*Desalination and Water Treatment*
www.deswater.com

34 (2011) 389–393
October

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doi: 10/5004/dwt.2011.2885

# Zero discharge fermentation plant design

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Received 3 September 2010; Accepted 3 January 2011

**ABSTRACT**

In recent years, there has been an increasing thrust towards zero-discharge operation of wastewater treatment plants. This has been driven by increasingly stringent discharge standards, as well as financial benefits stemming from the recycling of water around such facilities. The molasses-based fermentation industry is associated with high consumption of water and a high generation of high-strength effluent, due to the widespread use of molasses feeds. Traditional biological treatment for this effluent is incapable of meeting stringent discharge and reuse standards; therefore it must be supplemented with tertiary treatment options. The main options for water recovery are reverse osmosis (RO) membrane filtration and evaporation. The main problems for these treatment options is the high energy consumption associated with their use and the requirement for pre-treatment leading up to the RO stages. This paper will compare potential treatment options for high water recovery from the high-strength effluent generated by distilleries and yeast production plants on an economic basis, incorporating both operating costs and capital costs. Treatment options are considered for several different effluent sources. This includes a comparison of the use of both reverse osmosis and evaporation technology for water recovery on end-of-line effluent streams. The potential for a salt recycle from the end-of-line streams to pre-fermentation stages is explored as well as decolourisation of the molasses feed. This paper will also demonstrate the potential for energy integration between the biological treatment stages and the tertiary "polishing" stages. The biogas produced in the anaerobic digestion stage can be used to generate enough electricity to power the following treatment stages, while maintaining a high water recovery (>80%). This paper builds upon the work of Ryan et al. [1]. In their paper, the authors overestimated the levels of TDS reaching the RO stages. They failed to account for the ability of both the aerobic digesters and the nanofiltration treatment stages to remove TDS from the effluent. This paper then focuses on the potential for water recovery from a molasses-based fermentation plant and compares treatment technologies for this water recovery.

*Keywords:* Fermentation plant; Membrane filtration; Microfiltration; Nanofiltration; Reverse osmosis; Water recovery; Zero-discharge

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*Presented at the AMS6/IMSTEC10, The 6th conference of the Aseanian Membrane Society in conjunction with the 7th International Membrane Science and Technology Conference, Sydney Australia, November 22–26, 2010*