

GETTING MINDS OUT OF THE SEWER

How human psychology gets in the way of sensible solutions to recycling wastewater

In water-starved Orange County, California, engineers take treated wastewater from sewage processing plants and put it through a battery of filters and purifiers that produce a fluid that is more than clean enough to drink, according to government standards. A county facility opened in 2008 churns out 70 million gallons of this recycled water a day, enough to meet the needs of 600,000 residents. But instead of piping the ultrapure water to people's kitchen sinks, the county pumps it into the ground.

The reason has more to do with psychology than with engineering. The public was too squeamish about drinking recycled wastewater straight from the tap, local officials say; the “yuck factor” was just too great. So they came up with an alternative: About half of the reclaimed water is injected into wells to prevent seawater from seeping into local aquifers; the other half goes into basins, where it filters through sand and gravel to replenish the aquifers that supply drinking water. “This perception of a natural barrier where it's blending and mixing with all of our other water supplies ... helps people make the leap,” says Eleanor Torres, director of public affairs for the Orange County Water District and its euphemistically named Groundwater Replenishment System.

Technologically speaking, it's no huge feat to turn water contaminated with human waste into a usable resource. A report earlier this year by the National Research Council of the U.S. National Academies found that wastewater reuse could provide up to 27% of the public water supply in coastal commu-

nities in the United States. But getting communities to accept such projects often isn't easy. That's because—whatever the science says—winning people over involves the delicate work of overcoming deep-seated psychological barriers and cultural taboos surrounding human waste.

Cognitive sewage

The aversion to excrement is deeply rooted in the human psyche, and for the most part it serves us well, says Valerie Curtis, an evolutionary psychologist at the London School of Hygiene and Tropical Medicine. For our human and prehuman ancestors, pathogens were probably a greater overall threat than predators, Curtis says. That's why we have a strong, intuitive sense of disgust, she says: “Pretty much all the things we find disgusting have some kind of connection to infectious disease.”

Those intuitions can easily trump reason, says Paul Rozin, a psychologist at the University of Pennsylvania and a pioneer of research on disgust. In one classic experiment in the 1980s, Rozin gave college students a piece of fudge shaped like a dog turd. “They know it's chocolate, okay, and they like chocolate, but most of them won't eat it,” he says.

In fact, disgust can evoke what Rozin and colleagues call “magical” thinking. In one demonstration of this, they presented undergraduate students with a glass of juice. Then, using forceps, a researcher dipped a dead, sterilized cockroach into the glass. Despite

Drink up. California Representative Loretta Sanchez (D) (*above*) demonstrates the drinkability of recycled water at the inauguration of a treatment facility in Orange County.

assurances that the juice was perfectly clean and safe (which it was), the students had a strong aversion to taking a sip. And it didn't stop there. Even when the researchers provided new glasses filled with juice, students still didn't want to drink. It was as if people believed that the newly poured juice had somehow been contaminated by the roach, says Rozin's then-graduate student, Carol Nemeroff, who is now at the University of Southern Maine, Portland. Nemeroff thinks the same logic-defying thought process comes into play in getting people to accept recycled wastewater, especially for drinking. The question, she says is: “How do you get the cognitive sewage out, after the actual sewage is gone?”

Sometimes you can't. The yuck factor has scuttled proposed wastewater recycling projects in San Diego, Los Angeles, and elsewhere. Opponents of these projects effectively used slogans like “toilet to tap” to create a stigma that's hard to overcome, says Paul Slovic, a psychologist at the University of Oregon, Eugene, and president of Decision Research, a nonprofit research organization. Since the 1990s, Slovic has studied the mental shortcuts people use to assess risk. In work on attitudes toward nuclear and chemical waste disposal, for example, he found that whereas experts methodically tote up

Online

sciencemag.org

Podcast interview with author Greg Miller (http://scim.ag/pod_6095b).

risks and benefits, laypeople tend to decide intuitively whether a given material or technology is either good or bad. And once they decide a technology is bad, they tend to overestimate the risks and downplay the benefits. “For most of us, risk perception is not the output of a scientific, mathematical calculation, but of a gut feeling,” Slovic says.

Let’s be reasonable

Water agencies have taken note of this research, and in some cases they’re commissioning studies of their own. Slovic, Rozin, and Nemeroff collaborated on a 2008 survey of public attitudes sponsored by WaterReuse, a nonprofit organization in Alexandria, Virginia. That study, led by Brent Haddad, a social scientist at the University of California, Santa Cruz, found that educating consumers about the water cycle can help increase acceptance of recycled water. Most people have no clue what happens when they flush the toilet, Haddad says. In most of the developed world, what happens is this: Collected wastewater is treated to remove solids and pathogens and then pumped into the nearest natural body of water, where it can enter the water supply of the next community downstream. “Any city that’s at the bottom of a river is drinking the recycled wastewater of cities upstream,” he says. His survey found that when people realize they’ve been drinking unintentionally recycled water, they’re more willing to accept intentionally recycled water.

