

Case History In Optimizing Filtration To Reduce RO Fouling

Introduction

A large utility in the southeastern U.S. originally installed RO's in 1994 and had experienced fouling problems since the first day they were put online. The RO's would require weekly cleanings, sometimes after just 3 or 4 days of operation. Based upon a successful Streaming Current installation and a Particle Detection study performed at another utility site, Chemtrac was invited to look at what could be done to help the new plant resolve their RO fouling problem.

Chemtrac technicians ran preliminary test with the Particle Counter to generate a snapshot profile of the process. Based upon what those results revealed, the plant agreed to move forward with a proposed two-month trial. The goal of that trial was to demonstrate how Chemtrac's analytical equipment could be used to reliably optimize the pretreatment system. The focus of the pretreatment optimization program was centered on feeding a polishing polymer (or filter aid) ahead of their multimedia filters.

The trial consisted of the installation of Particle Detection equipment on each filter and a Streaming Current Monitor downstream of polymer addition. This equipment was instrumental in determining optimum polymer dosage as well as preventing against accidental overfeeds of the polymer.

The result of this two-month trial led to a significant reduction in RO Feedwater particulate and a significant decrease in RO fouling. The following report outlines how the equipment and the data was put to use to significantly improve filter performance and eliminate the RO fouling problem that had existed for 9 years.

October 15, 2003: Preliminary Filtration Performance Evaluation

Chemtrac Systems performed an initial filtration performance evaluation for the southeastern utility in October of 2003. A Particle Counter (model PC2400D) was moved to individual and combined filter effluents to record levels of particulate. Figure 1 shows the recorded particle counts (in red) at those various points.

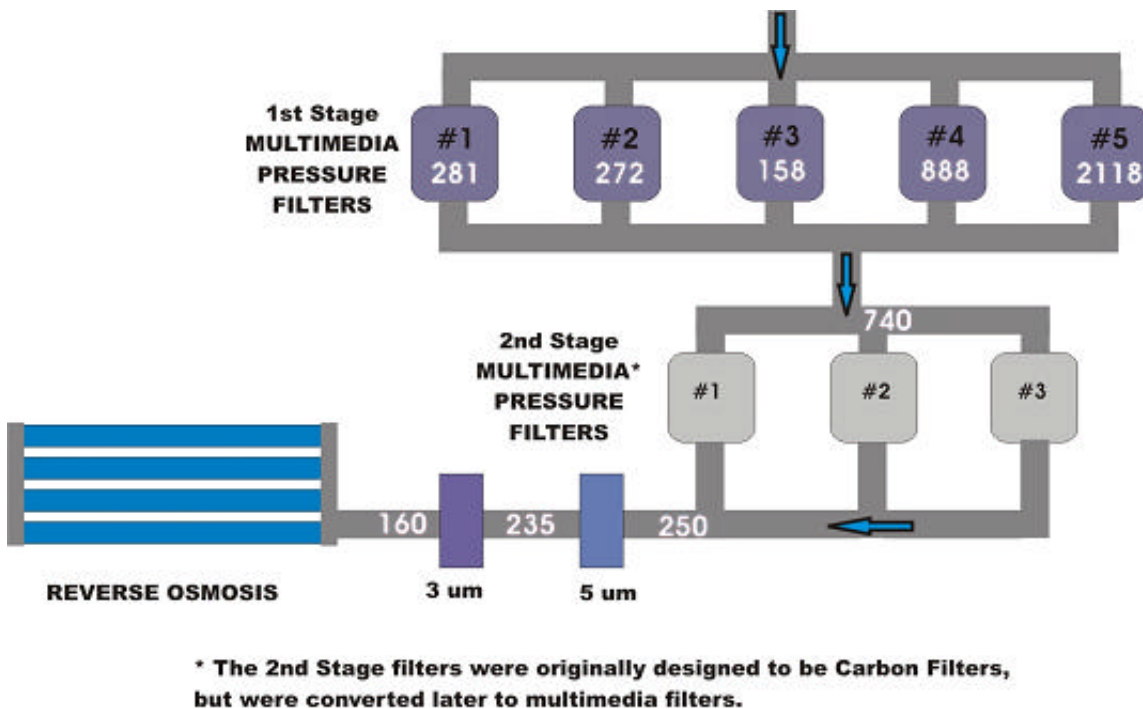


Figure 1

The concentration of particulate present in the effluent of #4 and #5 multimedia filters was high, especially in comparison to the other 1st stage filters. It was determined an internal media problem was the cause of these higher counts. These two filters were taken offline and a dramatic improvement was seen in the level of particulate going to the RO. The RO feed particle counts dropped from 160 (as seen above) to below 80 counts after #4 and #5 were removed from service.

