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Unconventional Membrane Processes for Waste-to-Resource Transformation

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Abstract Wastewater is an abundant source of water, energy, and various resources. Conventional membrane technologies often suffer from permeability and selectivity trade-off, lack of sufficient driving force, and/or insufficient selectivity towards target resource compounds. I present unconventional membrane-based separation processes that employ vapor- or solvent-based transport mediums, combined with biomimetic driving forces, to address the above issues and effectively recover water, energy, and high-value chemicals from challenging water sources. Specifically, three membrane processes are discussed. First, I show a reverse osmosis process that utilizes vapor-phase transport, overcoming the permeability and selectivity trade-off. Second, I discuss a mangrove-mimicking water treatment process that utilizes large nanocapillary pressures, and discuss the potential implication of water recovery from hypersaline industrial wastewater. Last, a solvent-assisted membrane process is presented for medium-chain fatty acids recovery as high-value biochemical as well as renewable energy sources from waste streams.

Keyword(s)
Membranes, Resource recovery, Capillary pressure, Reverse osmosis, Fatty-acids

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