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A novel process maximizing energy conservation potential of biological treatment: Super fast membrane bioreactor

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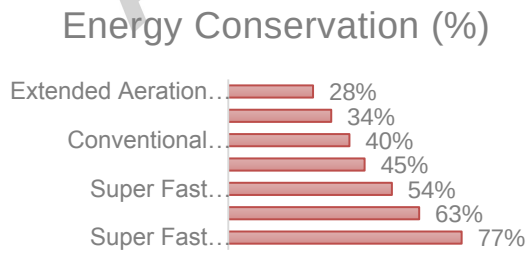
Abstract

The study evaluated the microbial behavior of a submerged super fast membrane reactor (SFMBR) with settled sewage and a soluble synthetic substrate (peptone mixture) exhibiting similar biodegradation characteristics with sewage. A laboratory scale SFMBR was run at very low sludge retention times of 0.5-2.0 d and a hydraulic retention time of 8 h. Effluent COD was always lower than the soluble COD in the reactor and remained in the range 14-28 mg/L for the peptone mixture and 36-44 mg/L for settled sewage. Significant characteristics of SFMBR performance were assessed by particle size distribution analysis; respirometry; modeling defining related process kinetics; and molecular analysis, which revealed changes in microbial community composition under different operating conditions. Model simulation was also performed for raw sewage for revealing COD fractionation in the permeate and biomass in the reactor for the same operating conditions. The results indicated, as predicted, partial removal of the particulate slowly biodegradable COD fraction while soluble biodegradable COD components were almost totally removed. Modeling also highlighted energy conservation and recovery as the major feature of SFMBR, which was assessed to vary between 54-77%, a range significantly higher than what can be achieved with different activated sludge alternatives.

Graphical Abstract



Keywords: Super fast membrane bioreactor; settled sewage and peptone mixture; respirometry; particle size distribution analysis; modeling