It was also discovered from this one day of testing that the cartridge filters were not performing to stated manufacturers specs (see figure 2). Particles above 5 micron in size were seen to be passing through their 5 micron and 3 micron absolute filters. This problem was eventually addressed and will be discussed in this report.

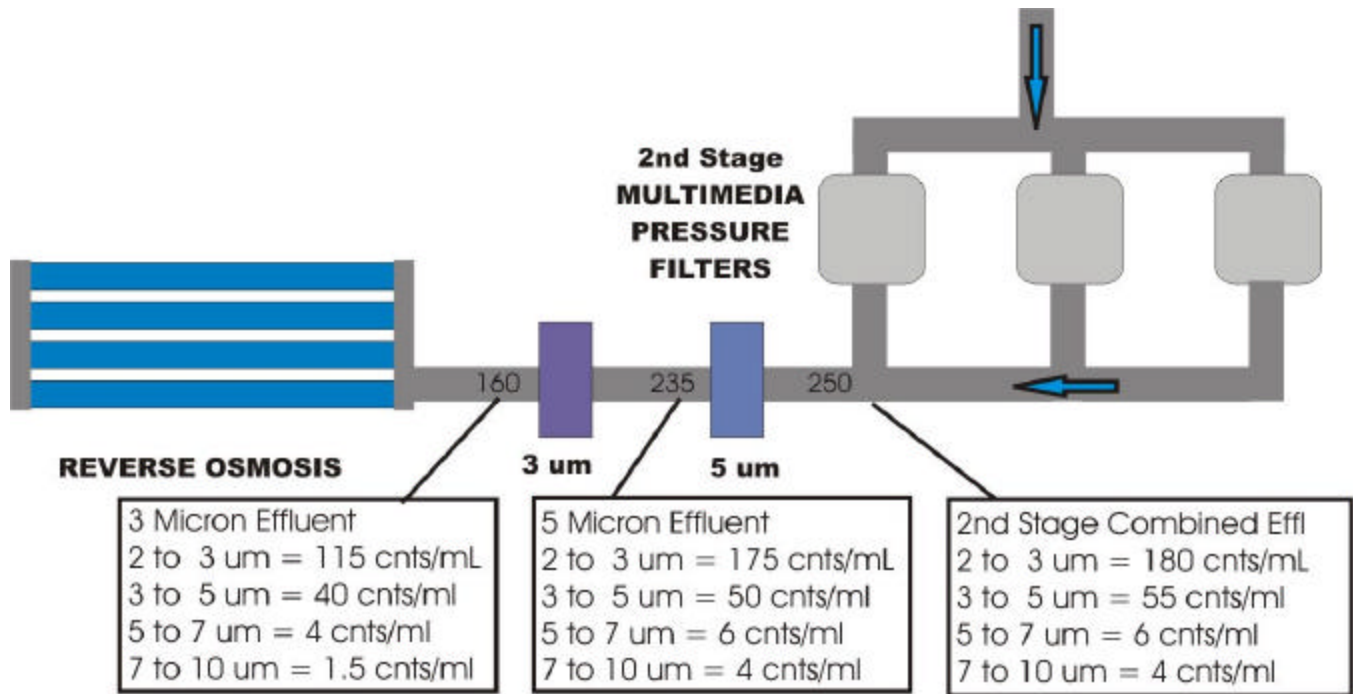
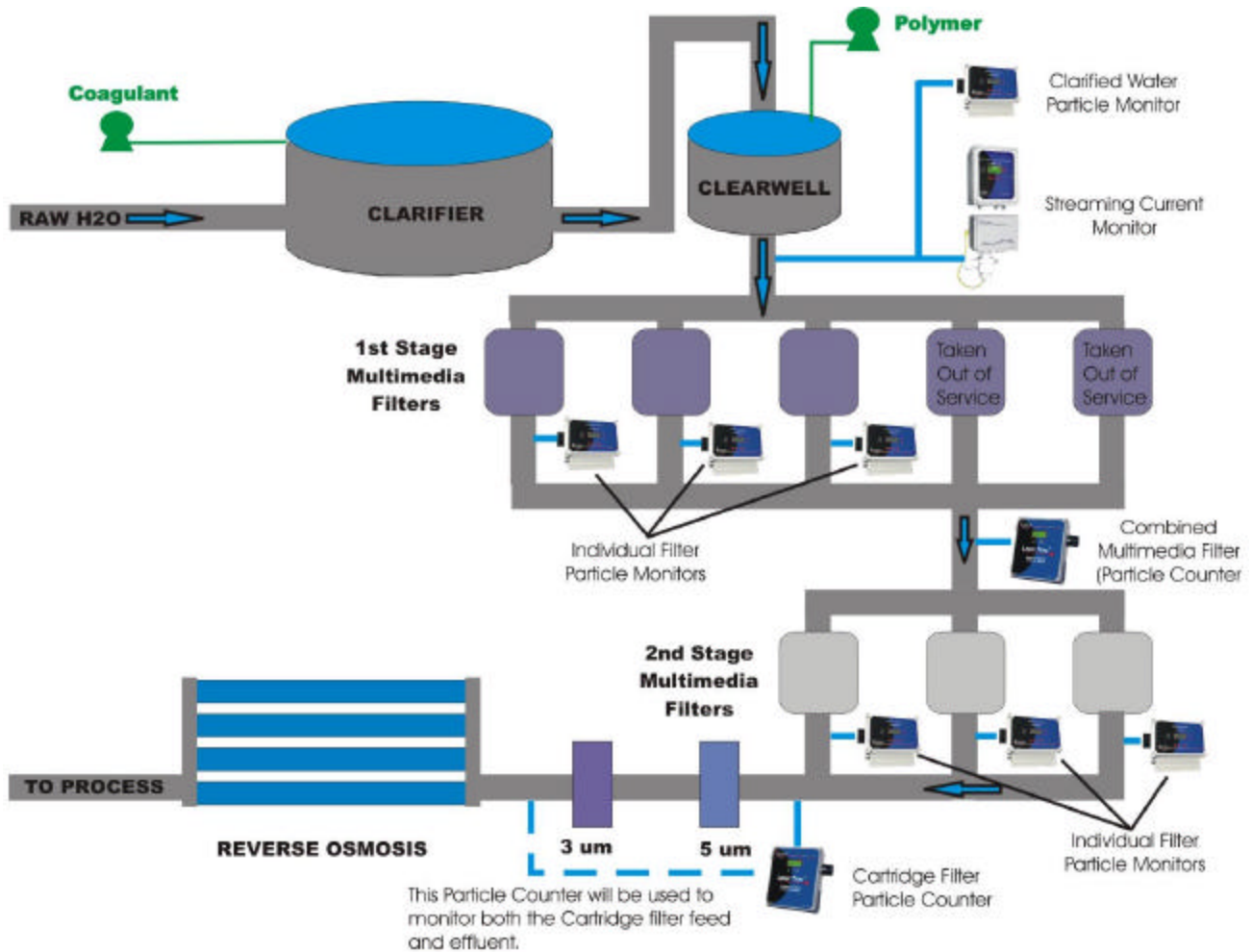


