VOLATILE FATTY ACIDS

Effect of Preacidification of Wastewater

Field experience with UASB reactors have shown that nonacidified wastewater give rise to more abundant granular growth than the wastewater in which carbohydrates are first all fermented to lower volatile fatty acids (VFA) [Vanderhaegen *et al*., 1992, Thaveersri *et al*., 1994, Weigant *et al*., 1983]. More complex soluble substrates such as sugar solutions give rise to very satisfactory granulation of the seed sludge. Also, the granules cultivated on carbohydrates do not deteriorate on feeding it with acidified wastewater [Wiegant *et al*., 1983].

It must be stated that granular sludge can be formed in reactors entirely fed with low-energy COD, such as lower VFA. Yet, in these systems, sludge bed doubling times are of the order of several months and the granules are rather small and fragile. In the treatment of vinasse it was reported that fresh vinasse gave rise to effective sludge bed growth, the granular yield observed was 10 times than preacidified vinasse [Vanderhaegen *et al*., 1992]. Similar observation was made while dealing with tannery wastewater. It was observed that one stage treatment showed better performance than two-stage system [Groenestijn *et al*., 1995]. Physical separation of methanogens and acidogens in two-phase system cannot enhance anaerobic bioconversion rates since; the necessary interspecies hydrogen transfer function is disturbed [Harper and Pholand, 1986].

Jhung and Choi [1995], have reported that higher COD/VA ratio favors granulation. For a lab-scale UASB reactor for complex carbohydrate waste treatment no granulation was observed at COD/VA ratio of one. When the ratio was increased to two the granules of 2 mm size were observed. Also, for the treatment of VFA mixture under thermophilic condition no granulation was reported [VanLier *et al*., 1994].

However, preacidification of sucrose was reported to be necessary to avoid bulking problems due to fluffy granules in UASB reactors operated at high loading rates. The maximum SLR for non-acidified sucrose was 0.5 kg COD/kg VSS.d. the maximum COD loading rate of 20 kg COD/ m^3.d. could be achieved due to bulking problems in UASB reactor [Angenent and Shihwu, 2001]. Absence of pre-acidification can create bulking problems due to abundant acidogenic bacteria at the surface of granules in UASB reactor operated at high loading rates.

In the study of biogas generation rate in a two-phase UASB reactor treating distillery wastewater, very low biogas developing rate was observed [Shin *et al*., 1992] than the biogas production rate reported for similar wastewater [Wiegant *et al*., 1985]. Granulation was observed in both acidogenic and methanogenic reactor, but the time required for granulation was much more than the single stage system.

It is reported that, during start-up, high VFA concentration i.e. greater than 300mg/L as acetic acid is not favorable for cultivation of good granular sludge. It is suggested that, during start-up, OLR should not be greater that 4.5 kgCOD/m^3.d and SLR should not be greater than 0.3kg COD/kgVSS.d. to avoid high concentration of VFA inside the reactor [Ghangrekar 1997]. It is reported that, during favorable loading condition of start-up i.e. at OLR 2.8.5kg COD/m^3.d and SLR 0.15-0.25kgCOD/VSS.d, VFA concentration in the reactor was also within the acceptable limit for proper granulation.

All these experiments clearly suggest that to achieve in-reactor granular growth, the feed should contain substantial amount of fermentable sugars. Also, syntrophic association of hydrogen oxidizing bacteria and hydrogen producing bacteria is important for granulation.