

Separation technology for water and valuable substances: BC membrane

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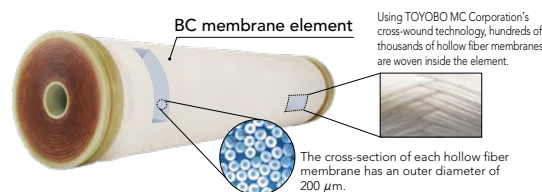
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What is a BC membrane?

A brine concentration (BC) membrane is a water treatment membrane capable of separating water from valuable substances. It leverages membrane technology developed over many years for seawater desalination and is one of the core technologies in the environmental solutions field at TOYOBO MC Corporation.



Development needs for BC membranes

In the 1970s, TOYOBO MC Corporation applied the spinning technology originally developed in its textile business to develop hollow fiber reverse osmosis (RO) membranes that allow water molecules to pass through while blocking certain molecules and ions. These RO membranes are highly chlorine-resistant, enabling chlorine disinfection and reducing problems caused by microbial growth, such as biofouling and membrane blockage. They have mainly been used for seawater desalination in the Middle East, supporting local water demand. Separately, they are also widely utilized in fields such as ultrapure water production.

On the other hand, RO membranes require pressure exceeding the osmotic pressure to move water molecules, meaning that higher pressures are needed as the feed solution concentration increases. With growing energy-saving needs for processing high-concentration solutions, such as valuable substance recovery and zero liquid discharge (ZLD), TOYOBO MC Corporation began developing BC membranes, which allow for efficient concentration at lower pressures.

Reducing environmental impact

BC membranes eliminate the osmotic pressure difference by flowing feed solutions of equal concentration on both sides of the membrane, allowing efficient concentration at lower pressures. BC

membranes can achieve concentrations more than twice as high as those possible with conventional RO membranes. In addition, TOYOBO MC Corporation not only manufactures the membranes but also develops BC membrane concentration systems. Compared to evaporation-based recovery methods, these systems offer more efficient concentration technology with reduced environmental impact.

BC membranes contribute to reducing environmental impact in the following applications:

- Reducing the volume of difficult-to-treat wastewater
- Improving recovery rates in seawater desalination
- Reusing various types of industrial wastewater
- Recovering valuable substances (such as lithium) from wastewater

Applications

BC membranes are currently being utilized in the following two areas:

1 Recovery of valuable substances from high-concentration wastewater

Conventional The evaporation method requires a large amount of energy to vaporize the feed solution.

BC membrane advantage By implementing a pre-concentration step, the energy demand for vaporizing the feed solution can be significantly reduced, thereby lowering operating costs in the recovery of valuable substances.

2 Salt production from seawater

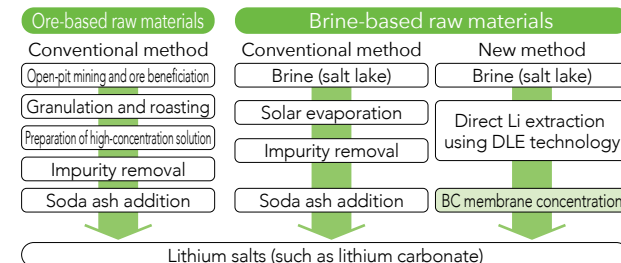
Conventional The seawater concentration step used electrodialysis with ion exchange membranes, which consumes a large amount of energy.

BC membrane advantage Using a BC membrane concentration system reduces energy consumption, contributing to lower CO₂ emissions in the production process. In Indonesia, BC membranes are used in a large-scale salt production plant with an annual output of 220,000 tons.

Application to lithium production and recovery

BC membranes are also utilized in lithium production sites and in processes for recovering lithium from used lithium-ion batteries.

Lithium production process



Lithium production

Conventional methods Lithium production has traditionally been carried out using the following two methods:

- Mining at ore deposits
- Natural evaporation of brine from salt lakes with high lithium content

Potential applications of BC membranes

The second conventional method requires vast land, takes a long time for production, and poses challenges in handling the evaporated water. As an alternative, direct lithium extraction (DLE), which extracts lithium directly from brine, has attracted attention. By incorporating BC membranes into the DLE process, faster production and improved recovery rates are expected.

Lithium recovery and reuse

We have successfully developed a system to concentrate and recover lithium from wastewater at lithium-ion battery component factories. In addition, the system has been adopted in the lithium recovery process from used lithium-ion batteries at a major battery recycling plant in China.

Future applications

BC membranes are expected to find applications beyond lithium recovery in the following areas, and research, development, and commercialization efforts will continue.

- Use in food processing and pharmaceutical manufacturing
- Volume reduction, reuse, and ZLD of industrial wastewater to meet environmental regulations; several factories and commercial facilities in China are already operating such systems
- Recovery of rare metals