EXPERIENCE WITH MBR-SYSTEMS FOR CLEANING HIGHLY LOADED ORGANIC WASTE WATER

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ABSTRACT

Two large scale case studies of MBR systems for cleaning highly concentrated waste water are presented and the design approach is thoroughly presented and discussed. Also several problems during start-up are addressed.

1. Background

Membrane Bioreactor Systems are well known and established for a wide range of applications nowadays. Due to the ability to adjust and control sludge age and to decouple hydraulic and sludge residence time it is possible to reach high degradation rates even for "hard" organic compounds (expressed via parameter chemical oxygen demand - COD) which are present e.g. in landfill leachate. Anyhow the membrane separation process demands more energy than conventional sludge sedimentation. Especially if highly concentrated organic waste water is processed the energy demand becomes significant also in terms of operating costs and therefore an anaerobic pre-treatment is often considered as alternative.

2. Aim

In the paper practical experience from two projets is presented. First case describes a full scale MBR installation to treat landfill leachate with a COD concentration of 25 kg/m³ and an Ammonia concentration of 4 kg/m³. As second case a MBR plant to clean waste water from renewable fuel production and from an animal fat refining with a average COD concentration of 150 kg/m³ and poor nutrient content is presented.

3. Method

Results from theoretical design based also on simulation models and from laboratory testing stage are presented and compared to data obtained from start-up of the full scale plants.

4. Main Results

Looking at the leachate treatment installation the elimination of high Nitrogen content by a nitrification/denitrification regime asks for a sufficient supply of carbon source. Therefore an anaerobic pre-treatment was not taken into account, since it would deplete COD. It became clear already a few weeks after beginning of operation that the exergy from the biological oxidation process had been under estimated. On the other hand an ammonia effluent concentration of below 20 mg/l had to be ensured in order to prevent the process to be stalled. As positive aspect the ceramic membrane is in operation since 18 years now.

Since the highly loaded organic waste water in the second case contains only a minor ammonia concentration an anaerobic pre-treatment was thoroughly tested in pilot scale on-site. Due to insufficient nutrient supply and/or toxic ingredients in the waste water and/or improper reactor design a stable operation could not be ensured. Also the biogas would show a very high content of hydrogen-sulfide and the amount would be too low to yield significant revenue if used as fuel in an existing steam boiler. It was proven by on-site pilot tests that an aerobic MBR is much less sensitive to process fluctuations and also toxic ingredients. Consequently the large scale plant was built as aerobic MBR, taking into account the drawback of significantly higher energy costs. After adjusting nutrient supply and anti-foam measures during start-up the plant ensures now the stipulated emission limits and the cross-flow organic membrane unit is performing excellently.

KEYWORDS

Membrane Bioreactors MBR, Microfiltration, Ceramic Membranes (Scale-Up)