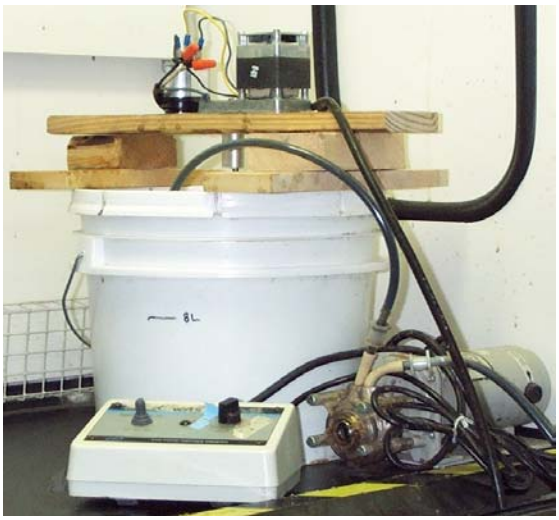

Figure 1: Fermentor setup with the peristaltic pump and controller.

A fermentation step prior to the anaerobic stage of EBPR can significantly favor growth of PAOs because they preferentially use VFAs as a food source. In this study, a fermentor has been set up and operated to maximize the amount of VFAs within the system (see Figure 1). The feed to the fermentor is screened dairy wastewater from Virginia Tech's Dairy Science facility. The bacteria in the fermentation reactor first hydrolyze (break down) complex, biodegradable particles found in the feed. This step is followed by the fermentation step, which involves production of acetic acid (a prominent VFA), some other VFAs, and some alcohols. This research project will expand in the future and will include an evaluation of one aspect of the operating EBPR system. To date, the fermentation work is well underway. We anticipate presenting a poster that highlights the benefits of applying fermentor-supplemented EBPR to dairy waste, and the operation, maintenance and performance of the fermentor to date.

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