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# RESOURCE

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## Landscape Irrigation

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# Igloo-shaped Poo-Gloos Eat Sewage

Growing towns can save millions; study shows devices cut pollutants

Taylor Reynolds

**I**nexpensive igloo-shaped, pollution-eating devices nicknamed Poo-Gloos can clean up sewage just as effectively as multimillion-dollar treatment facilities for towns outgrowing their waste-treatment lagoons, according to a new study.

“The results of this study show that it is possible to save communities with existing lagoon systems hundreds of thousands, perhaps millions, of dollars by retrofitting their existing wastewater treatment facilities with Poo-Gloos,” says Fred Jaeger, chief executive officer of Wastewater Compliance Systems, Inc. (WCS), which sells the Poo-Gloo under the name Bio-Dome.

Wastewater treatment in small, rural communities is an important and challenging engineering task. Proper treatment includes disinfection and the removal of unwanted pollutants. Most rural communities rely on wastewater lagoons as their primary method of treatment because lagoons are simple and inexpensive to operate. Lagoons are large ponds in which sewage is held for a month to a year so that solids settle while sunlight, bacteria, wind, and other natural processes clean the water, sometimes with the help of aeration.

But as communities grow and/or pollution discharge requirements become more stringent, typical wastewater lagoons can no longer provide adequate treatment. Until now, the only alternative for these communities was to replace lagoons with mechanical treatment plants, which are expensive to build and operate. Mechanical plants treat water in 30 days or less, using moving parts to mix and aerate the sewage, speeding the cleanup. They require electricity, manpower, and sometimes chemicals.

Kraig Johnson, chief technology officer for WCS, and his research team developed the Poo-Gloo when he worked as a research assistant professor of civil and environmental engineering at the University of Utah. The Poo-Gloo was designed to address the problem faced by communities outgrowing their sewage lagoons. The device provides a large surface area on which bacteria can grow, providing the microbes with air and a dark environment so they consume

wastewater pollutants continuously with minimal competition from algae.

The new study outlines results of a pilot project conducted in 2009 at Salt Lake City’s Central Valley Water Reclamation Facility. WCS obtained an exclusive license from the University of Utah to commercialize Poo-Gloos, and the devices have been deployed in six states in either full-scale installations or pilot demonstrations. Every installation has shown that Poo-Gloos provide treatment that meets pollution-control requirements.

Lynn Forsberg, public works director for Elko County, Nev., recently started using Poo-Gloos in a county sewage treatment lagoon system in Jackpot, Nev., after a successful pilot test. “Our alternative was to go with a full-blown [mechanical] treatment plant that would have cost about four times as much and be much more labor intensive,” he says.



Pollution-eating, igloo-shaped devices nicknamed Poo-Gloos sit in an unfilled sewage lagoon in Plain City, Utah, before the lagoon is filled. (Photos and illustration courtesy of Waste Compliance Systems, Inc.)

## How Poo-Gloos work

Poo-Gloos use a thriving bacterial biofilm to consume pollutants. Two dozen or more igloo-shaped Poo-Gloos are installed on the bottom of the lagoon, fully submerged and arrayed in rows. Each Poo-Gloo consists of a set of four progressively smaller, plastic domes nested within each other, like Russian nesting dolls, and filled with plastic packing to provide a large surface area for bacterial growth.

Rings of bubble-release tubes sit at the base of every Poo-Gloo and bubble air up through the cavities between domes. The air exits a hole in the top of each dome. As air moves through the dome, it draws water from the bottom of the lagoon up through the dome and out the top.

Each Poo-Gloo occupies 2.6 m<sup>2</sup> (28 ft<sup>2</sup>) of space on the bottom of a lagoon while creating 260 m<sup>2</sup> (2,800 ft<sup>2</sup>) of surface area for bacterial growth. The combination of large surface area, aeration, constant mixing, and a dark environment that limits algae make Poo-Gloos capable of consuming pollutants at rates comparable with mechanical plants.

