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Short Communication

# Recent Advancements in the Key Concepts of Membrane Distillation

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## DESCRIPTION

Among the modern methods for cleaning drinking water, membrane processes are the most efficient and energy-efficient. Membrane water purification methods include microfiltration, ultrafiltration, nano-filtration, direct and reverse osmosis, and Membrane Distillation (MD). MD is developing as one of the potential membrane technologies for the purification of waste and drinking water from different salts of heavy metals and radionuclides, as well as applications in the food and textile sectors, as well as pharmaceutics. A typical MD process consists of three stages: Evaporation of the feed solution from the hot side of the membrane, vapour transfer through the pores of the hydrophobic membrane, and condensation of vapour on the permeate side of the membrane.

The porous membrane in the MD process must be hydrophobic, allowing only water vapour molecules to flow through but not bulk water. The membrane should also be thermally stable in order to resist high temperatures and have low thermal conductivity in order to avoid heat loss across the membrane. MD provides major benefits over other membrane separation technologies, including a high degree of purification from metal salts (more than 90%) and other nonvolatile chemicals, relatively moderate working temperatures and pressures, and simplicity of hardware design.

Bodell originally used the phrase "membrane distillation" in a patent, and Findley published the first scientific publication on the subject in 1967 [1,2]. In Direct Contact Membrane Distillation (DCMD), he examined several membrane materials (aluminium foil, cellulose film, and glass). Silicone and Teflon have been employed as materials to boost the hydrophobicity of the membrane. The standards for membranes used in MD were set based on these findings.

Another review described nanofiber-based membranes made by electrospinning for application in MD [3]. Membranes composed of electrospun fibres demonstrated good salt rejection and water flow values. However, the scientists stated that identifying the right membrane structure, design, and fabrication procedure is critical for improving performance. Pan et al. evaluated recent achievements in electrospun non-fibrous membranes for MD, including both the original nanofiber membranes and their modification (for example, using inorganic nanoparticles and fluorine-containing chemicals) [4]. The modification of membranes for MD resulted in improved performance and salt rejection. The authors do, however, mention the issue of large-scale manufacture of modified electrospun membranes and their fouling behaviour.

Direct Contact Membrane Distillation (DCMD) is the most basic form, in which a hydrophobic membrane separates the flow of hot and cold liquids. The pressure difference induced by the temperature differential between the two sides of the membrane results in mass transfer via the membrane pores. Only water vapour molecules should flow through the pores of the membrane during the MD process, whereas liquid molecules should not pass through the pores of the hydrophobic membrane. Volatile substances evaporate due to the difference in vapour pressure, whereas vapour molecules travelling through the pores condense on the cool side (permeate).

Recent developments in key components of MD, such as membrane distillation setups, membrane requirements, and membrane kinds, are discussed. TeM's have regular pore geometry with the ability to control them per unit area, a narrow pore size distribution, a thin thickness, and a tortuosity. As a result, such membranes have the potential to be employed as model membranes for the development and validation of theoretical mass, heat transfer, LEP, and fouling.

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