Pfizer Inc: Treated Water Reuse and Zero Discharge in Puerto Rico

By reusing the effluent from its wastewater treatment system, a Pfizer facility found a way to reduce groundwater usage and comply with strict effluent discharge limitations.

Pharmaceutical and consumer health care products are produced at the Pfizer Pharmaceuticals LLC (Pfizer) facility located in Vega Baja, Puerto Rico. Approximately 1,000 people are employed at the facility. To increase its production capacity, Pfizer determined that it needed to increase the hydraulic capacity of its wastewater treatment system from 665 to 950 cubic meters per day. The facility was designed to comply with strict discharge limits established by Puerto Rico's Environmental Quality Board and the U.S. Environmental Protection Agency. It also was designed to produce water that could be reused in the site's utilities operations. For discharge to a receiving water, the treated effluent had to comply with a dissolved solids permit limit (of 500 mg/l) and to low levels of other parameters such as metals. The treatment facility expansion that was started up in 1997 is an advanced wastewater treatment system.

The upgraded wastewater treatment system includes the following steps: an equalization step to reduce the variability of the waste applied to downstream operations; an activated sludge system to reduce the concentration of organic materials and suspended solids; a chlorination step to inactivate microorganisms; dual media filtration to further reduce the suspended solids; and a granular activated carbon system to reduce the concentration of dissolved organic materials followed by a reverse osmosis system. The reverse osmosis system includes a separate pretreatment system including pH control, chlorination, chemical addition, and final filtration. The pretreated effluent is pumped across the reverse osmosis membranes. The brine stream from the reverse osmosis system is treated to remove metals and then hauled off-site to a municipal wastewater treatment facility where it is treated and discharged to the Atlantic Ocean.

The reverse osmosis system was designed to achieve high water recovery (approximately 85 percent of the water fed to the reverse osmosis system) and high salt rejection (approximately 90 percent).

To accomplish these objectives, the reverse osmosis system operates in a two-stage mode with intermediate pumping. The reverse osmosis system brine stream generated in the first stage is treated in the second stage to minimize the overall volume of brine that is produced by the operation. Since the brine is disposed off-site, the two-stage system has reduced transportation and off-site disposal costs.

The reverse osmosis permeate was initially discharged to the receiving water, but is currently reused as makeup water to the cooling towers and as boiler feed water. The permeate is also injected into gas turbines to reduce nitrogen oxide (NOx) emissions. By reusing the permeate, the facility was able to reduce its extraction of groundwater by approximately 400 to 450 cubic meters per day.

The water reuse system has brought intangible benefits to the facility, including conservation of Puerto Rico's groundwater resource, the good will and support of the public and regulatory agencies, and a reduction in cost to treat groundwater for use as makeup to cooling towers and boilers. During the first year of operation, the system yielded Pfizer savings in excess of $300,000 (USD). The principal challenges in implementing this project was that reverse osmosis had not previously been used in Pfizer in a wastewater treatment application. There was also a concern about using treated effluent as cooling tower makeup and the potential for fouling, scaling, and corrosion in the cooling water system.

Besides allowing the Pfizer facility to grow, the water reuse project has benefited the local environment. As indicated, the water reuse system has greatly reduced the facility's extraction of groundwater and eliminated the discharge of a treated effluent to a receiving water that has limited assimilation capability.

The reverse osmosis system is not without challenges. For example, the reverse osmosis system membranes can become fouled by inorganic and organic suspended solids. This condition results in more frequent cleaning of the membranes, operating at higher operating pressures, and decreasing membrane life. Pfizer manages this inherent challenge in the reverse osmosis process through its strong preventive maintenance program.