Water Efficiency Case Study:
Millipore Corporation, Jaffrey

Millipore Corporation is a multi-national corporation that provides membrane filtration and purification technology for life science research, biotechnology, and the pharmaceutical industry. The plant in Jaffrey fabricates products used primarily by the pharmaceutical industry. This production requires large quantities of extremely pure water that is produced by reverse osmosis (R/O) and/or ion exchange technology.

Millipore gets process water from an on-site bedrock well and uses water obtained from Jaffrey Water Works for domestic purposes. This case study reviews how Millipore Corporation supplemented their main reverse osmosis membrane filtration system (Figure 1) by staging the system reject stream through another R/O system (Figure 2) to conserve water in the plant and reduce the cost of wastewater disposal.

Figure One

Process Water Schematic Before Recycling
Millipore Corporation, Jaffrey, NH

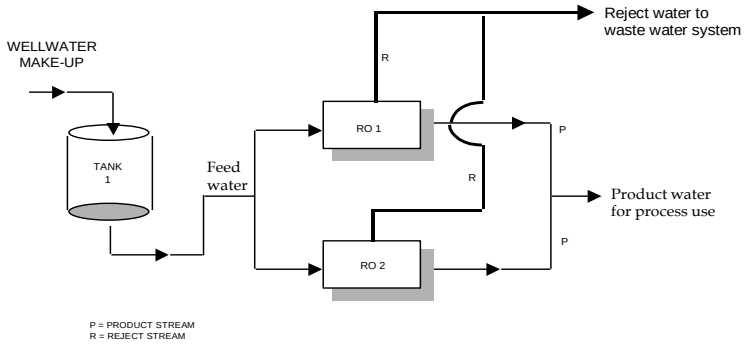

Figure 1

Figure Two

Process Waste Water Schematic After Recycling
Millipore Corporation, Jaffrey, NH

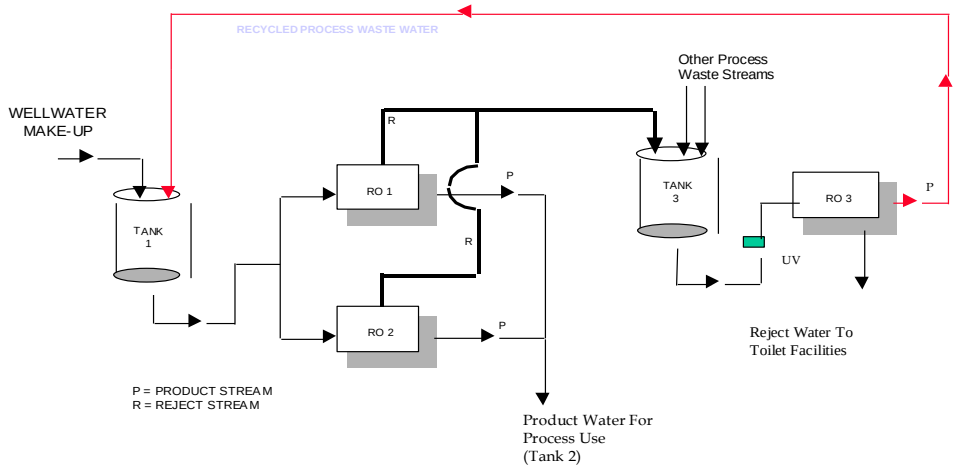

Figure 2

R/O technology works by forcing water under pressure through a semi-permeable membrane. This results in the reduction of the level of suspended and dissolved solids in the water. This process removes virtually all organic compounds and 90-99 percent of all ions from Millipore's process water.

Millipore's initial investment for the new R/O system (R/O #3) was $54,750 including all equipment, engineering, and installation costs. The annual cost of operating the system is $7,000. Total annual savings resulting from a reduction in wastewater disposal and electrical energy use amount to $38,000. Millipore realized a payback on the capital cost and installation of R/O #3 system in just 1.6 years.

Process Overview

Well water from a storage tank outside the plant is pumped to the main floor of the plant. It first passes through a pre-treatment system consisting of sand filtration followed by a 5-micron filter and chlorination and then into storage tank #1. This water is then pumped into R/O Units #1 and #2 that pressurize it (450-500 psi) through 52 membrane filters (see Photo 2). R/O product water is piped to a large tank (#2) on the second floor and eventually out to the plant to be used as process water. The R/O systems run constantly to maintain the necessary high water quality and low bacteria levels. To conserve the high quality R/O water, the second-floor tank overflows by gravity back to tank #1 on the main floor.

Photo 2. Millipore's R/O Units #1 and #2

Reject water from R/O units #1 and #2 formerly went directly to drain but is now directed into storage tank #3 as feed to R/O #3 (see Photo 3). Before entering R/O Unit #3, reject water is pumped through a carbon filter to remove chlorine and a UV treatment device to kill most of the bacteria. Chlorine must be removed from the reject water because the membranes in Unit #3 will not function properly if there is chlorine in the water. This unit also operates at a lower pressure than the other units, closer to 300 psi. One hundred percent of the reject water from R/O Units #1 and #2 goes through Unit #3 and 70 percent is recycled back into the makeup water storage tank #1 for Units #1 and #2. The remaining 30 percent reject water from Unit #3 flows to toilet facilities used by employees.

Photo 3. Millipore's R/O Unit #3
(Storage Tank #3 and Carbon/UV treatment system in the background)

Results

Millipore has experienced very little difficulty in the setup and operation of R/O Unit #3. Health, Safety and Environmental Engineering (HSE) Manager for Millipore, Steven Dark, stated that the key to success with this R/O membrane filtration system was knowing the process thoroughly and working closely and carefully with the supplier.

One of the disadvantages to the closed-loop system is the higher operation and maintenance cost. However, this is offset by the wastewater disposal and energy cost savings provided by the system. The R/O membranes must be cleaned on a regular basis to maximize their lifetimes. For most newer systems, this is accomplished with a "clean in place" process. At a replacement cost of $300 apiece, routine cleaning of the membranes, although expensive, is a cost-effective practice. Millipore replaces their R/O membrane filters approximately every three years.

Another concern with closed-loop systems is the risk of recycling contamination into process water and the potential for increased contaminant concentrations above allowable limits in wastewater. Strict monitoring of the system is required to minimize or eliminate these problems.

Steven Dark feels that Millipore's improved R/O system is an environmentally sound practice that saves significant amounts of water while providing the financial benefits of greatly reduced wastewater disposal and energy costs. For more information about Millipore's water efficiency practices, Mr. Dark may be reached at (603) 532-8711.