

The Importance of Coagulant Pretreatment in Surface-Water Membrane Applications

Summary

An optimized coagulant pretreatment strategy was developed and implemented at a customer site where a complex feed-water presented considerable pretreatment challenges for the reverse osmosis (RO) system. A series of on-site studies focused on improving multimedia filter performance as measured by critical RO feed-water parameters. The project resulted in significant cost savings due to reduced organic and microbiological fouling in the RO system.

Challenge

A cogeneration power customer had concerns regarding the ability of his RO machine to meet the design specifications for permeate flow rate. The membranes were fouling very quickly and the fouling was irreversible. As a result, the customer lost \$500K in revenue in 2005 due to decreased steam production. The rapid irreversible fouling led to four membrane replacements in 2005 which cost an estimated >\$100K in materials and labor.

On-site evaluations and destructive membrane autopsies confirmed that the primary problem was organic fouling and microbiological growth. It was critical to resolve the RO feed-water quality problems immediately and implement a pretreatment program that would ensure a properly functioning RO machine with extended membrane life.

Background

The RO feed is supplied from a raw water tank that combines surface water and process condensate. Chemical pretreatment includes chlorination of the raw water tank, coagulant before the multimedia filters, and antiscalant before the cartridge filters. See Figure 1.

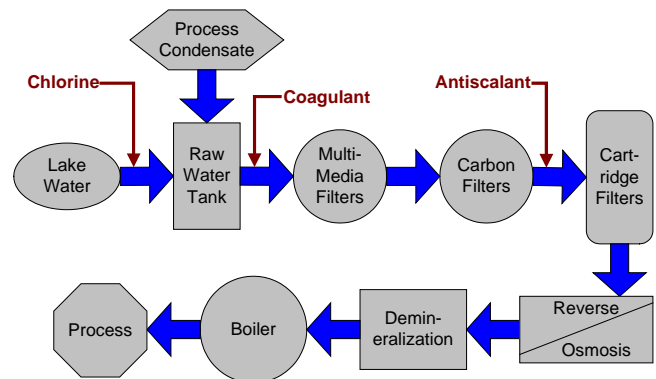


Figure 1

The feed water has moderate color and turbidity and immeasurable silt density index (SDI). Onsite testing confirmed that the multimedia filters were not removing color and turbidity with the existing coagulant pretreatment. In addition, the multimedia filters were not effectively removing particulate matter based on particle size analysis and SDI data.

Since the multimedia filters were not effectively removing organic and particulate materials, the carbon filters were forced to endure excessive organics loading. This compounded the problems at the plant since the heavy organics and particulate loading in the carbon filters provided a thriving environment for microbiological growth. The resultant RO feed water had high SDI's, high turbidity, and was loaded with microbiological organisms.

In addition, it was discovered that the existing coagulant treatment program was actually contributing to the multimedia filtration problems due to gross overfeed (see turbidity and color data in Table 1).



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Table 1

	Existing Pretreatment	Non-Treated Condition	Optimized Pretreatment
SDI [RO feed water]	5.6	6.0	2.1
Turbidity (NTU) [before MMF's]	10.7	1.4	1.4
Turbidity (NTU) [RO feed water]	1.8	0.5	0.2
Color (Pt/Co) [before MMF's]	81.0	16.0	N/D
Color (Pt/Co) [RO feed water]	14.0	4.0	0.0

Solution

It was necessary to address and resolve the multimedia filtration process in order to; reduce the SDI of the feed water, reduce the levels of microbiological growth in the system, and ultimately reduce the rate of membrane replacements that resulted from excessive fouling.

A three-step approach was used to establish the optimized coagulant treatment program. This approach is considered a best practice and is recommended whenever possible:

1. Jar Testing

The SoliSep* MPT coagulant sample kit (#L4128) was obtained for use with a jar tester. Onsite jar-testing studies were used to identify candidate coagulants for online testing at various dosages. Three products yielded appreciable floc formation within the targeted reaction time that was established for this site:

- SoliSep MPT100
- SoliSep MPT101
- SoliSep MPT134

2. On-Line Testing

Based on the results of the jar testing, the three products above were applied to the customer's RO system at a broad range of dosages. SDI, turbidity, and color were closely monitored to establish performance comparisons for each product/dosage. All three of the products effectively reduced the SDI's and turbidity; however, SoliSep MPT134 yielded the best results. Table 2 lists performance data

for the optimum dosages of each product (measured prior to the RO):

Table 2

Coagulant	SDI	Turbidity	Color
Solisep MPT100	5.3	0.6	13
Solisep MPT101	3.9	0.9	9.0
Solisep MPT134	2.1	0.2	0.0

3. Extended system monitoring

The best performing dosage of SoliSep MPT134 was then permanently implemented at the plant. SDI, turbidity, and color were tracked daily for several weeks to monitor trends and further adjust the coagulant dosage until the optimized performance was established. Minor adjustments to the chemical feed-rate were required to further optimize the RO feedwater parameters.

Results

The approach described in the previous section resulted in improved coagulation and more effective multimedia filtration. These improvements were demonstrated by improved performance data (SDI, turbidity, and color). The table above illustrates the multimedia filter performance as a function of coagulant pretreatment.

In addition, the majority of the particulate and organics were now being filtered out in the multimedia filters where residual chlorine is present to prevent microbiological growth. With properly functioning multimedia filters, the carbon filters were no longer burdened with excessive particulate and organics fouling. As a result, the microbiological problems in the RO system became manageable with intermittent non-oxidizing biocide treatment.

Today, the customer is producing permeate water above and beyond the design specifications for the RO machine. The current membranes have been in operation for the past eight months without replacement, whereas they were previously being replaced every three months with new elements. The customer is pleased with the restored RO performance and the plant is now operating at full capacity.

Contact the Membrane Chemicals Technical Marketing team for assistance in designing and/or optimizing your chemical pretreatment program.