Advancements in Ceramic Membranes – They are Not All the Same

Where: Caesars Forum**,** 3911 Koval Lane, Las Vegas, NV 89109

Booth Location: #205

Presentation Date & Time: Thursday, February 24th , 2022 / 9:15 AM – 9:45 AM

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Ceramic membranes, predate polymeric membrane, and have been in continuous use since the 1940's with one of their initial applications being in the Manhattan Project of World War II. Utilization of ceramic membranes for water purification started in the late 1980's when they were still classified as strategically controlled goods. Initially this classification made commercial applications restricted until their controlled designation use was deregulated in the 1990s. The core ceramic membrane technology of the 1940s is still in commercial use today.

The public perception is that ceramic membranes are all the same. This is an erroneous perception! There has been significant advancement in ceramic membranes over the past 80 years and the technology is now very diverse.

Today the technology has gone from alpha alumina to silicon carbide, Titanium dioxide, zirconium dioxide, etc.) and are available as hybrids, composites or true (100%) and each membrane has its own set of properties (hydrophilicity, strength, permeability, fouling potential, chemical resistance, etc). Add to this, geometry, method of construction, process, and the ceramic membrane technology to be used becomes extremely important to overall performance and cost structure.

A significant portion of "ceramic membranes" today are actually hybrid ceramic membranes and contain polymeric materials such as glues, epoxy, etc. that limits life and causes constraints on temperature, pH, and cleaning chemicals / concentrations. This makes the membrane like a chain which is only as strong as its weakest link. A true 100% ceramic membrane negates these limitations.

Another common issue with early ceramic membrane technology is filtrate choking. This is the difficulty of getting the filtrate out of the membrane substrate. Methods such as machined channels have been employed to alleviate this problem at the expense of performance and durability. Other technology advancements achieve success without these adverse consequences.

This paper will address the advancements in ceramic membrane technology over the last 80 years that has enhanced durability, efficiency, cost and the process innovation that it has contributed to. Research, Advancements, and Innovation in membranes