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Pharmaceutical wastewater treatment by membrane bioreactor process – a case study in southern Taiwan

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Abstracts

A pilot-scale study of pharmaceutical wastewater treatment by a membrane bioreactor (MBR) process in southern Taiwan is presented in this paper. A 10 m^3/day capacity MBR plant consisting of an aeration tank and a membrane bioreactor was installed to remove organic matter (measured in terms of chemical oxygen demand (COD)). The performance of the MBR was monitored for a period of 140 days. The removal of COD was on average over 95%. The effluent did not contain any suspended solids. During the 140 days of operation, manual cleaning was carried out twice and chemical cleaning was carried out once. A natural logarithmic evolution of the viscosity with TSS concentration was observed. The results of SEM and EDX demonstrated that the fouling on the membrane outer surface was mainly due to microorganisms and/or the sludge physiological properties. The results indicated that the MBR system has potential as a means of treating high-strength and fluctuating strength wastewater with consistent performance.

Keywords: Membrane bioreactor; Pharmaceutical wastewater; Viscosity; Scanning electron microscope

1. Introduction

The existence of pharmaceutical substances in the aquatic environment and their possible effects on living organisms are a growing concern [1].

The treatment of pharmaceutical wastewater to the desired effluent standards has always been difficult due to the wide variety of the products that are produced in a drug manufacturing plant.

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Variable wastewater composition and fluctuations in pollutant concentrations cannot be treated by conventional treatment plants. Activated sludge process is a well-known process for removing various organic contaminants and organic carbon. However, the substances synthesized by pharmaceutical industries are organic chemicals that are structurally complex and resistant to biological degradation [2].

The use of membrane bioreactor (MBR) in wastewater treatment is becoming increasingly important, because they offer several advantages, i.e. high biodegradation efficiency, smaller footprint and less sludge production [3].

Recent literature shows that MBR can be effective in removing these emerging contaminants. During the last three years research results were published in this particular area, reflecting the growing number of MBR applications for treatment of specific chemical compounds, such as pharmaceuticals, fragrances and endocrine disrupting compounds. However, various aspects of practical applications still received little or no attention to date [4,5] and the application of the MBR in treatment of pharmaceutical wastewater is still in its infancy. While there are many similarities in the design parameters for municipal plants, industrial plants show considerable variations in design, control and operational performance.

This paper presents the results of a pilot-scale MBR performance used in the treatment of pharmaceutical wastewater in Southern Taiwan Science Park (STSP).

2. Materials and methods

2.1. Experimental setup and operation

Fig. 1 shows the MBR plant constructed to treat wastewater from a pharmaceutical company. The company is located at Southern Taiwan Science Park (STSP). Regulation requires the COD of the wastewater should be reduced to below 450 mg/L in order to be discharged into a tertiary treatment plant in the STSP Administration which has an effluent COD limit of 50 mg/L.

The system consisted of two tanks with a total volume of 20 m^3. The first tank is a biological tank (10 m^3) and the second tank has a dual

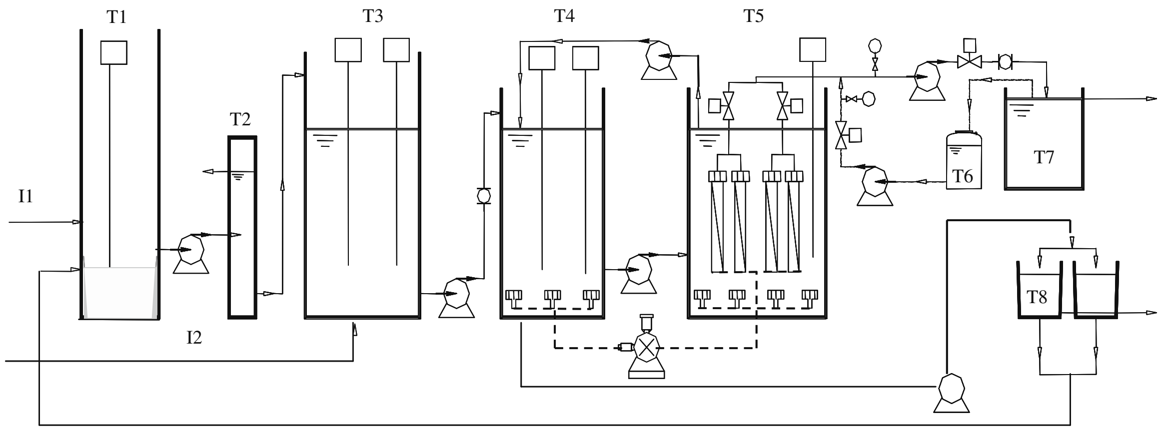

Fig. 1. Schematic diagram of the MBR system for pharmaceutical wastewater treatment. I1: influent from pharmaceutical manufacturing processes; I2: influent from septic tank effluent; T1: wet well; T2: solvent–liquid separation; T3: equalization tank; T4: biological tank; T5: membrane bioreactor; T6: backwash tank; T7: effluent tank; T8: sludge drying bed.