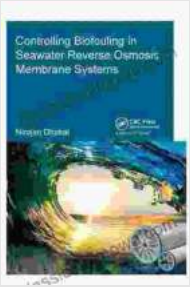
Controlling Biofouling in Seawater Reverse Osmosis Membrane Systems: The Delft Experience



Controlling Biofouling in Seawater Reverse Osmosis Membrane Systems (IHE Delft PhD Thesis Series)

by Rowan Jacobsen

4.8 out of 5

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Biofouling is a major problem in seawater reverse osmosis (SWRO) membrane systems, leading to reduced performance and increased energy consumption. The formation of biofilm on the membrane surface can cause a decrease in water flux, an increase in pressure drop, and an increase in the concentration of salt in the permeate. In severe cases, biofouling can lead to membrane failure.

A number of methods have been developed to control biofouling in SWRO systems, including chemical cleaning, physical cleaning, and the use of biocides. Chemical cleaning involves the use of chemicals to remove biofilm from the membrane surface. Physical cleaning involves the use of physical methods, such as brushing or scraping, to remove biofilm from the membrane surface. Biocides are chemicals that are used to kill or inhibit the growth of microorganisms.

The choice of biofouling control method depends on a number of factors, including the severity of the biofouling, the type of membrane, and the operating conditions of the SWRO system.

Chemical Cleaning

Chemical cleaning is a common method for controlling biofouling in SWRO systems. A variety of chemicals can be used for chemical cleaning, including acids, bases, and oxidants. The choice of chemical depends on the type of biofilm and the severity of the biofouling.

Acids are typically used to remove inorganic deposits, such as calcium carbonate and iron oxide. Bases are typically used to remove organic deposits, such as proteins and polysaccharides. Oxidants are typically used to kill or inhibit the growth of microorganisms.

Chemical cleaning is typically performed by circulating the cleaning solution through the SWRO system. The cleaning solution is typically heated to a temperature of 40-60°C (104-140°F). The cleaning time can vary from several hours to several days.

Chemical cleaning can be effective in removing biofilm from the membrane surface. However, chemical cleaning can also damage the membrane if it is not performed properly. It is important to follow the manufacturer's instructions for chemical cleaning.

Physical Cleaning

Physical cleaning is another common method for controlling biofouling in SWRO systems. A variety of physical cleaning methods can be used, including brushing, scraping, and ultrasonic cleaning.

Brushing is a simple and effective method for removing biofilm from the membrane surface. Brushes can be made of a variety of materials, including nylon, polyester, and stainless steel. Brushing should be done gently to avoid damaging the membrane.

Scraping is a more aggressive method for removing biofilm from the membrane surface. Scrapers can be made of a variety of materials, including metal, plastic, and rubber. Scraping should be done carefully to avoid damaging the membrane.

Ultrasonic cleaning is a non-contact method for removing biofilm from the membrane surface. Ultrasonic cleaning uses high-frequency sound waves to create cavitation bubbles in the cleaning solution. The cavitation bubbles collapse and create a shock wave that removes biofilm from the membrane surface.

Physical cleaning can be effective in removing biofilm from the membrane surface. However, physical cleaning can also damage the membrane if it is not performed properly. It is important to follow the manufacturer's instructions for physical cleaning.

Biocides

Biocides are chemicals that are used to kill or inhibit the growth of microorganisms. Biocides can be used to control biofouling in SWRO systems. However, biocides can also be harmful to the environment and human health.

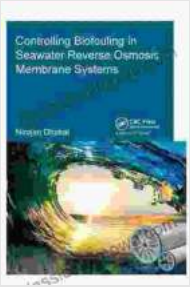
A variety of biocides can be used to control biofouling in SWRO systems, including chlorine, bromine, and ozone. Chlorine is the most commonly

used biocide in SWRO systems. Chlorine is effective in killing a wide range of microorganisms. However, chlorine can also be corrosive to the membrane and other components of the SWRO system.

Bromine is a less corrosive biocide than chlorine. Bromine is also effective in killing a wide range of microorganisms. However, bromine is more expensive than chlorine.

Ozone is a powerful oxidizing agent that can be used to kill a wide range of microorganisms. Ozone is also effective in removing organic matter from the membrane surface. However, ozone can be difficult to handle and can be harmful to the environment.

The choice of biocide depends on a number of factors, including the severity of the biofouling, the type of membrane, and the operating conditions



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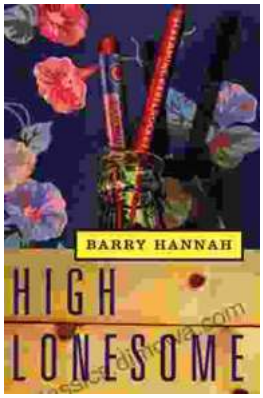

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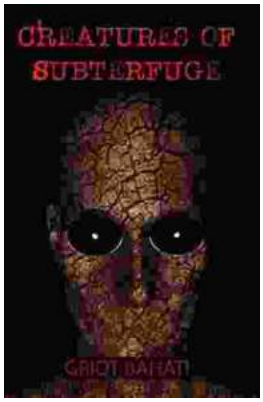

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