A more recent study sponsored by WaterReuse expands on this idea, suggesting that framing reuse projects in the context of the urban water cycle—in which all water is essentially recycled—can help make them more acceptable. The focus should be on what the water is now (clean and safe) rather than where it came from in the recent past (a sewage treatment plant), says Linda Macpherson, a co-author of the recent study and a reuse technologist at CH2M Hill, an engineering and consulting firm that works with water agencies around the world. “We’ve got to get people to start thinking of water as a reusable resource,” Macpherson says.

Borrowing a few lessons from psychology might help water-reuse projects gain traction, but it takes old-fashioned politicking too. In Orange County, the water district made sure key politicians were onboard from the beginning, and they reached out to various communities they knew were likely to be wary of the project, including mothers’ groups and the region’s Vietnamese and Latino immigrant communities, which have tended to be sus-



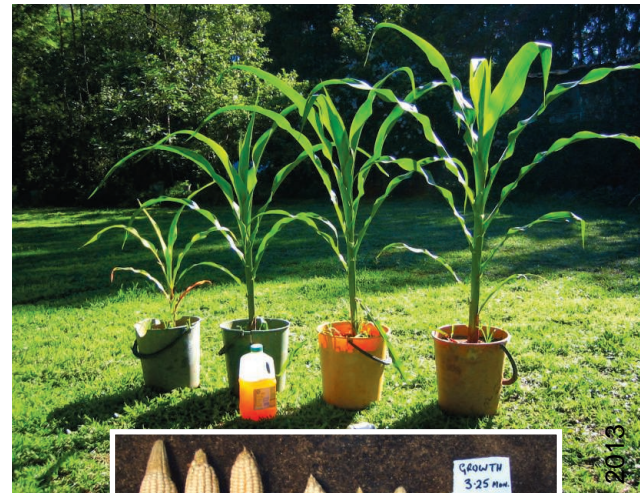
Brown and yellow revolution. Composted feces (upper left) and urine (upper right) can increase crop yields, if the intuitive aversion to handling human waste can be overcome.

picious of the government, Torres says. The district tried to build trust in those communities by sending local doctors and engineers to answer their concerns. And they’re doing it again now to pave the way for an expansion of the Groundwater Replenishment System that will increase its capacity to 100 million gallons a day by 2014. Torres thinks acceptance is growing and will eventually lead to direct potable reuse. “The younger generation, I think they get it more,” she says.

The poo taboo

Disgust for feces is universal, but it varies in degree in different cultures, says Sarah Jewitt, a geographer at the University of Nottingham, University Park, in the United Kingdom. In China and other parts of Southeast Asia, for example, people have used human manure to fertilize crops for centuries, Jewitt says. China is also a leader in biogas production from human and animal feces. “I would describe them as a more fecophilic society,” Jewitt says. “They have fewer taboos.” Indian society, in contrast, is one of the more fecophobic. That manifests in a number of ways, including the stigma faced by the workers who clean toilets and remove waste from community latrines, Jewitt says.

Attitudes also tend to fluctuate with time. Jewitt notes that the editorial pages of British newspapers in the 1840s and 1850s endorsed collecting London’s sewage to fertilize nearby farms. By the end of the Victorian era a few decades later, however, enthusiasm for such endeavors dimmed and the flush-it-and-forget-it men-



tality became predominant, Jewitt says.

But in some European circles, the pendulum is swinging back. Composting toilets and diversion toilets that collect urine for use as fertilizer (see p. 673) have been widely adopted by some communities in Germany and Sweden. These so-called ecological sanitation (“ecosan”) technologies could be especially beneficial in parts of the developing world where water is scarce and no sewage infrastructure exists, says Elisabeth von Muench, who oversees ecosan efforts for the German Agency for International Cooperation. Ecosan advocates would like to see people in developing countries leapfrog flush toilets, just as they’ve gone straight to mobile phones without a landline stage. But composting toilets haven’t yet taken off on a global scale—at least partly, experts believe, because the small amount of hands-on upkeep required can run headlong into taboos about handling excrement.

In general, the places where ecological sanitation, wastewater recycling, and other alternative strategies for handling human waste have taken root are those where the waste can be used to fulfill an urgent local need: for fertilizer, energy, sanitation, or clean water. In other words, these projects tend to have the best chance of success in places where intuitive disgust can be overcome by other powerful forces of human psychology—such as the desire to live a healthier, wealthier, and more comfortable life.

—GREG MILLER