ceramics for water reuse

By Paul Manison

Ceramic membranes offer sustainable solutions for water reuse applications

Industrial facilities that use large amounts of water are facing the prospect of increasing regulation of water withdrawal and discharge. Scarcity is the main driver of global water reuse policies.

In China, population growth, economic factors and physical scarcity have driven water treatment and reuse efforts. China's target is to increase water reuse from its current 14% to 25% by 2015. Other examples include Saudi Arabia, which aims to increase water reuse from 11% to 65% by 2016, and Spain, which aims to increase water reuse from 11% to 40% by 2015.

Government intervention will become more prevalent as the need for drinking water increases pressure for industrial water reuse. For example, the state government of São Paulo, Brazil, has introduced initiatives to protect drinking water for the region's inhabitants, forcing industry to look for ways to reuse its wastewater or obtain recycled water from another source. Filtration facilities already have been proposed and built to meet São Paulo's water needs.

In the U.S., treated water reuse currently is at about 11%. While no official targets have been set, 10 of the largest U.S. cities may face severe danger of water shortages in the near future, according to the National Resources Defense Council. As a result, regulations likely will be imposed to respond to these shortages.

Ceramic Filters

In response to global water reuse trends, ceramic water filtration and purification membranes are growing in popularity.

Currently, ceramics account for 25% of the membrane filtration market, with polymer membranes encompassing most of the remainder. While polymer membranes dominate the water and wastewater treatment market, ceramics are resistant to abrasion and have high chemical resistance, making them suitable for industrial applications that require filtration of challenging media.

In the filtration of water containing oils or fatty acids, for example, surfactants (emulsion-breaking chemical dispersants) often are required to limit the formation of an organic fouling layer on the surface of polymer membranes. The intrinsic properties of ceramic membranes can be adjusted for these types of applications, limiting the need for dispersant additives. This is because ceramic materials have hydrophilic properties that can be adjusted for specific applications by tailoring their surface zeta potential via the material chemical composition. A more hydrophilic membrane material will promote the flow of clean water through its structure while repelling other fluids, such as oily liquids. This improves the flow rate of filtrate through the membrane and enhances its selectivity properties.

Ceramics also can enable a wider range of clean-in-place (CIP) options. In some applications, membranes have to be cleaned with harsh chemicals and be able to withstand high pressure from two directions. Automatic CIP operations can be performed without interrupting the filtration process for ceramic membranes.

Additionally, newly developed ceramic membranes can achieve great compactness due to their versatility in design and geometry. These design specifications also contribute to the energy efficiency of such systems.

Industrial Applications

As the ceramic water filtration and purification market continues to mature, more energy-efficient systems with ceramic tubular membranes will be used in industrial wastewater treatment processes.

Material scientists and product development engineers from Morgan Advanced Materials' U.K.-based Innovation Hub are working on new porous ceramic components with a filtration layer of approximately 25 µm, about a quarter of the diameter of a human hair. These ceramic membranes are designed for use in micro and ultrafiltration (UF) applications, including purifying industrial wastewater so it can be reused or safely discharged into the environment. They will offer reliable performance in high-temperature environments in the presence of harsh cleaning chemicals or where chemically aggressive or high-viscosity fluids need filtering. Moreover, the ceramic membranes can be specified to highly complex geometries and tight tolerances, facilitating more flexible designs that make filtration modules more energy efficient.

Morgan also is working with experts in the fields of filtration, water treatment and fluid circulation systems to provide them with customized filters. This allows the company to develop unique membrane filter materials that perform efficiently in harsh environments, thus maximizing the potential for water reuse and recycling.

Additional efforts with academic partners are focusing on the production of new industrial-scale ceramic membranes with porous structures. This ceramic membrane material will offer filters with minimal flow resistance—up to 1.5 times lower than traditional asymmetric ceramic membranes for a given pore diameter, potentially reducing energy consumption by the same factor.

From the Field

Several U.S. pilot plants are using ceramic membranes with UF for industrial water reuse. A pilot ceramic membrane treatment system was developed by Colorado's Parker Water & Sanitation District, which treats water from a local reservoir for everyday water needs, underground aquifer replenishment and drought management reserves. Ceramic membranes, with an estimated life of up to 20 years, were selected to reduce the installation's life-cycle cost.

Sustainability is becoming increasingly important for industry, and the environmental benefits of water filtration are well recognized. The development and application of new ceramic water filtration membranes will enable industry to reduce maintenance and energy usage, lower operational costs, and conserve water. WWD

Paul Manison is a business manager for Morgan Stourport. Manison can be reached at paul.manison@morganplc.com.

For more information, write in 1109 on this issue's reader service form on page 102.