Figure 2

After demonstrating the level of sensitivity and ease of use of Chemtrac’s particle detection equipment, the plant agreed to setting up an equipment trial. The primary goal was to optimize filtration to reduce RO fouling. RO fouling had been a continuous problem since the RO’s were first installed in 1994. Due to the level of fouling, operators were required to perform weekly RO cleanings.

Particle Monitor Sensors were installed on every filter so a comprehensive system profile could be obtained. Having a sensor on each individual filter, as shown in figure 3, provided data on how flow changes and backwashes affected filter performance. Particle Counters were installed on combined effluent of the 1st and 2nd stage multimedia filters (the second Particle Counter sample location could be easily moved from Cartridge filter influent to effluent and also in-between the 5 and 3 micron filters).

A recommendation was made by Chemtrac to consider feeding a cationic polymer ahead of the 1st Stage Multimedia filters to optimize filtration performance. The plant personnel immediately went to work on this concept and had a product brought in by their chemical supplier. Subsequently, a Streaming Current Monitor was also installed by Chemtrac to monitor polymer dosage and net charge effects it had on treated water going to the multimedia filters.



Equipment Installation

Figure 3

November 11, 2003: Polymer Feed Initiated

As seen in figure 4, the effect of the polymer addition was dramatic. The multimedia effluent counts immediately dropped by over 50%. The data also shows that at the exact moment polymer feed was started the particulate concentration was relatively high due to the #2 multimedia filter having just been backwashed.

Figure 5 shows data from Particle Monitor Sensors installed on individual multimedia filters. This data clearly shows the effect of a filter backwash. Prior to any backwashes, all three filters were trending similarly. Filter #1 was backwashed on morning of Nov. 10, and this caused an increase in particulate concentration that lasted 24 hours (up until the polymer feed was initiated). After polymer addition was started, the particulate from all three filters immediately decreased and reached equal values.

Figure 4

Combined Multimedia Effluent

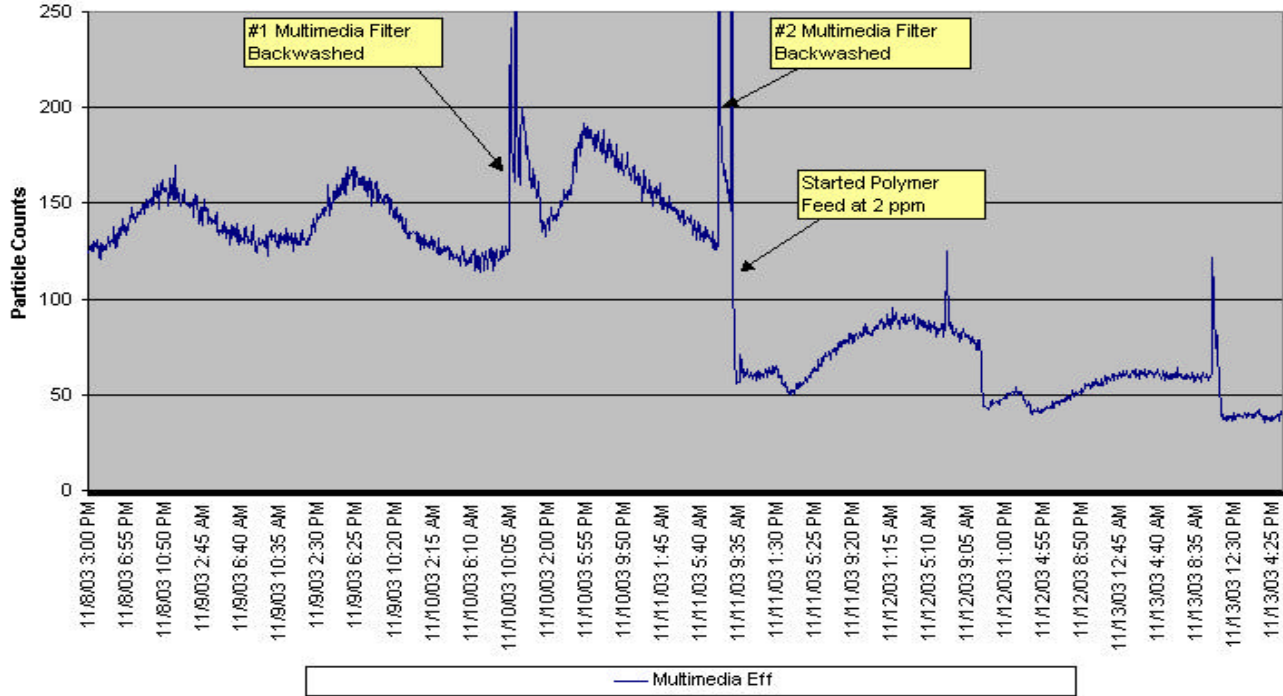
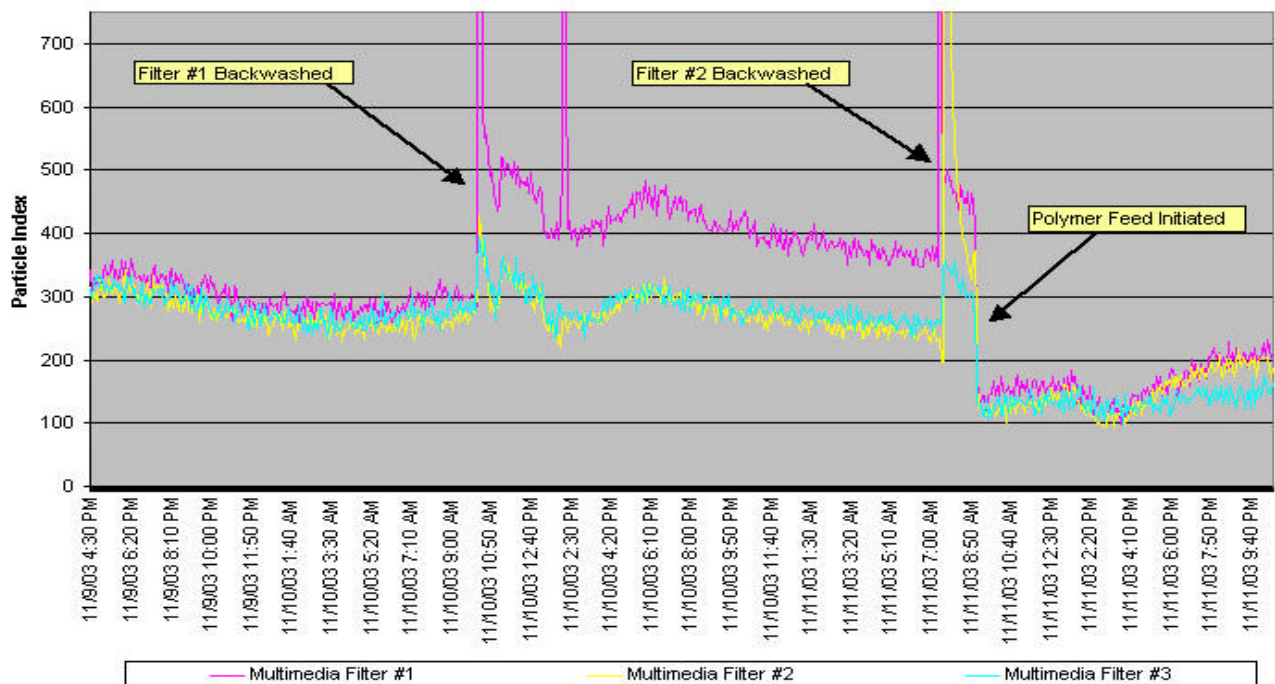


