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Membrane-Based Energy-Efficient Resource Recovery from Wastewaters

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Abstract:

Since the turn of this century, wastewaters are no longer merely viewed as the source of environmental pollution but rather as source of various valuable resources, such as purified water, nutrients (nitrogen and phosphorus), precious metal (lithium, palladium, etc.), and renewable energy. The economic benefits of these valuable resources could potentially offset the cost of wastewater treatment, enabling a paradigm shift toward a sustainable energy/environment and a circular economy. Membrane technology has gained enormous attention in the past decade to achieve an energy-efficient resource recovery from wastewaters, thanks to its notable advantages, including small footprints, superior treated water quality, sustainable operation, and versatile applications scenarios. Nevertheless, the existing membrane system suffers from low treatment/recovery efficiency, relatively high energy consumption, poor understanding of fundamental transport mechanisms, severe membrane fouling, and high maintenance costs. Mitigating these problems represents both a significant challenge and an important opportunity. This work will cover the state-of-the-art knowledge on novel membrane and membrane processes to achieve energy-efficient resource recovery from wastewaters as well as the treatment/recovery performances at the system-scale and opportunities for future resource recovery processes.

Keywords: Membrane technology; resource recovery; circular economy; membrane materials and processes