ABSTRACT

Sears, Keith J. Ph.D., Purdue University, May, 2004. Feasibility of Recovering Active Bacteria From Waste Activated Sludge. Major Professor: James E. Alleman.

The purpose of this study was to investigate the feasibility of recovering active biomass from waste activated sludge. It was hypothesized that if active bacteria are recovered from waste sludge and subsequently recycled back to the activated sludge reactor, multiple process benefits could be realized. Computer modeling revealed that under typical operation, activated sludge flocs contain approximately 60% non-bacterial components (i.e., inert particulates, unbiodegradable particulate organics, and particulate endogenous residues). These components accumulate in the activated sludge reactors, increasing the necessary reactor volume needed for treatment. It was determined through density measurements that these non-bacterial portions of floc exhibited higher density values, and therefore, it was theorized that separation between activity fractions may be possible. Prior to any differential separation it was concluded that a disaggregation step was required to initially separate flocs into discrete particles. A series of deflocculation alternatives were investigated with ultrasonic irradiation being the most successful. The results of these experiments indicate that ultrasonic irradiation of activated sludge followed by 30 minutes of settling can produce a supernatant with heterotrophic specific oxygen uptake rates (SOURs) of over 2 times the SOUR measured in the bulk mixed liquor. It was estimated that approximately 26 percent of the initial heterotrophic activity could be recovered within only 11% of the initial volatile mass. This increase in

supernatant SOUR is a result of the release of slow/non settling bacteria from the activated sludge floc during ultrasonic irradiation. This release allows the biological activity of the supernatant to increase at a rate which is correspondingly higher than the increase in particulate organics. Autotrophic bacterial analysis revealed that nitrifying organisms, while sensitive to the effects of ultrasonic irradiation, can similarly be recovered. The optimal irradiation density to recover ammonia oxidizers was lower than the ultrasonic density required for heterotrophic bacteria. A density of 200 W/L with an exposure time between 1 and 2 minutes produced a supernatant with a specific ammonia removal rate of over 2 times the initial mixed liquor SOUR.

Deflocculation using sulfides also provide successful disaggregation of activated sludge flocs. However, the toxic impact to ammonia oxidizers was deemed too significant for this to be a successful deflocculating alternative. The results indicate that under catabolically-active conditions enhanced cultures of ammonia oxidizers were extremely sensitive to the presence of sulfide. Similar sulfide impact tests conducted with inactive ammonia oxidizers exposed during anaerobic conditions, albeit at higher dosage levels, also revealed that their subsequent aerobic activity would correspondingly be retarded.