ANALYSIS OF A PILOT-SCALE ANAEROBIC BAFFLED REACTOR TREATING DOMESTIC WASTEWATER

ABSTRACT

This thesis presents a chemical, microbiological and mathematical analysis of an anaerobic baffled reactor (ABR) treating domestic wastewater. The purpose of this study was to gain an understanding of the mechanisms of treatment of domestic wastewater in an ABR at pilot-scale, and to use this understanding to develop some guidelines for the design of ABR technology for the anaerobic treatment or pre-treatment of domestic wastewater. Previous research has been undertaken on ABR technology, but no detailed studies of the performance of an ABR on domestic wastewater at pilot-scale have been reported.

In this thesis, operating data from a 3 000 ℓ pilot-scale ABR are presented and analysed. Two hypotheses were proposed: that (i) the baffled design of the reactor would facilitate phase separation whereby acidogenic and methanogenic processes predominate in different physical locations in the reactor; and (ii) the critical design parameter is the applied hydraulic retention time.

The principle findings of this research were:

- The pilot-scale ABR functioned as a solids retention device. Particulate material was retained through settling in the first compartment, forming a gel-like matrix. Reduction of solids occurred through anaerobic conversion to CH_4 and CO_2.

- Partial phase separation of acidogenic and methanogenic communities was observed.

- The major factor that controlled biomass washout rate and therefore reactor performance was upflow velocity in each compartment. At higher upflow velocities, slow growing micro-organisms failed to establish, resulting in increased solids accumulation rates, while at lower upflow velocities, stable digestion proceeded.

- Relatively poor treatment rates were obtained due to the low inherent alkalinity of waters in eThekwini municipality resulting in low operating pH values.

- Insufficient pathogen reduction was observed indicating that post-treatment of effluent would be required.

It was concluded that the benefit of the baffled design was related to the system's solids retention characteristics and that the critical design parameters for an ABR domestic wastewater treatment unit were compartment upflow velocity and applied hydraulic retention time.