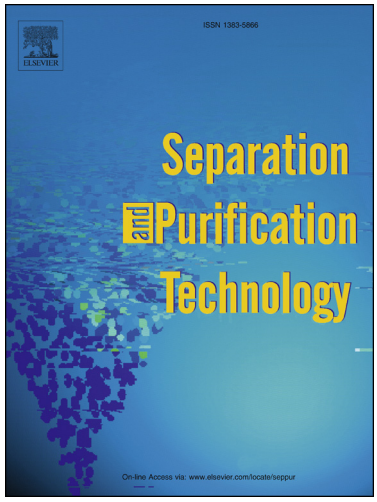

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Optimisation of filter design and operation for wastewater treatment sludge

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ABSTRACT

Wastewater treatment (WWT) produces a biomass or sludge that must be dewatered in order to reduce its volume and subsequent disposal costs. Although WWT sludges can be compressed to high solids concentrations under enough force, they are also highly impermeable such that it takes a long time to remove the water. This leads to low throughputs for dewatering devices such as filters and centrifuges, which means that dewatering contributes a significant proportion of the overall cost of WWT. Improvements to throughput at a given final solids concentration or higher solids concentrations at a given throughput can represent substantial cost savings to the WWT industry.

Recent developments in understanding the highly compressible nature of WWT sludges have led to a fundamentally rigorous description of their dewaterability. In addition, methods have been developed for measuring their compressibility and permeability over a broad range of solids concentrations, which allows the prediction of their behaviour using models of dewatering devices. In this work, the dewatering properties of an Australian WWT sludge are used in a validated model of flexible-membrane or diaphragm plate-and-frame filtration. The model is used to optimise the filtration time to give the maximum throughput for various values of cavity width and handling time. Flexible-membrane filtration is versatile in that there is a given squeeze time to reach a certain solids concentration for each fill time, but there is only one combination of fill and squeeze that maximises the throughput. This work shows that, due to the highly impermeable nature of WWT sludges, the maximum throughput is when the fill time is the shortest such that filter presses for WWT sludges are optimally operated by loading enough sludge to fill the press and then immediately squeezing. For slow-filtering materials such as WWT sludges, the maximum throughput varies inversely with cavity width such that small cavity widths, within the constraints of cake release, are preferable.

KEYWORDS