World Academy of Science, Engineering and Technology
International Journal of Environmental and Ecological Engineering
Vol:16, No:07, 2022

Enhanced Solar-Driven Evaporation Process via F-Mwcnts/Pvdf Photothermal Membrane for Forward Osmosis Draw Solution Recovery

Authors : Ayat N. El-Shazly, Dina Magdy Abdo, Hamdy Maamoun Abdel-Ghafar, Xiangju Song, Heqing Jiang

Abstract : Product water recovery and draw solution (DS) reuse is the most energy-intensive stage in forwarding osmosis (FO) technology. Sucrose solution is the most suitable DS for FO application in food and beverages. However, sucrose DS recovery by conventional pressure-driven or thermal-driven concentration techniques consumes high energy. Herein, we developed a spontaneous and sustainable solar-driven evaporation process based on a photothermal membrane for the concentration and recovery of sucrose solution. The photothermal membrane is composed of multi-walled carbon nanotubes (f-MWCNTs)photothermal layer on a hydrophilic polyvinylidene fluoride (PVDF) substrate. The f-MWCNTs photothermal layer with a rough surface and interconnected network structures not only improves the light-harvesting and light-to-heat conversion performance but also facilitates the transport of water molecules. The hydrophilic PVDF substrate can promote the rapid transport of water for adequate water supply to the photothermal layer. As a result, the optimized f-MWCNTs/PVDF photothermal membrane exhibits an excellent light absorption of 95%, and a high surface temperature of 74 °C at 1 kW m−2 . Besides, it realizes an evaporation rate of 1.17 kg m−2 h−1 for 5% (w/v) of sucrose solution, which is about 5 times higher than that of the natural evaporation. The designed photothermal evaporation process is capable of concentrating sucrose solution efficiently from 5% to 75% (w/v), which has great potential in FO process and juice concentration.

Keywords : solar, pothothermal, membrane, MWCNT
Conference Title : ICSWRM 2022 : International Conference on Sustainable Water Resources Management
Conference Location : Dubai, United Arab Emirates
Conference Dates : July 28-29, 2022