Ceramics Demonstrate Reversible Cationic Polymer Fouling

Background

Ceramic membranes are widely recognized to be more robust than polymeric membranes. Chemical resistance, temperature stability, mechanical strength and the inherently higher flux rates of ceramics all contribute to significant performance benefits. Combined with the polymeric cost parity offered by Nanostone’s innovative CM-131™ UF module, ceramics are now a viable option in mainstream water treatment applications. Another key attribute of Nanostone’s ceramic membrane is its high degree of hydrophilicity, or affinity for water.

Hydrophilicity and Fouling Resistance

A routine approach to assessing membrane hydrophilicity is measuring the contact angle of a droplet of water placed on the surface of the membrane. The contact angle formed at a three-phase interface gives an indication of membrane surface energy. The procedures for measuring the contact angle are outlined in the Water Research Foundation Web Report #41021.

This key property plays a critical role in both the membrane’s fouling resistance and the ability of the membrane to recover from a fouled condition. Fouling resistance has major membrane performance implications relating to flux, cleaning cycle frequency, and overall membrane life. The following describes the role of Nanostone’s hydrophilic membrane in the full recovery of the membrane performance following intentional fouling with cationic polymer. Even the smallest amounts of cationic polymer are known to irreversibly foul polymeric membranes.

The lower the observed contact angle, the greater the hydrophilicity. The average contact angle of Nanostone’s ceramic membrane are compared with several polymeric membranes in the chart below.
Nanostone’s UF Pilot Validation Work

For the past 18 months, Nanostone has been operating pilots with its innovative ceramic UF membrane at a number of global sites. In addition to demonstrating baseline performance, a key objective of the testing has been to challenge the membrane to a number of adverse conditions to assess overall robustness.

These pilots have been operated across mainstream water treatment applications in several industries. The rigorous conditions evaluated in the various applications under study include feed water with:

- 1,000 ppm oil (oily waste water)
- 1,000 NTU turbidity (backwash recovery)
- 30 ppm iron (groundwater)
- 680 ppm suspended solids (CT blow down)

In all cases, Nanostone’s ceramic UF membranes have demonstrated exceptional fouling resistance with complete permeability recovery after routine cleaning protocols.

Cationic Polymer Challenge Test

A pilot operating on untreated surface water was recently subjected to 10 ppm of cationic polymer to simulate a clarifier overfeed upset that would be catastrophic to polymer membranes.

The results below show the expected rapid rise in net driving pressure as the cationic polymer was applied. A routine base/acid chemical cleaning protocol was applied after the net driving pressure approached 60 psi. The cation polymer fouling of the ceramic membrane was proven to be completely reversible as the pre-polymer dose permeability was restored following cleaning.

References
