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Applications, Issues and Futures of Nanofiltration for Drinking Water Treatment

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1. Definition and Classifications

Membrane process has been increasingly used in water and wastewater treatment, because these processes can successfully produce water of superior quality compared to conventional processes (1, 2). The pressure-driven membranes are classified to four types: microfiltration (MF), ultrafiltration (UF), nanofiltration (NF), and reverse osmosis (RO). The word NF was defined because its separation cutoff size was in the 1 nm range (3). Water passing through the membrane is called permeates, while the remaining water is called concentrate or retentate. Permeate is relatively free of targeted dissolved solutes, which in RO and NF is free of ions such as sodium, chloride, calcium or magnesium, and dissolved natural organic matter (NOM) (2, 3).

2. Applications

In recent years, membrane processes such as NF membranes have been widely recognized as the best technologies for water treatment (4). The primary goal of NF membranes is to use it for water softening, desalinate brackish waters, and reduce disinfection by-product (DBP) precursors. Other objectives including advanced treatment for water reuse, NOM (5), the rejection of pharmaceutically active compounds (PhACs) (1, 6-8), hormones and pesticides (3), and specific contaminant removal including arsenic (9), fluoride (10), nitrate, nitrite, selenium, and radionuclides. NF can reject 80 - 95% of divalent ions such as Ca^{+2} and Mg^{+2} (3). The study showed that NF can effectively reject cephalexin, tetracycline, acetaminophen, indomethacin and amoxicillin from water (1).

3. Significant Issues

NF membranes are susceptible to fouling. The main matters of membranes fouling and scaling are precipitation of metals and salts, suspended matter and biological matter (1, 4, 5). For example, humic and alginate acids increase fouling and reduce flux (5). In addition, solutes rejection such as amoxicillin and cephalexin and permeate flux were reduced by increasing foulants concentration (6). Therefore, feed water requires pretreatment. Permeate typically requires post-treatment for the dissolved gases removal as well as alkalinity and pH adjustment (1-3). The other significant issue of membrane facilities is treatment of concentrate flow before disposal (4).

4. The Future

The installation of NF facilities is expected to increase for water treatment in future in the world. It is due to the increase of population, urbanization of coastal and arid areas, scarcity of freshwater supplies, the increasing contamination of freshwater supplies, greater reliance on oceans, and poorer quality supplies such as brackish groundwater and treated wastewater.

5. Conclusions

The effectiveness of NF in water and wastewater treatment has now become one of the most reliable standard techniques to obtain good quality drinking water. Therefore, It is recommended that the Iranian water and wastewater engineering companies should study the possibility of utilizing a greater number of NF plants for water treatment, water reuse, and in particular, desalination of brackish water and specific contaminants removal.

Authors' Contributions

Mohammad Ali Zazouli and Edris Bazrafshan made extensive contributions into the review and finalization of this manuscript.

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