Reverse osmosis (RO) treatment of Tucson’s share of Central Arizona Project (CAP) water is being considered to reduce the dissolved salt content of the water to better match Tucson’s existing groundwater supply. Improvements to the RO process, including pretreatment and post-treatment measures, are needed before large-scale production of treated CAP water can become cost-effective.

**PROJECT TEAM**

**Investigators**
Wendell Ela (UA) - Lead  
Jim Baygents (UA)  
Jan Theron (NAU)

**Research Assistants**
Dongxu Yan (UA)  
Ashley Smith (UA)  
Umur Yenal (UA)

**PROJECT FUNDING CYCLE**
2007

**PROJECT GOALS**
This project had three main goals: 1) conduct preliminary laboratory bench-scale RO tests to reduce CAP water salinity, 2) create an annotated bibliography of literature on the state of the art of inland desalination, and 3) hold a workshop of invited experts to develop a research agenda for improving desalination technology and addressing salinity management in Arizona.

**BACKGROUND/RESEARCH METHODS**
CAP water originating in the Colorado River is a primary source of potable and irrigation water in Arizona. This water is higher in salinity than many current sources, bringing into central Arizona more than 1,000,000 tons of salts per year. These salts go into the region’s soils, either initially upon irrigation or after discharge or reuse of the treated wastewater from sewage treatment plants. Ultimately, the salts move into and impair the quality of the underlying groundwater. Removal of salt from CAP and other source waters, treated wastewater, and moderately saline to brackish groundwater resources is necessary to create a sustainable water supply for Arizona.

In bench-scale trials, the research team investigated specific pretreatment, RO membrane, and post-treatment processes using CAP water to increase the production of high-quality usable water (permeate) and decrease the proportion of rejected brine water (concentrate). Advances are needed in these areas to yield the most voluminous, cost-effective supply and decrease the cost of disposing the concentrate. Prevention of scaling in the RO membranes is the key to improving treatment efficiency and was the focus of this research. A variety of water chemistry, pressure, temperature, and RO membrane characteristics were studied to identify scaling causes and optimal RO membrane selection and design.

**KEY SCIENCE FINDINGS**
Previous work with CAP water suggested that barium sulfate is one of the first minerals to precipitate on the RO membranes. This study showed that other miner-
with Dr. Ela as Principal Investigator, RO Pretreatment Using Ion Exchange Brine Recycle and Selective Precipitation (AWI-08-12). The National Water Research Institute selected this project for co-funding.

CONCLUSIONS and RECOMMENDATIONS

This project was one component of a larger effort to maximize water recovery using RO technology to treat CAP water and to minimize the amount of concentrate produced. More research and significant improvements in both are needed to make RO treatment of CAP water truly cost-effective. The results of the workshop of invited experts, convened as part of this project, point the way to applied desalination research needed to cost-effectively treat CAP water, reclaimed wastewater, and other moderately saline to brackish water sources and dispose of the concentrate left after treatment.

The investigators compiled an annotated bibliography of 77 key state-of-the-art publications relevant to inland desalination. These references provide a point of entry into the literature on a particular aspect of the subject. Finally the investigators convened a highly successful workshop of invited experts who developed an agenda for applied desalination research in Arizona. [The workshop report with the bibliography available on AWI website.]

KEY STAKEHOLDER ENGAGEMENT AND OUTCOMES

This project is one component of a larger research effort to improve desalination of CAP water using an RO treatment train. This project depended, in part, on bench-scale laboratory equipment and funding already provided by the U.S. Bureau of Reclamation and financial support by the University of Arizona Technology Research Initiative Fund (TRIF). The overall project also is supported by the Metropolitan Water District, Tucson Water, the cities of Oro Valley and Marana, and the Flowing Wells Irrigation District. In 2008, AWI funded another component of this effort

SEM Image: Silica Scaling of RO Membrane

The investigators identified scale formation by silica and calcium carbonate. There was no evidence of barium sulfate and little evidence of calcium sulfate precipitation. The investigators also measured salt rejection by the RO membrane under different pressure, temperature, and membrane spacing conditions, developing the type of data needed to design an efficient full-scale RO facility in the future.

For additional information about desalination research, see Salinity Management and Desalination Technology for Brackish Water Resources in the Arid West: A Workshop. The fact sheet and final report for AWI-07-42 and the workshop are available on the AWI website.

AWI and the project team express their thanks to Brown and Caldwell, Erroll L. Montgomery and Associates, and Damon S. Williams and Associates for providing financial support to the salinity workshop convened as a part of this project.

FIND OUT MORE

Final Reports and other information available at

www.azwaterinstitute.org

ARIZONA WATER INSTITUTE
845 N. PARK AVENUE SUITE 532
TUCSON, AZ  85719
520-626-5627

Project: AWI-07-42 Ela