SUITABLE WASTEWATER TYPES

Wastewater Composition

The composition of wastewater plays an important role in granulation process. The presence of high hydrogen partial pressure (pH_2) in the lower portion of sludge bed is reported to be essential for granulation [Wentzel *et al*., 1994]. This pH_2 is then brought to low values at upper portion of sludge bed by the action of hydrogenotrophic methanogens. Thus, a partial phase separation occurs at the bottom of the sludge bed which is helpful for granulation and hence, granulation mainly takes place in this zone. To create an environment with a high pH_2 in an anaerobic fermentation system, the influent substrate must be able to generate H_2 at a high rate during acidogenesis. Substrates that fall into this category are carbohydrates or proteins in soluble (and, possibly colloidal) form. Industrial wastewaters from sugar industry, breweries, apple juice, yeast factory, and grape wine satisfy this criterion and give granulation in UASB reactor [Wu *et al*., 1987, Wentzel *et al.*, 1994].

For waste containing mainly proteins, granulation proceeds satisfactory; but problems may arise from foaming and protein precipitation under conditions of overloading or low pH less than 6.0 [Grin *et al*., 1983, Souza, 1986, Shin *et al*., 1992]. More importantly, they release ammonia upon degradation, which may exert an inhibition effect on microbial activities. High SS concentration in influent can affect granulation and performance of the reactor adversely. The influent SS concentration shall be less than 1 g/L and SS to COD ratio shall be less than 0.5 for successful operation of the reactor [Souza, 1986].

For waste that contains substrates, which do not yield hydrogen in the fermentation process (short chain fatty acids), granulation will not takes place. No granulation in the UASB reactor was reported for acetate only as substrate. For the waste where H_2 generated is preferentially utilized by other organisms such as sulphate reducers, granulation is limited because of reduced amount of H_2 available to the hydrogenotrophic methanogens e.g., paper pulping waste. However, the granular yield does not reduce to zero even when SO_4 supplementation is in excess [Russo and Dold, 1989]. For the waste containing substrates that can be broken down only under low H_2 partial pressure conditions, no high pH_2 zone will develop and granulation will not take place e.g. lipids, oleate [Wentzel *et al*., 1994].

SUITABLE WASTEWATER TYPE

Typical industries where UASB reactors are reported to be most successful for wastewater treatment are beet sugar, cane sugar, starch, breweries, dairy, tannery, food processing industries and paper and pulp. This process is also proved to be feasible for the treatment of domestic wastewater. The feasibility of this process has already been proved for these wastewater in wide COD range from 500 to above 10000 mg/L. The treatment is feasible under both mesophilic and thermophilic conditions but temperature above 15^{o}C is essential for proper treatment [Bogte *et al*., 1993]. When wastewater is mostly in biodegradable form efficiency of COD removal of 85 to 90% can easily be achieved with this process, with short hydraulic retention time of 6 to 12 h. When the wastewater is not easily biodegradable COD removal efficiency of 60 to 80 % can still be achieved. Once, the proper start-up of the reactor is achieved with generation of good quality of granular sludge, having good settling characteristics and activity, very high Organic Loading Rates (OLR) greater than 30 kg COD/m^3.d can be applied.