Figure 5

1st Stage Multimedia Filters



During the first 5 days of the trial, polymer was fed at a 2 ppm dosage. This dosage produced a +4.00 Charge Value on the Streaming Current Monitor. This level of cationic charge was the first indication that a 2 ppm dosage was too high. The approach during these first two weeks was to feed polymer for short periods of time while incrementally decreasing feed until an optimum dosage was found. Optimum was generally defined as the point at which further reductions in particulate concentration were not obtainable. Figure 6 shows how intermittent polymer feed impacted particle counts.

There was an immediate reduction in particle counts each time the polymer feed was started, followed by a gradual increase once the feed was shut off. The second week of polymer addition is when reductions were made. With each reduction in polymer dosage, particle concentration decreased until the 0.2 ppm dosage was reached. This information was used to determine that approx. 0.4 ppm dosage would be used for continuous feed.

Intermittent Filter Aid Feed And Resulting Multimedia Particle Counts

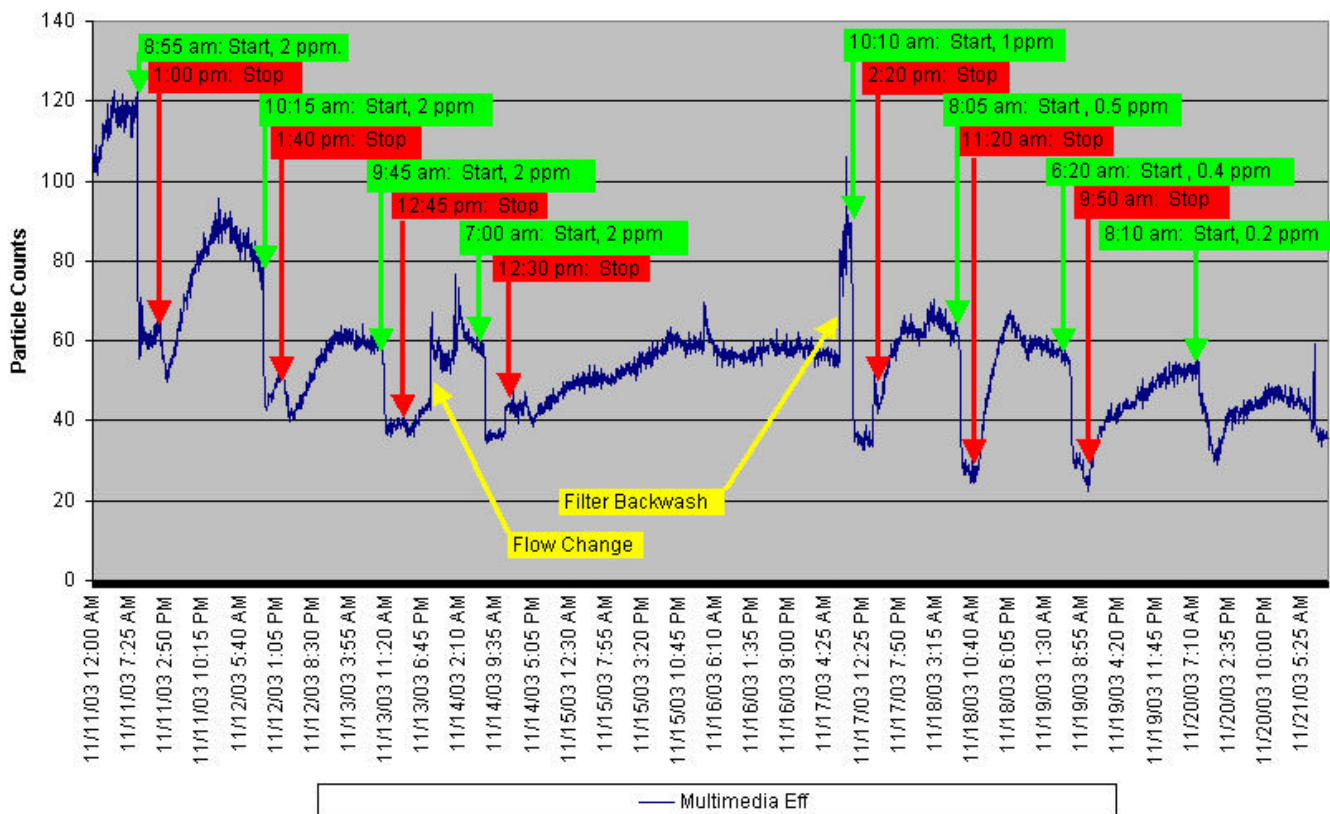


Figure 6

Below are the charge readings provided by the Streaming Current Monitor (SCM) for the various polymer dosages. Plant operators did use the charge reading as an assurance that the polymer dosage was in the desired range after making any adjustments to pump settings (as required when large flow rate changes occurred) and after making down new batches of polymer.

2ppm = +4.00	1ppm = +4.00	0.5ppm = -0.25
0.4ppm = -2.50	0.2ppm = -6.39	0ppm = -8.00

November 25, 2003: Began Applying Constant Polymer Dosage

As seen in figure 6, after applying a constant dosage of 0.4 ppm, particulate steadily dropped and RO feedwater particles above 2 micron eventually reached zero counts.

