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HTP Collaboration: Partnering to Advance Solids Processing and Energy Production

"Converting the wastewater solids produced by treatment plants in the U.S. with hydrothermal processing could [conservatively] produce about 128 billion cubic feet of natural gas per year and save treatment utilities $2.2 billion in solids disposal costs."

JEFF REED
Director of Business Strategy and Advanced Technology, SoCalGas

Hydrothermal processing (HTP) could be a game changer for the wastewater industry, particularly when it comes to solids treatment. The technology holds great promise, offering the ability to turn solids into renewable energy and eliminating the drawbacks typically associated with solids management—such as the cost of disposal and public opposition to its application. The concept is not a new one—using the same components that have long formed fossil fuels in nature (water, heat, pressure, and time), but accelerating the conversion so that it occurs in less than an hour rather than millennia. WRF recognized the technology's potential early on, fast tracking research through LIFT and partnering with other organizations to help accelerate its progress.

Up until that point, the U.S. Department of Energy (DOE) had been focused on converting algal biomass and other organic feedstocks into usable fuel, and was having high rates of success. In fact, process testing at their Pacific Northwest National Laboratory (PNNL) resulted in converting nearly 100% of algal biomass into biofuel, and earned them several patents.

In working with LIFT, sights were soon set on applying HTP to wastewater sludge. With its high water content and rich organic matter, sludge seemed particularly well suited for a process that relies on water to reform organic matter into biofuels at elevated temperatures and pressures. As opposed to algae, which can carry a high price to grow and harvest, sludge feedstock actually carries a negative cost, because many utilities are currently paying to dispose of or land apply biosolids.

If the results found with algal biomass can be duplicated using wastewater sludge as a feedstock and the economics are favorable, HTP could potentially replace anaerobic digestion as the industry standard for solids reduction and biofuel production. Now, anaerobic digestion typically only converts between 50% to 60% of wastewater sludge into energy, leaving behind 40% to 50% as biosolids. HTP would be nearly twice as effective in energy conversion. HTP also offers benefits over other thermochemical processes, such as eliminating the need (and cost) of drying feed. The drying process can be energy intensive, often using most of the energy that is generated. However, HTP is specifically designed for wet feed stock, so its net energy yield is naturally higher.

Genifuel, a company focused on efficiently producing renewable energy, licensed the HTP technology from PNNL. In 2015, WRF organized a group of interested collaborators to begin testing the technology's limits and advancing its potential. Through the LIFT Biosolids to Energy Utility Focus Group, WRF along with the U.S. Environmental Protection Agency (EPA), DOE, and a group of about 10 wastewater facility owners began supporting bench-scale testing of the technology on wastewater sludge. The utilities agreed to share the cost of the evaluation, contributing $45,000. An EPA infrastructure grant administered by WRF further funded $55,000, and $150,000 of in-kind funding provided by DOE through PNNL, brought the project value to roughly $250,000.

Pilot tests began at PNNL on three different types of wastewater solids: primary sludge, secondary sludge, and post-digester sludge. The research measured the amount of biocrude oil and methane gas produced from the various sludge feeds by HTP and determined the wastewater sludge concentration that can be successfully pumped without interruption during normal operation. WRF produced an independent, third-party report on the tests. The overall results were positive, confirming the technology's potential for treating wastewater and prompting interest in pilot testing at participating utility sites.

Through collaborations with PNNL and Genifuel, one such site, Metro Vancouver, a partnership of 23 local authorities in British Columbia, is leading an effort to build a demonstration plant. Based on current wastewater treatment rates, PNNL conservatively estimates that this technology has the potential to produce up to 30 million barrels of oil each year in the United States alone, and Metro Vancouver hopes to be the first utility in the world to see results first hand.

According to Paul Kadota, program manager at Metro Vancouver, "It's great having LIFT pool resources and evaluate technologies in a concerted effort across the entire wastewater industry—this would be impossible for a single utility to do. We also value the networking experience, particularly with peer utilities across North America and overseas. In our view, gone are the days when new technologies are piloted at multiple sites by the inventor without independent review or sharing of information among the host utilities."

Also on the horizon are plans to build a hydrothermal wastewater processing plant at Central Contra Costa Sanitary District just outside of Oakland, California. The ground-breaking project will use HTP to convert wastewater solids into renewable natural gas as well as liquid fuels and is part of a $2.4 million DOE grant awarded to a consortium led by WRF. The consortium, which also includes Southern California Gas Company (SoCalGas), Genifuel, PNNL, Merrick & Co., Tesoro Corp., MicroBio Engineering, Brown and Caldwell, Metro Vancouver, and more than a dozen other utilities, will plan and design the new facility. A second phase, if awarded, could include as much as $15 million in DOE funds for facility construction.

According to Jeff Reed, SoCalGas' director of business strategy and advanced technology, "This new technology could have an enormous impact on energy and waste. Converting the wastewater solids produced by treatment plants in the U.S. with hydrothermal processing could [conservatively] produce about 128 billion cubic feet of natural gas per year and save treatment utilities $2.2 billion in solids disposal costs. A city of one million people could produce more than 600 million cubic feet of natural gas per year, save more than $7 million per year in disposal costs, and power nearly 7,000 vehicles per day."

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