

## 5 Conclusions and Recommendations

### 5.1 Conclusions

According to the results of this pilot scale study, it can be concluded that UASB reactions can be used successfully to achieve 70 – 75% COD removal from high strength wastewaters, at ambient temperature (28° C).

The main design criteria for successful performance of UASB are the organic loading rate and overflow rate, while important operational criteria are pH, alkalinity, sludge, seeding and acclimatization.

The volumetric organic loading rate can be as high as 15 kg COD/m<sup>3</sup> .day when the sludge is well acclimatized and VSS has reached more than 20,000 mg/l. However, the up flow rate has to be less than about 0.13 m/hr in order to prevent washout of sludge. These two design criteria determine the cross sectional area and height required for a reactor, operating in the flocculent sludge regime.

Gas collection and utilization or flashing arrangements also should be provided.

The pH of the reactor contents should be maintained above 7.0 in order for the methanogenic bacteria to grow. Since acidogenesis and acetogenesis lower the pH value, the alkalinity should be high to buffer the reactor contents.

Buffering can be done by either adding chemicals, or recycling part of the effluent back into the reactor with the influent, a recirculation ration of 0.5:1 produced good results in the study.

Granulation of sludge could not be obtained even after 85 days of stable operation. This is perhaps due to the low upflow velocities used in the study.

The methane gas produced was much less than that expected from theoretical calculations. This aspect needs to be studied further as the gas produced could provide economic advantages to the industries.

## **5.2 Recommendations**

UASB reactors seem to be a technically feasible method of reducing the BOD and COD of high strength waste water by 70 – 75% under ambient conditions and volumetric organic loading rates of up to 15 kg/m<sup>3</sup>.day provided well acclimatized seed sludge is used at the start up.

Causes for low gas production should be further investigated, so that UASB can be made attractive to the industries as a source of cheap energy.

The upflow velocity has to be controlled in order to prevent washout of sludge. However, it is reported that higher up flow velocities (> 0.8 m/hr) are required to produce sludge granulation. It is also reported that granulated sludge improves the performance of UASB reactors remarkably. Further studies are needed to determine the conditions need for formation of granules under the ambient conditions.