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Sun-Driven Evaporation Enhanced Forward Osmosis Process for Application in Wastewater Treatment and Pure Water Regeneration

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Abstract : Forward osmosis (FO) is one of the important processes during the wastewater treatment system for environmental remediation and fresh water regeneration. Both Egypt and China are troubled by over millions of tons of wastewater every year, including domestic and industrial wastewater. However, traditional FO process in wastewater treatment usually suffers low efficiency and high energy consumption because of the continuously diluted draw solution. An additional concentration process is necessary to keep running of FO separation, causing energy waste. Based on the previous study on photothermal membrane, a sun-driven evaporation process is integrated into the draw solution side of FO system. During the sun-driven evaporation, not only the draw solution can be concentrated to maintain a stable and sustainable FO system, but fresh water can be directly separated for regeneration. Solar energy is the ultimate energy source of everything we have on Earth and is, without any doubt, the most renewable and sustainable energy source available to us. Additionally, the FO membrane process is rationally designed to limit the concentration polarization and fouling. The FO membrane's structure and surface property will be further optimized by the adjustment of the doping ratio of controllable nano-materials, membrane formation conditions, and selection of functional groups. A novel kind of nano-composite functional separation membrane with bi-interception layers and high hydrophilicity will be developed for the application in wastewater treatment. So, herein we aim to design a new wastewater treatment system include forward osmosis with high-efficiency energy recovery via the integration of photothermal membrane.

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