

High Recovery Nanofiltration/Reverse Osmosis Integrated Treatment System

Using both systems to recover more than 90 percent of an impaired water source

Bottom Line

This system can provide/recover more water to help restore/maintain existing ground water aquifers.

Better, Faster, Cheaper

This treatment system:

- Saves energy by using a high flux, low-pressure system
- Reduces chemical use
- Lowers capital and operating costs
- Reduces waste discharge and associated disposal costs
- Increases local water supplies.

Principal Investigator

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Collaborators

- Sanitation Districts of Los Angeles County
- Water Replenishment District of Southern California

San Gabriel River spreading basins.



Problem

The Los Angeles County's Groundwater Reliability Improvement Program (GRIP) is designed to improve reliability and reduce dependency on imported water to replenish the ground water in this area. To achieve this goal, a significant portion of the imported replenishment water needs to be replaced with locally produced, high-quality recycled water.

Reverse osmosis (RO) treats impaired waters by forcing a concentrated solution of salts through a semipermeable membrane to a region of low solute concentration. The membrane is designed to allow only water to pass through this dense layer, while preventing the passage of solutes (such as salt ions). However, one of the main drawbacks of using RO membranes is that these systems are typically limited to recovering approximately 85 percent of the impaired waters, leaving 15 percent as a concentrated waste. This limitation stems from the potential for soluble salts to precipitate, or stick to, the membrane surface (known as membrane scaling).

Solution

Nanofiltration (NF) membranes, unlike RO membranes, are designed to selectively remove compounds such as salts or organic contaminants that can cause scaling, while allowing other compounds to pass. By using an NF system to first treat impaired water and then using an RO system, a dual system can recover much more water.

Overall NF/RO integrated system feed pressure requirements are lower than typical high-pressure RO membrane systems, thus saving energy as well. Moreover, the integrated system's product water has higher total dissolved solids concentration than RO systems, and is thus less corrosive, reducing costs for post treatment stabilization.

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Rio Hondo spreading basins.



Application

This Reclamation Science and Technology Program research project worked with the Sanitation Districts of Los Angeles County (Sanitation Districts) and the Water Replenishment District of Southern California to provide a pilot-scale test for this NF/RO integrated system. Eventually, these results may be used in an advanced water treatment plant to produce 10,000 acre-feet of water per year (about 9 million gallons per day).

Pilot-scale testing was conducted from August 2011 to March 2012, at the Sanitation Districts' San Jose Creek Water Reclamation Plant using effluent from an ultrafiltration system as source water to evaluate the:

- Operational performance of the NF/RO integrated system for feed pressure, fouling, and related cleaning requirements.
- Rejection performance of the NF/RO integrated system for relevant constituents for indirect potable reuse projects including nitrogen, total organic carbon, and chemicals of emerging concern (e.g., N-Nitrosodimethylamine [NDMA], 1,4-dioxane, hormones, pharmaceuticals, and personal care products).

The NF/RO integrated system was operated for over 3,000 hours in two distinct phases, with different anti-scalant products for membrane scale control. Phase one used SpectraGuard (Professional Water Technologies), which was not effective for scale control and resulted in relatively significant membrane fouling in both the primary NF and secondary RO systems. Phase two used Y2K (King Lee Technologies), which was effective for controlling membrane scale formation. In phase two, the pilot system was operated for approximately 3 months (~ 2,000 hours), with significantly less fouling compared to phase one. Over the 3-month operating period, the normalized specific flux for the primary NF and secondary RO systems decreased by 16 and 28 percent, respectively.



Future Plans

The results from this study demonstrated that the NF/RO integrated treatment system concept is a viable alternative to a standard RO system and can potentially be employed for the GRIP project. The next steps would involve a demonstration project if funding becomes available.

“NF/RO integrated treatment system concept is a viable alternative to a standard RO system and could be employed for the GRIP project. The main advantages of this system include the ability to operate at an overall recovery of approximately 93 percent and to achieve a high degree of rejection for many of the constituents that are relevant for indirect potable reuse projects, including total organic carbon and select chemicals of emerging concerns.”

Bruce Mansell
Engineer, Los Angeles County
Sanitation Districts

More Information

Science and Technology Program
research project:

[www.usbr.gov/research/projects/
detail.cfm?id=7251](http://www.usbr.gov/research/projects/detail.cfm?id=7251)

Mansell, Bruce, 2012. *GRIP--
Evaluation of a High Recovery
NF-RO Integrated Treatment
System*. Prepared by Sanitation
Districts of Los Angeles County.

[www.usbr.gov/research/projects/
download_product.cfm?id=7251](http://www.usbr.gov/research/projects/download_product.cfm?id=7251)