

How Sewage Gets Recycled



Mayor Jerry Sanders cites a number of concerns for his opposition for sewage recycling, but those are countered by water experts.

Photo: Sam Hodgson

By [ROB DAVIS](#)

Friday, Oct. 3, 2008 | Got bad news if you think that the water you drank this morning came straight from a pristine mountaintop high in the Sierra Nevada or Colorado Rockies.

Odds are pretty good those water molecules -- those life-sustaining hydrogen and oxygen atoms -- have been inside someone (or something) else's body sometime during man's time on Earth. Conjure whatever romantic storyline you want, because there's only so much water on the planet. Maybe Columbus quaffed them while sailing the ocean blue. Maybe a dinosaur guzzled them from a prehistoric watering hole.

Or maybe they were in a warm beer on a Vegas poker table a few days ago.

With environmentalists, water agencies and San Diego's City Council supporting recycled sewage as a new drinking water source, it is vital to understand that underlying concept: All drinking water is recycled. But the type of recycling the City Council is studying would be the first of its kind in California: Directly taking purified sewage and pumping it into the San Vicente Reservoir, a drinking-water source.

Let's settle on the terminology for the council's effort: We're calling it sewage recycling. Opponents call it toilet-to-tap. Which is not entirely accurate, because the oversimplified phrase ignores the purification process. Proponents call it "indirect potable reuse" or "reservoir augmentation." Which may be accurate but aren't entirely comprehensible.

As the City Council considers approving a temporary water-rate increase in November to pay for a four-year, \$11.8-million pilot study of sewage recycling, the concept continues to face skepticism -- most notably from Mayor Jerry Sanders, who vetoed the council's pilot project. (The veto was ceremonial; the council overturned it.)

Sanders' objections echo common concerns among those who want to know whether it's safe to drink recycled sewage or whether traces of pharmaceuticals and other drugs commonly found in sewage could be ingested, posing a human health threat.

"I'm still concerned about the pharmaceutical impact," Sanders says. "We've seen other people express those concerns. Nobody's ever done what the council wants to do. And I want to make sure we're going to be providing safe clean drinking water if we're going to be doing that."

Sanders' claim about precedent is not true: Fairfax County, Va., a densely populated Washington, D.C. suburb, uses the same process as is proposed in San Diego: Filling a reservoir with purified sewage. San Diego would be the first in California. Other water districts recycle sewage, but use different techniques. The Orange County Water District opened a sewage recycling facility this year that allows the purified sewage to soak into an underground aquifer before being consumed.

The city of San Diego's own study, and interviews with experts and water agencies that rely on recycled sewage, debunks Sanders' health concerns. More pharmaceuticals slip through the city's existing drinking-water

treatment process than would through the sewage purification process. And Sanders' other concerns about sewage recycling's cost are as yet unproven.

San Diego, an arid region desperate for new water sources, has flirted with sewage recycling for nearly 15 years. As the City Council vote approaches, one assumption underlies their push: That scientists and public health experts agree that drinking recycled sewage is safe.

How Sewage is Purified

The idea seems counterintuitive -- that a glass filled with purified, filtered sewage could be cleaner than what comes out of the tap. But if you dropped two tap-water ice cubes in a glass of recycled sewage straight from the treatment plant -- straight out of the filtration process -- you'd actually be adding chemicals.

The process of purifying sewage removes pharmaceuticals to non-detectable levels. The city's existing water treatment process does not. Recycled sewage would actually be cleaner. Experts say its purification process is the most effective way to produce clean water.

The city's existing drinking water treatment process, which takes water from reservoirs and makes it drinkable and bacteria-free, doesn't remove pharmaceuticals. The mayor has not suggested that the city's tap water is unsafe or contaminated by pharmaceuticals. The city does not routinely test for pharmaceuticals; their presence in water is not regulated by the state or federal government. The drugs are found in such small levels that most laboratories don't yet have the technology capable of detecting them.

When scientists describe pharmaceuticals in the drinking water as traces, they do not mean half an Advil diluted in a glass of water. Pharmaceuticals and other drugs have shown up in water supplies and rivers across the country because when we take medicine, our bodies don't process it all -- some gets flushed down the toilet. The sewage is dumped in rivers such as the Colorado, which gets about 2 percent of its flow from sewage treatment plants.

Testifying before Congress in April, Shane Snyder, a scientist with the Southern Nevada Water Authority, which supplies Las Vegas, said the highest concentration of any pharmaceutical in regular drinking water supplies is about 5 million times lower than its therapeutic dose. The traces

are measured in parts per trillion. (One part per trillion is a single drop of dye in 500,000 barrels of water or 20 Olympic swimming pools.)

