Investigation of parameters affecting the ultrafiltration of oil-in-water emulsion wastewater

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ABSTRACT

The ultrafiltration (UF) of model oily wastewater containing an emulsifier was investigated in order to determine the main parameters affecting the flux, retention and membrane fouling. The experiments were carried out with a laboratory UF device, using regenerated cellulose UF membranes. The finding that the fall in flux with time correlated best with the cake formation model is in accordance with the result that increasing resistance during filtration is caused predominantly by the concentration polarization, while the participation of membrane fouling in the total resistance is negligible. Analysis of the parameters affecting the UF of oily wastewater demonstrated that the flux is mainly influenced by temperature and concentration (besides the membrane pore size), while the concentration and the stirring speed are the parameters affecting the resistance. The retention increased slightly with concentration, but this was mainly determined by the membrane pore size.

Keywords: Ultrafiltration; Oily wastewater; Membrane fouling; Modelling

1. Introduction

Oily wastewaters and oil-in-water emulsions are among the main pollutants discharged into the water environment [1,2]. The amounts of oily wastewater generated from metal-working facilities are increasing every year [3]. Oily emulsion wastes contain considerable amounts of mineral oil, which is highly resistant to biochemical decomposition. These emulsions consist of a complex mixture of water, oil and additives such as emulsifiers, corrosion inhibitors, antifoamants and extreme pressure agents. Oils lose their functional properties in time, because of the severe operating conditions and the presence of contaminants and must therefore, be replaced. The disposal of a large volume of oily wastewater would impose places a significant burden on the environment, and hence removal of the oil (2–10 vol.% of the total waste [1]) and other pollutants is required before disposal [4–7].

Free or suspended oils can readily be separated from the aqueous phase of these wastes by simple physical processes. However, chemically stabilized oil-in-water solutions must be managed in an...