

Pilot Evaluation of Ceramic Membranes for Manitowoc Public Utilities Water Treatment Plant

PWN Technologies: J. Zheng, G. Galjaard and H. Shorney-Darby
Manitowoc Public Utilities: R. Michaelson and P. Aumann



INTRODUCTION

From November 2014 to March 2016, PWN Technologies (PWNT) conducted pilot operations of ceramic membrane filtration at Manitowoc Public Utilities (MPU) water treatment plant (WTP). The aim was to evaluate the performance of the ceramic membrane when

treating surface water from Lake Michigan, and to provide some design parameters for a 12 mgd plant. The pilot work was divided into two phases: phase 1 was critical flux determination, with only pre-treatment of 500 micron strainer; phase 2

was operation with coagulation pre-treatment. In the phase 2, the backwash (BW) and enhanced backwash (EBW) frequencies were optimized, as well as the coagulation conditions.

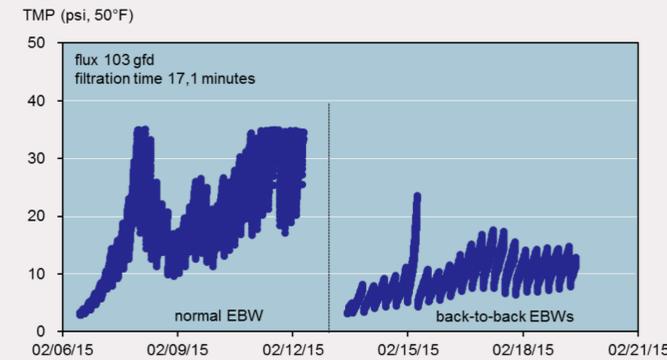
METHODS

- A skid-mounted ceramic membrane pilot plant
 - o 269 sqft ceramic membrane (Metawater, Japan)
 - o nominal pore size 0.1 micron
 - o standard Metawater coagulation unit
- Pre-screened raw water (500 micron)
- Sumalchlor 50 PACl coagulant (aluminum content 12.4%)
- Coagulant dosage 10 to 20 ppm as product
- Coagulation pH 6.4, 7.0 or ambient
- Chlorine (100 ppm) and acid (pH <3) EBW, back-to-back mode
- Chlorine (500 ppm) and acid (pH 1.5) for clean-in-place
- 17 runs tested (various flux, loadings until BW and EBW)

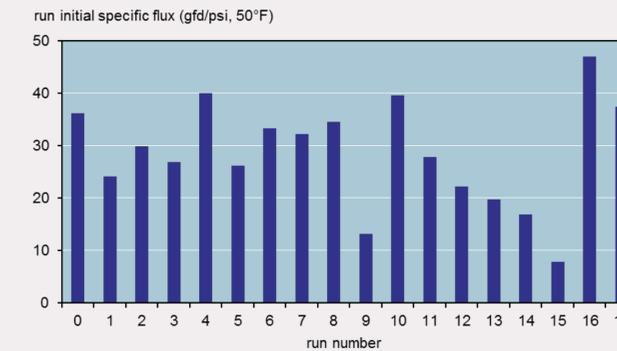


RESULTS

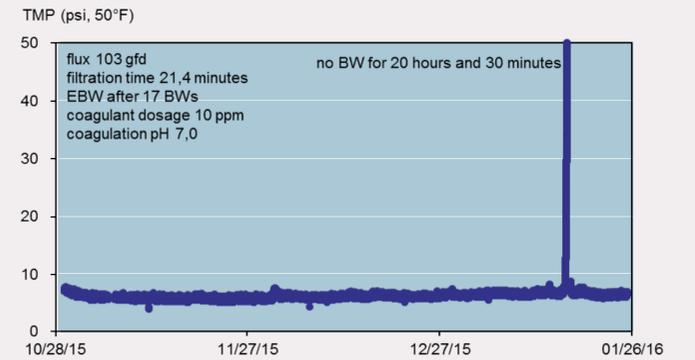
TMP development without coagulation pre-treatment



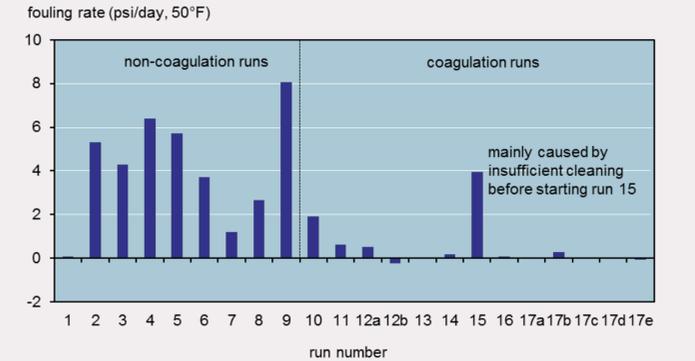
CIP efficiency (runs 1 to 15, chlorine CIP alone; runs 16 and 17, chlorine CIP followed by acid CIP)



TMP development with coagulation pre-treatment



fouling rates (runs 1 to 17, runs 12 and 17 with sub-settings)



CONCLUSIONS

- ◆ A sustainable flux of 103 gfd can be maintained with a CIP interval of 12 months (possibly longer) with coagulation pre-treatment
- ◆ Cleaning with a 500 mg/L chlorine solution for at least two hours has adequately restored the specific flux when working without coagulation; but during the coagulation test runs, a pH 1.5 acid CIP after the chlorine CIP was needed, and this combination restored the specific flux to very high extent.
- ◆ An indicative full-scale system, designed to the parameters of flux 103 gfd, BW interval 40 minutes, EBW with 100 mg/L chlorine followed by EBW with pH < 3 using sulfuric acid after every 12 BWs.

ACKNOWLEDGMENTS

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