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Commentary

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Brief Note on Forward Osmosis in Manufacturing Industry

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DESCRIPTION

Forward Osmosis (FO) is a membrane treatment technology that uses the osmotic pressure differential to treat two fluids at once, allowing for energy-efficient water and wastewater treatment. There are several applications possible, including one in industrial water management. Here in this, the basic concept of FO is explored, and the state-of-the-art in FO application in industrial industries is detailed. FO has been utilised in the food and beverage sector, as well as the chemical and pharmaceutical industries, coal processing, micro algae cultivation, textiles, pulp and paper, electronics, and vehicle manufacturing. There were also FO articles on heavy metal reduction and cooling water treatment. However, FO has so far only been employed in lab-scale research. Upscaling on a pilot or full-scale basis will be the next step. Long-term fouling behaviour, membrane cleaning strategies, and operating procedures are all critical topics that need to be investigated further. Furthermore, energy and economic studies must be conducted before full-scale FO can be implemented in industries.

Innovative and Energy-Efficient Water and Wastewater Treatment is in great Demand

Many of the United Nations' Sustainable Development Goals (SDGs) from 2015 are tied to ample water supply. Agriculture utilises 70% of the world's freshwater, followed by industry, which consumes 19%. As a result, greater water use in agriculture and industrial production processes is critical to achieving all of the SDGs. Water is recycled often, reducing the need for freshwater and the quantity of wastewater produced. The majority of therapeutic devices, on the other hand, consume a lot of power. To achieve sustainability, water and wastewater treatment must become more energy efficient.

Water recycling technologies frequently employ membrane filtration. Micro, ultra, and nano-filtration, as well as reverse osmosis, are examples of traditional membrane technology (MF, UF, NF, RO). Pumping creates a transmembrane pressure differential, which they employ. Impurities are rejected as water molecules travel across the membrane. Forward Osmosis (FO) is a membrane technique that generates water flow across the membrane by using the osmotic pressure differential between two solutions. However, the application *in-situ* or in-line, which allows for direct resource or water recovery and recycling, is more beneficial. Several instances have been reported in several domains, including forward osmosis.

It might potentially be used to treat wastewaters that pressure-driven membrane technologies have been unable to handle. Given the wide range of industrial wastewaters, FO may be useful for treating two wastewaters in a single treatment phase, resulting in one concentrated and one diluted wastewater. This energy-saving combination might

lead to more effective water and resource management in industry. To highlight the present state of the art, a study related to forward osmosis use in the industrial sector was undertaken. Other studies on forward osmosis in general or specific aspects, such as membrane fouling, membrane characteristics, draw solutions, hybrid processes, application in seawater desalination, wastewater treatment, produced water treatment, food processing, resource recovery from municipal wastewater, and osmotic membrane bioreactors, are available.

Technology of forward osmosis: Forward osmosis is a membrane-based technique for treating two liquid streams. This shows how the system functions. The FS has a low osmotic pressure. On the opposite side of the membrane lies the so-called Draw Solution (DS), this has a greater osmotic pressure. A semi-permeable barrier separates FS and DS. A shift in osmotic pressure causes water to pass through the membrane from the FS to the DS side. The diffusing water dilutes the DS, while the FS is intensified. Physical exertion is rarely necessary. As a result, the only source of energy is the pumping of FS and DS through the flow channels adjacent to the compressor. FO provides the following benefits when compared to other therapies:

• Minimal energy usage
• Simultaneous treatment of two streams in a single treatment phase
• Simple removal of fouling layers owing to lack of compression
• Liquids that is unsuitable for other membrane processes

Forward osmosis is a promising solution for energy-efficient water use in industrial industries. FO uses have been investigated in the food and beverage industry, chemical industry, pharmaceutical industry, coal processing, micro algae culture, textile industry, pulp and paper industry, electronic industry, and vehicle manufacture. Heavy metal removal and cooling water treatment were explored, both of which might be related to industry. Forward osmosis has been used to clean wastewater, dilute liquids, and concentrate liquids.