PERFORMANCE EVALUATION AND YIELD DETERMINATION FROM A FULL-SCALE BIOLOGICAL AERATED FILTER

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Abstract

Biological aerated filters (BAFs) are an emerging wastewater treatment technology designed for a wide range of municipal and industrial applications. BAFs utilize an inert media, either dense granular or floating, which supports biomass retention in the filter bed. BAFs offer an alternative to typical biological treatment processes; however, knowledge of the process is often limited, especially in the US market. Through various studies, process improvements were made for filter media selection, backwash protocols, and hydraulic load effects.

During the summertime monitoring, seeded and unseeded nitrified effluent BOD_5 samples were performed on a full-scale BAF. Discrepancies were found between seeded and unseeded samples, which warranted further investigation. Four biological treatment seeds and a commercial microbial seed were screened for appropriate seed volumes in comparison to the glucose:glutamic acid (GAA) assay, a standard for BOD_5 analysis. After initial screening, a range of seed samples was applied to the BAF effluent for BOD_5 and $cBOD_5$ analysis, and to GGA and carbonaceous GGA (cGGA) analysis. A proposed seed screening protocol was developed using a ratio of measured BOD_5 values in comparison to theoretical GGA standard BOD_5 values.

Biomass observed yield values were calculated for the full-scale BAF. Three individual mass balances were conducted to quantify the consumption of soluble COD in the filter and the mass of influent particulate matter filtered from the waste stream. Retained particulate matter is a substrate source for the biomass; however, the particles must be hydrolyzed into metabolizable monomers before being consumed by the biomass. A bench-scale BAF was designed and constructed to investigate the degree to which

particle hydrolysis occurred in the full-scale system. Additionally, fluorescein diacetate was used during one of the experiments as a model particulate substrate to quantify the activity associated with hydrolytic enzymes in the bulk-liquid. Hydrolytic activity by cell-free extracellular enzymes in the bulk-liquid increased when particle substrate was present. Therefore, it appears that cell-free extracellular enzymes participate in the hydrolytic mechanism for particle degradation. Biomass observed yields were calculated for the full-scale BAF using full-scale mass balances and bench-scale particle hydrolysis experiments.