## How much poo can a Poo-Gloo do?

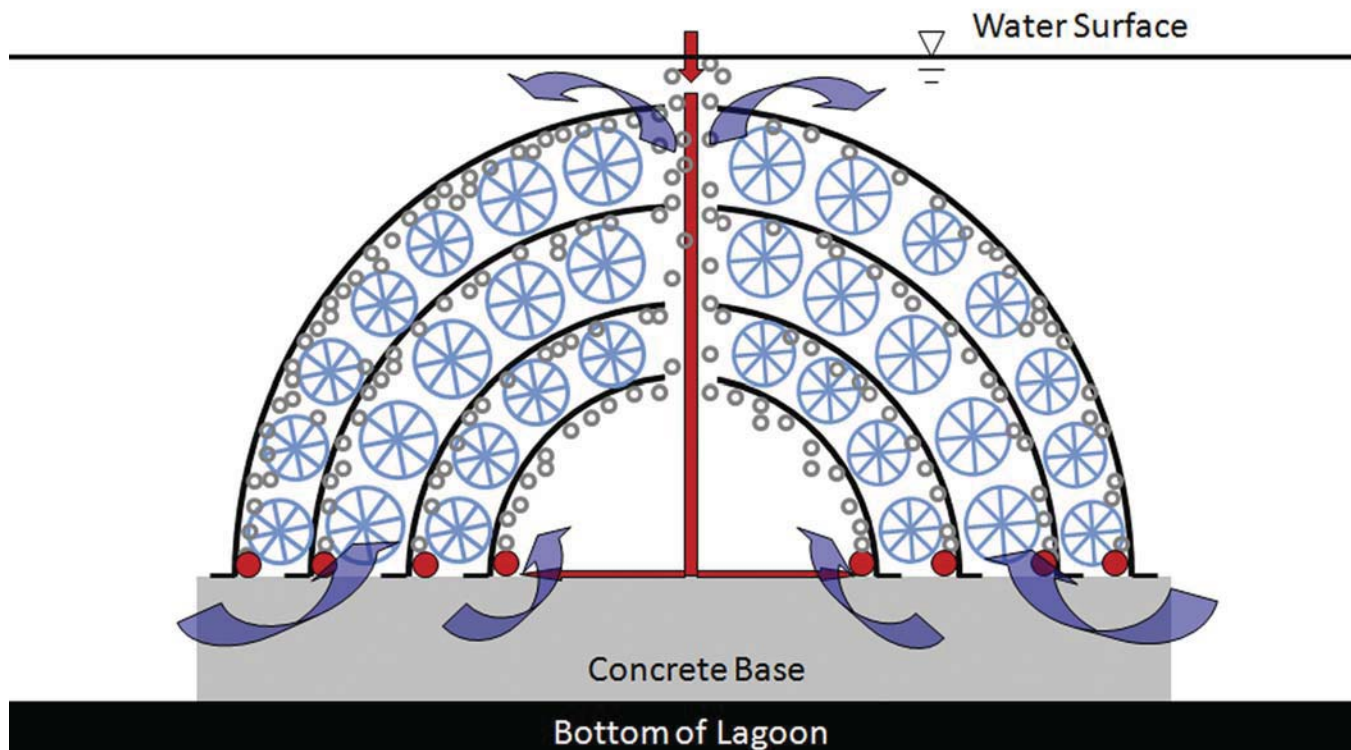
Johnson spent time in the wastewater industry before obtaining his master's and doctoral degrees in civil and environmental engineering. In 2002, he set about developing a

product that could be used to retrofit wastewater lagoons easily and inexpensively. After seven years, with the help of fellow professors, graduate students, and many laboratory tests, Johnson was ready for the first field test.

Johnson built a pilot unit using a large construction dumpster welded shut so that it was watertight. The container held seven Poo-Gloos. Johnson enlisted the help of Salt Lake's Central Valley Water Reclamation Facility to test it. The researchers ran multiple tests using untreated wastewater from the plant to determine the extent to which commonly regulated pollutants could be removed from the wastewater before discharge back to the treatment facility.

The study aimed to determine optimal operating conditions for Poo-Gloos and evaluate their performance at different water temperatures, levels of aeration, and sewage volumes and concentrations. The study found that the devices consistently achieved high levels of treatment and were affected only slightly by changing water temperatures and aeration levels:

- Biological oxygen demand—a measure of organic waste in water—was reduced consistently by 85 percent using Poo-Gloos, and sometimes by as much as 92 percent.
- Total suspended solids fell consistently by 85 percent, and sometimes by as much as 95 percent.



Cross-section showing the inner workings of a Poo-Gloo. Each Poo-Gloo—or Bio-Dome—includes four nested domes with plastic packing (*wagon wheel shapes*) between them to provide a large surface area on which sewage-eating bacteria grow. A hose (*red*) sends bubbles (*gray circles*) upward through the Poo-Gloo, and the air helps pull wastewater up through the device (*blue arrows*).

- Ammonia levels dropped more than 98 percent with Poo-Gloo treatment in warmer water and, more importantly, by as much as 93 percent when temperatures dropped below 10°C (50°F)—conditions that normally slow bacterial breakdown of sewage.
- Total nitrogen levels fell 68 percent in warmer water and 55 percent in cooler water.

“The removal rates we saw during the pilot test are comparable to removal rates from a rotating biological contactor, which is a commonly used device in mechanical treatment facilities,” Johnson says. “We couldn’t be happier with the performance.”

Johnson conducted the study with Hua Xu, postdoctoral fellow in civil and environmental engineering, University of Utah, and Youngik Choi, professor of environmental engineering, Dong-A University in South Korea.

There may be uses for the Poo-Gloos beyond municipal wastewater treatment.

“The bugs will adapt to consume whatever is available,” says Johnson. “In addition to the pollutants discussed in our paper, we’ve also seen great results in the consumption of other significant pollutants. We’re in the process of filing patents. We’ve only just scratched the surface with Poo-Gloos.”

Johnson and his team originally nicknamed the devices Poo-Gloos because they are shaped like igloos. But as possible uses began to expand to industries beyond municipal sewage treatment, Wastewater Compliance Systems decided to sell them as Bio-Domes.

### The bottom line

Each Poo-Gloo requires little maintenance and the same amount of electricity as a 75W bulb, putting operating costs for Poo-Gloo systems at hundreds of dollars per month rather than thousands, which is typical of mechanical treatment plants. Some communities may operate Poo-Gloos “off the grid” by powering them with solar or wind energy systems.

The results of the new study prompted a number of communities to abandon more expensive alternatives in favor of installing Poo-Gloos. These early adopters can be found in Jackpot, Nev.; Glacier National Park, Mont.; and Plain City and Wellsville, Utah. Mobile pilot Poo-Gloos have been deployed in Louisiana, Alabama, and Wisconsin, so potential customers, engineering firms, and regulators can see firsthand how they work before they commit tax dollars to the technology.

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For information on the Poo-Gloos and Wastewater Compliance Systems, please visit: [www.wastewater-compliance-systems.com](http://www.wastewater-compliance-systems.com).



**Bio-Domes are installed with a crane at Jackpot, Nev.**



**Half-submerged Bio-Domes in Wellsville, Utah, are visible as the lagoon fills.**



**Fully submerged Bio-Domes in Wellsville, Utah.**