Alcohol and Distillery Wastewater

Distilleries use different kinds of raw materials such as sugarcane juice, sugar molasses, or corn for production of alcohol. The use of different materials and the different processes applied, result in a wide variety of effluents produced. The process conditions under which good results of the anaerobic process are obtained depend heavily on the type of the distillery effluent being treated. The choice of the right set of process parameters for every type of distillery effluent has shown to be crucial importance for the anaerobic process.

Anaerobic treatment with the UASB process has shown to be a feasible method of treating alcohol distillery effluents. Several types of vinasse including evaporator condensate have been treated successfully by the Biopaq-UASB system. COD removal efficiencies in the range of 65-90% could be achieved, largely depending on the kind of feedstock used and depending on the process conditions in the distillery. Similar treatment studies are reported by applying volumetric loading rates up to 22 kg COD/ m^3.d with COD removal efficiencies up to 88%. Production of good quality granular sludge has been confirmed.

Anaerobic treatment of recalcitrant distillery wastewater by a thermophilic UASB reactor has been reported by Hideki Harada *et. al,* [1996]. In another publication treatment of distillery effluent with the UASB process has been discussed by Driessen, *et. al.* [1994]. The treatment of cane molasses based vinasse has been reported successful at volumetric loading rates up to 10-15 kg COD/ m^3.d with COD removal efficiencies of 65-70 %. It has been stated that the use of granular anaerobic sludge is not a prerequisite since well settleable heavy flocculent sludge is formed. Wine vinasse is also very well anaerobically biodegradable. At volumetric loading rates up to 20 kg COD/m^3.d, COD removal efficiencies of 90-95% are reported. Condensate from a beet molasses based distillery is reported to be easily biodegradable. COD removal efficiencies of 85% have been achieved at a volumetric loading rate up to 18 kg COD/ m^3.d [Bal and Dhagat, 2001].

A two-phase UASB system was studied by Shin, *et.al.,*[1992] for high-rate treatment of concentrated distillery wastewater. The phase separation was obtained by adjusting pH in each reactor. When Influent SS concentration was 4.1g/L, the first phase UASB reactor was effectively operated applying loading rate up to 16.5 kg COD/m^3.d. In the methanogenic UASB reactor, loading rates up to 44 kg COD/m^3.d could be applied resulting in removal of

80% of influent COD with a specific gas production of 16.5 L/L.d. A two-phase UASB system was operated to investigate its efficiency and the morphological characteristics of both acidogenic and methanogenic granular sludges [Shin *et.al.,*1992]. From the investigated results, the following conclusions were made.

1. Efficient phase separation was obtained by adjusting pH in acidogenic and methanogenic reactors.
2. The acidogenic granular sludge, formed after 90 days of operation, consisted of long chain of large rods, short plump rods and cocci of various sizes, which have different shapes and cytoplasmic appearances from common methanogenic bacteria.
3. Long multi-cellular filaments of *Met.hanothrix* species with diverse entrapped bacteria were prevalent in the methanogenic granule, which formed on 120^{th} day.
4. It is expected that extensive microscopic studies in acidogenic granular sludges should help in understanding the granulation process.

Start-up performance of the modified UASB process in four winery plants was investigated by Cheng, *et.al.,* [1990]. A pilot scale experiment was conducted on alcohol distillery and wastewater treatment with UASB by Shen Li-Xian, [1985]. During a period of 11 months, COD reduction of 90.8% and BOD reduction of 97.5% was obtained. A pilot plant of 6 m^3 capacity was operated for 5 months for a nutrient deficient wastewater for corn-ethanol production as a pretreatment technology using UASB process. The treated effluent was further subjected to secondary treatment (aerobic trickling filter), which resulted in good quality effluent satisfying international standards for water pollution control [Sax, 1985]. At 9.3 kg COD/m^3.d organic loading and 9.4 h hydraulic retention time, about 76% COD and 88% BOD removal efficiencies were achieved in UASB reactor.