VALORIZATION OF DAIRY INDUSTRY EFFLUENTS USING MEMBRANE TECHNOLOGY

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ABSTRACT

The dairy industry is the source of large quantities of food processing wastewater. In general, dairy wastewater streams, that contain relatively high concentrations of organic matter such as proteins, carbohydrates and lipids, are characterized by variability in composition and flow rates due to batch processing of various products[1]. In recent years, research is focused on valorization of industrial waste-waters including those from the dairy industry [2,3]. The work presented herein is part of a EC-H2020 project (SPOTVIEW - *Sustainable Processes and Optimized Technologies for Industrially Efficient Water Usage*) focusing on two relevant targets: a) Selection of appropriate novel separation processes for the recovery/recycling of valuable substances from selected effluent streams. b) Process development for valorization of various effluent streams (currently processed in conventional wastewater treatment facilities) for energy recovery and significant water savings. A novel technology, involving sequential anaerobic membrane bio-reactor (anMBR) and aerobic bio-reactor (aMBR) treatment, has been systematically investigated, under different organic loading rates, for efficient effluent treatment and biogas production.

Regarding recovery/recycling of valuable compounds, two types of streams (designated as “flushing milk” and “flushing yogurt”) were studied. These streams result from flushing of equipment, processing milk and yogurt, with water meeting hygienic standards. The following four types of membrane processes were systematically examined at CERTH: Microfiltration (MF), Ultrafiltration (UF), Micellar enhanced Ultrafiltration MEUF) and Nanofiltration (NF). The main results of the experimental study are summarized as follows.

- Microfiltration exhibits poor useful compound retention/selectivity; thus, it is considered inappropriate for the particular effluent treatment task.
- Particular types of UF membranes exhibit satisfactory selectivity and modest energy consumption.
- Nanofitration exhibits the best retention/selectivity; however, due to increased feed-pressure requirements, energy consumption is significant.
- Micellar-Enhanced UF (MEUF) does not lead to increased separation-process efficiency, for the fluids tested; considering also the cost of required surfactants, it does not hold advantages over regular UF.
- Submerged-type UF membranes is a particular version of UF technology that emerges as the best choice overall, for the purpose of this study. This UF membrane type is characterized by relatively high selectivity, low fouling tendency and performance stability as well as relatively low energy consumption.

Concerning effluents from dairy products processing, to be fully exploited, these are mainly by-product streams (i.e. UF permeate, fat-free whey and whey) that are characterized by high organic load (>60,000 mg/L COD). The overall performance of a lab-scale anaerobic/aerobic membrane bioreactor (MBR) system is considered quite satisfactory for the treatment and valorization of such dairy effluents with significant organic load. In particular, the removal efficiency of organic matter (i.e. TOC removal) was > 99% whereas the biogas production rate was determined to be >75 % of the theoretical methane production yield. Finally, the resulting effluent from the final stage of anaerobic/aerobic MBR was of high quality, thus permitting its reuse/recycling for water conservation.

ΒΙΒΛΙΟΓΡΑΦΙΑ

[1] Britz TJ, van Schalkwyk C, Hung YT. (2006) *Waste treatment in the food processing industry*: 1-28.

[2] Balannec B, Gesan-Guiziou G, Chaufer B, Rabiller-Baudry M, Daufin G. (2002) *Desalination*,147: 89-94.

[3] Hamoda MF, Al-Awadi SM. (1996). *Water Sci. Tech.*, 33 (10-11): 79-85.