A person could drink 50,000 glasses of water a day without any health effects from pharmaceuticals, Snyder told Congress.

Snyder has analyzed San Diego's water for one of the city's earlier sewage recycling studies. His work focused on the effectiveness of the key technology used in sewage recycling: Reverse osmosis. That technology, Snyder says, is the most effective tool for purifying drinking water.

"The average wastewater plant in the United States would not have the degree of efficacy for removing pharmaceuticals as would a modern reverse osmosis treatment plant," Snyder says. "Even in drinking water the treatment process is very simplistic. Comparatively, the reverse osmosis is producing a very high-quality water."

A 2005 analysis of San Diego's treated sewage found trace levels of caffeine, insect repellent and drugs used to treat epileptic seizures, urinary tract infections and high cholesterol. Reverse osmosis and a subsequent disinfection step removed all of them to non-detectable levels.

Here's how reverse osmosis and sewage purification works: A toilet flushes. The sewage goes through the pipes to a treatment plant. There, it sits as the solids are filtered out. The gunk goes to a landfill. At this point, the water is already clean enough to be used for irrigation. Then the water heads to the filtration process, the actual method by which sewage gets purified in three steps.

Step one: The already treated sewage passes through a series of tiny fibers which serve as microscopic filters. This pulls out bacteria and viruses.

Step two: Reverse osmosis. The sewage is forced through thin membranes with holes so small that water molecules are about the only things that get through. This is the same technology used to desalinate seawater. It stops just about everything.

Step three: Hydrogen peroxide gets added to the water, which then gets zapped with ultraviolet light. This eliminates two chemicals that can sneak through the membranes, and also disinfects the water.

The third step is an added layer, a fail safe. Mike Wehner, an assistant general manager of the Orange County Water District, explains why: "We don't know everything yet. This is an additional barrier."

In Orange County, which began recycling sewage earlier this year, the pure water then filters into the ground and winds up in an underground aquifer. It stays at least six months, mixing with the water that naturally fills the basin, before getting sucked out, treated and, ultimately, swallowed again.

In San Diego, the recycled water would instead be pumped into the San Vicente Reservoir. As part of the City Council's project, the city will study how long it could be retained there before being consumed.

The Cost Question

In addition to questioning the pharmaceutical load in recycled sewage, Mayor Sanders has raised another objection: Its cost.

The process is "tremendously expensive" and would yield only a small amount of supply, Sanders says, questioning whether the city would be better served by building another desalination plant on the coast.

Whether Sanders is right or wrong about the cost is still uncertain.

The Orange County sewage recycling facility produces water for \$850 an acre foot (enough to supply two families for a year). Grants and subsidies cut the cost to about \$550 an acre foot, close to the price of pumping in imported water from the Colorado River and Sacramento Delta, San Diego's two main sources of water.

The Carlsbad seawater desalination plant, which Sanders has endorsed as being vital for the region, will produce water for \$950 an acre foot once operational. (A subsidy cuts the cost to \$700.)

Recycling sewage is less expensive than desalinating seawater, Wehner says. Even though the treatment process is similar -- both filter water through reverse osmosis membranes -- pushing saltwater through the membranes uses more energy than treated sewage because of seawater's high salt content.

For San Diego, the cost of finding new water sources or desalinating seawater will be higher than recycling sewage, Wehner says.

"The lines are crossing," says Mike Markus, the Orange County Water District's general manager. "Recycled water is becoming cost-comparable to imported water."

But San Diego is currently limited by the amount of sewage it could purify - - cutting the economies of scale. Orange County built a plant that treats 70 million gallons daily. San Diego, which already operates a plant that partially recycles sewage (it doesn't go through that three-step purification process) can produce 24 million gallons daily.

San Diego's 2006 study of sewage recycling estimated it would cost \$1,230 per acre foot to recycle sewage at the North City Water Reclamation Plant -- not including subsidies.

If the city undertakes a pilot study, it will reevaluate that cost. Marsi Steirer, deputy director of the city's Water Department, says technology improvements may have cut the cost or inflation may have increased it.

Those improvements in reverse osmosis membranes have made desalination increasingly cost-effective and have continued boosting levels of contaminants removed during treatment. Reverse osmosis membranes have improved to the point that Wehner says water agencies will someday feel comfortable putting purified sewage directly into drinking-water pipes.

Snyder agrees that the country's future water supplies will increasingly include purified sewage. He says, "Our destiny is one of reuse as the population continues to expand."