Story by Kathy Wythe

Reclaiming a valuable, clean resource

Texas cities increasingly embracing potable reuse

In May 2013, the Colorado River Municipal Water District opened a $14 million advanced water treatment plant to apply additional treatment to reclaimed wastewater in Big Spring. The geodesic dome-roofed water storage tank (pictured) holds wastewater before it is treated at the plant. Photo courtesy of Texas Water Development Board.

A Texas water supplier has become the closest to date in the United States to use what is commonly referred to as "toilet to tap" technology. In May 2013, the Colorado River Municipal Water District opened a $14 million advanced water treatment plant to apply additional treatment to reclaimed wastewater to supplement Big Spring's drinking water supply.

Although many experts call the Big Spring system direct potable reuse technology, the water district calls it indirect potable reuse because it blends the reclaimed water with raw surface water before sending the water to a conventional drinking water treatment system.

The small village of Cloudcroft, New Mexico, also blends highly treated wastewater with natural waters and then places the mixed water in a storage reservoir for about two weeks before sending it through the drinking water treatment plant. New Mexico health authorities classified this project as indirect potable reuse because of the blending part of the process.

Close behind Big Spring is possibly Brownwood, which has received funding approval to construct a proposed direct potable reuse plant. Once constructed, the city must conduct a study that demonstrates the plant can produce water that meets federal and state drinking water standards, according to the Texas Commission on Environmental Quality (TCEQ). If approved, the plant will pump reclaimed wastewater treated to drinking water standards directly into the drinking water distribution system without first blending it with any other water. The only currently operated reuse system in the world in which the treated water is fed directly into the distribution system is in Windhoek, Namibia.

In the world of water reuse, distinctions are important when it comes to definitions. Reclaimed water is domestic or municipal wastewater treated to a quality suitable for a beneficial use. Potable reuse refers to the use of reclaimed water to supplement drinking water supplies. Indirect potable reuse usually includes water entering an environmental buffer such as a river, lake or aquifer before it is delivered to the drinking water treatment plant. Direct potable reuse, however, uses engineered treatment processes instead of an environmental buffer to purify the reclaimed water before introducing the reclaimed water either into the drinking water treatment plant or directly into the drinking water distribution system.

Using reclaimed water for nonpotable uses is a strategy that has been around for years. Farmers have used reclaimed water to irrigate their crops; industries have used it for fire protection; and cities have used it to water golf courses or public parks, among other uses.

As the state's population continues to grow and unused surface water and groundwater supplies diminish, reuse is becoming an even more popular and widely used method to increase water supplies. In the 2012 state water plan, more than 10 percent of the water management strategies for the year 2060 are water reuse strategies.

"Most regional water plans include reuse strategies to meet nonpotable demands — such as golf course irrigation, for example," said Jorge Arroyo, former director of innovative water technologies at Texas Water Development Board (TWDB), "or indirect potable reuse, which entails reclaiming and treating wastewater and recycling it to surface water reservoirs or aquifers used as drinking water sources."

El Paso Water Utilities, North Texas Municipal Water District and Tarrant Regional Water District all use indirect potable reuse to supplement their drinking water. Now, direct potable reuse is gaining attention.

The Big Spring advanced water treatment plant uses a three step process to treat the wastewater: microfiltration, reverse osmosis and advanced oxidation. This photo shows the reverse osmosis equipment. Photo courtesy of Texas Water Development Board.

According to Arroyo, three regional water plans have specifically identified direct potable reuse as either recommended water management strategies or alternative strategies if strategies recommended in the 2012 water plan prove unfeasible.

Why now?

Dr. Bill Batchelor, professor and holder of the R.P. Gregory '32 Chair in the Zachry Department of Civil Engineering at Texas A&M University, said water suppliers are looking at using direct potable reuse now because of necessity.

"We are doing reuse because we need to, because alternative water sources are not available," Batchelor said.

Arroyo agreed. "Direct potable reuse projects are considered in cases where conventional water sources are insufficient or economically inaccessible," he said.

TWDB provided a loan for the Big Spring project and has committed to funding the Brownwood project, Arroyo said.

While diminished available water supplies are definitely the main driver in this increased interest, Dr. Ellen McDonald, a principal at Alan Plummer Associates, Inc., said because of research conducted over the last 10 to 15 years, the research and professional community has become more comfortable with the fact that the available treatment technologies can produce high quality purified water.

"The big focus now is on making sure we understand how to operate these treatment systems in a way that ensures that the treatment processes perform properly and the system has appropriate redundant processes and safeguards," she said. "As we bring the pipes closer and closer together between the wastewater and water systems, there is less time to react if there is a problem. Operationally figuring out how to control these systems and determining what to monitor, where to monitor and how to monitor is the real challenge with direct potable reuse."

Although the risk of a potential breach of the treatment process is not unique to direct potable reuse projects, Arroyo said the design of direct potable reuse projects requires redundancy in the treatment process and close monitoring of all treatment phases.

The technology used

Batchelor stressed that the treatment processes or technologies for direct potable reuse are not new; they have existed for years. "The technology has been there but the cost and need were not," he said. "The technology has definitely improved, the costs have decreased and the reliability has increased. The developments in treatment technology have made it easier to do direct potable reuse."

"The Big Spring plant is new in the sense that it is direct, but the idea of using a water supply that is partly made of wastewater is very old," Batchelor said. "We have been doing that for a very long time."

At the Big Spring operation, wastewater is first treated at a conventional wastewater treatment plant. Then, instead of being discharged into a creek, ⇨

Definitions

Direct potable reuse: Reclaimed water is transported directly from a wastewater treatment facility to a drinking water treatment and distribution system without being released to the natural environment.

Indirect potable reuse: Reclaimed water is released to the natural environment from which it is subsequently taken and treated for potable consumption.

Direct nonpotable reuse: Reclaimed water is transported directly from a wastewater treatment facility to a site for nonpotable beneficial uses such as landscape irrigation, power plant cooling and manufacturing without being released to the natural environment.

Indirect nonpotable reuse: Reclaimed water is released to the natural environment and then taken and used for nonpotable uses, such as golf course irrigation.

the reclaimed water is treated a second time at the advanced treatment plant. This facility adds three advanced processes to the conventional treatment method. About 5 to 20 percent of this twice-treated water is then blended with surface water from one of the district's reservoirs and treated again at Big Spring's drinking water treatment plant. The blended water may also go to surface water treatment plants in Snyder, Odessa, Stanton and Midland, according to TCEQ.

"The water is really going through three treatment plants before people drink the water," Batchelor said.

Big Spring's new advanced treatment plant uses microfiltration, reverse osmosis and advanced oxidation, Batchelor said. In the first two steps, membranes filter out particles in the water. Microfiltration removes essentially all bacteria and other large organisms that cause disease. Reverse osmosis removes dissolved materials and even smaller organisms, such as viruses that could potentially be pathogenic.

"Those two steps give barriers to transmission of pathogens," Batchelor said.

The final step, Batchelor said, is advanced oxidation. In this step, chemicals are added and ultraviolet light is used to destroy very low concentrations of potentially toxic organic compounds that could get through reverse osmosis.

"This process has multiple barriers to remove organisms that might cause disease and to remove organic and inorganic compounds that might be toxic," he said.

The treatment processes used at the Big Spring plant "have been tested and used elsewhere and shown to be effective," McDonald said.

As interest in direct potable reuse increases in Texas, TWDB is taking a leadership role in helping to advance potable reuse so it can be implemented in a safe and practical manner. Alan Plummer Associates, Inc., through a project partially funded by the TWDB, is developing a resource document that will assist water providers as they plan and consider the viability of a direct potable reuse project for their systems, McDonald said.

"One of the things we are looking at in our TWDB study is technologies that don't involve reverse osmosis, because reverse osmosis has the challenge of producing concentrated brine that has to be disposed of somewhere," she said.

Dealing with brine disposal can be challenging and expensive, she said. "Big Spring has a place to dispose of its brine relatively inexpensively. Not all utilities will have this luxury."

Cleaner than drinking water

Batchelor pointed out that Big Spring will actually be using a smaller percentage of treated wastewater in its drinking water than the city of Houston, which uses indirect potable reuse by acquiring its drinking water from Lake Livingston.

Much of the water that flows into Lake Livingston originates from wastewater treatment plants in the Dallas area. Time and natural processes in the Trinity River further "treat" the water before it reaches the lake. Once Houston draws the water from the lake, it goes through the normal treatment for drinking water.

"From the statistics I have seen, water coming from Lake Livingston has a higher fraction of wastewater than Big Spring will have," he said.

The Big Spring reclamation plant replaces natural processes that take place in a river, Batchelor said.

"The water that is being produced in the Big Spring plant is extremely high quality water," McDonald said.

A report issued by the National Research Council in 2012, *Water Reuse: Potential for Expanding the Nation's Water Supply Through Reuse of Municipal Wastewater*, substantiates the idea that reclaimed water is safe. A council news release stated: "The concentrations of chemicals and microbial contaminants in reuse projects designed to augment drinking water supplies can be comparable to or lower than those commonly present in many drinking water supplies."

Although technology and safety are no longer barriers to direct potable reuse, public acceptance is.

"The yuck factor that people have with direct reuse is really not related to what the concentrations of any particular contaminants are, it is related to the general idea," Batchelor said.

Arroyo said the public needs more information about the benefits, risks and risk-management approaches of potable reuse through increased educational outreach and that is one reason for the Alan Plummer study.

McDonald agreed that getting beyond public perceptions is difficult. She cautioned, however, that direct potable reuse isn't always the best answer for a water supplier.

"We need to be careful about getting so excited about it that we don't consider all the other options," she said.

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