R/O Feedwater Particle Reduction Using Filter Aid In Multimedia Filters

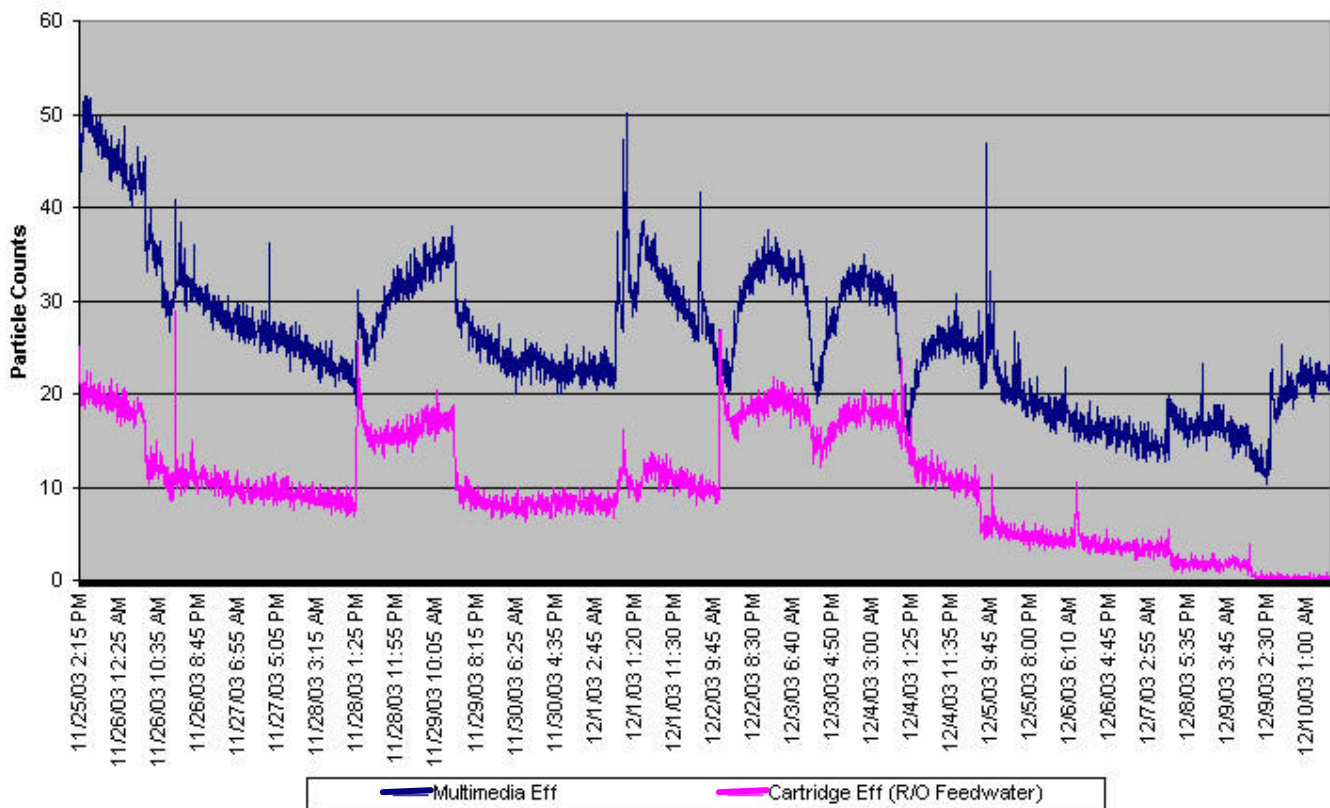


Figure 7

The noticeable increases in particulate concentration seen above (i.e. Nov 28 & Dec 2) were due to large increases in flow rates caused by putting both RO trains in service.

December 9, 2003: New Cartridge Filter Put In Service

Once the trial was underway and particle concentrations were starting to steadily decrease, the decision was made to replace the 5 and 3 micron cartridge filters with 3 micron and 1 micron filters. The first attempt to acquire 3 and 1 micron cartridge filters quickly proved the value of the Particle Counter. After operators installed (what they believed to be) 3 and 1 micron cartridge filters, the particle counter showed no significant improvement in RO feed water particle counts (the particle count and distribution were no different than values obtained with the 5 and 3 micron filters).

Further investigation revealed a mistake made by the filter supplier. They had shipped another set of 5 and 3 micron filters instead of the 3 and 1 micron that were ordered. The problem was eventually corrected and the new filters were installed. Without the Particle Counter, and knowing the actual size of particles passing through these cartridge filters, the customer would not have known of this mistake.

Summary

Significant improvements were noted after the installation of new RO membranes. Plant operators recorded the DP only going from 25 to 26 psig after 1 full month operation (no cleaning was performed during this time). When the previous set of new membranes were installed, pressure immediately increased and cleaning was required after just 4 days of operation. Operators are currently cleaning the RO's once a month as preventive maintenance. No significant pressure increases or loss of flow through the membrane has occurred in the last 3 months.

The utility purchased a Particle Counter and a 4 sensor Particle Monitor system, based upon their level of satisfaction with the type of data that was provided, the sensitivity, and ease of use. The Particle Monitor sensors are used to optimize filter rinse time to prevent being put online prematurely. The Particle Counter was installed on the cartridge filter effluent. This gives final indication of RO feedwater quality and alerts operators to any possible system upsets. There are also plans to automatically control the coagulant dosage in the Graver clarifier with an SCM (upon the relocation of coagulant injection).

Chemtrac offers the best monitoring tools available for optimizing coagulation and filtration processes. Chemtrac has been manufacturing Particle Detection technology for over 10 years and Streaming Current Monitors for over 20 years. Call Chemtrac at 800-442-8722 (or 770-449-6233) if you have questions about how Chemtrac might be able to assist you with your application.