S1.1.3 Operations on Ceramic Membrane Performance in the Industrial and Municipal Water Segment

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Ceramic membranes continue to make improvements in surface area and production costs which are making them more and more competitive with polymeric membranes. Regardless of membrane material, membrane fouling is one of the most prevailing problems associated with any membrane system. Membrane fouling is also source water specific, and the optimization of the system performance via periodic hydraulic backwashing, chemical dosing, and clean-in-place strategies have to be tuned for the application at hand.

Cost-parity between polymeric and ceramic membrane is an explicit goal for Nanostone Water. To that end, Nanostone has conducted multiple pilot trials in dead-end filtration mode in the U.S. municipal market and industrial wastewater market for the past two years to assure performance across the wide range of conditions. The pilot systems were deployed in a variety of field applications with varying source water qualities including high TSS feeds from cooling tower blowdown, softening and clarification in reuse applications, iron/manganese removal from groundwater with ozone, ozonated biological effluent for makeup water use, and spent filter backwash water recovery. The pilots were also stress-tested with direct coagulation of surface water at high flux rates and cold water conditions (a detrimental de-rating on conventional polymer UF fluxes). Results of field studies show that a conventional backwash method with a pump at moderate flux rates can be effective as flux maintenance for ceramic membranes.

For turbid feed streams with high TSS loading, a stable operating flux at 90 gfd (150 LMH) minimum was achieved with dead-end operation, without the need for high crossflow or air scouring. Surface waters with low turbidity achieved stable operating flux at 230 gfd (391 LMH). Hydraulic backwashes for all cases were operated at 1x to 3x production rates, in line with polymeric membrane UF operation.

This paper will present pilot study results for industrial and drinking water applications varying in feed temperature, types of suspended solids in the feed water due to upstream pretreatment conditions, and the methods employed to recover membrane performance after system upsets. Also presented will be Nanostone's ceramic UF system membrane integrity testing to achieve log removal credits under EPA's Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR).