Industrial Innovations

FOR TOMORROW

Advances in Industrial Energy-Efficiency Technologies

Oxygen-Enriched Cocombustion of Sewage Sludge and Municipal Solid Waste

Burning municipal solid waste (MSW) with sewage sludge provides an alternative method of waste management for cities. A new cocombustion technology allows a higher ratio of sludge to MSW.

Municipalities are seeking alternative methods of managing sewage sludge.

In recent years, municipal planners have responded to stricter regulations governing the handling and management of the nearly 7 million tons (6.3 million metric tons) of dry sewage sludge produced each year. With ocean dumping banned and landfill disposal limited, cities are seeking alternative ways to manage sewage sludge. Dewatered sewage sludge (approximately 80% water) can be burned in facilities designed for municipal solid waste (MSW), but the kinetics of combustion require that the ratio of sludge to MSW remain low.

One solution to help manage sewage sludge is oxygen-enriched cocombustion of sewage sludge and MSW. In a cost-shared partnership with Air Products and Chemicals, Inc., through the National Renewable Energy Laboratory (NREL), the U.S. Department of Energy's (DOE's) Office of Industrial Technologies has examined this concept as a method for improving the combustion of dewatered sewage sludge with MSW in an existing waste-to-energy plant.

The new cocombustion technology allows a higher ratio of sludge to MSW.

With conventional sludge/MSW cocombustion methods, moisture levels in the sludge affect the efficiency of the combustion process—furnace temperatures are lowered, incomplete combustion occurs, and feed rates are reduced whenever the amount of sludge exceeds 2% to 3% of the MSW being burned. Through the DOE project, researchers wanted to show that the proportion of sludge could be substantially increased by increasing the oxygen level in the combustion chamber from 21% to 25%.

Oxygen enrichment of combustion air enhances combustion kinetics. At the same time, the rise in combustion temperature that normally accompanies oxygen enrichment is tempered by the high moisture content of the sewage sludge. The oxygen requirement for the cocombustion process depends on the solids content of the sludge, the sludge feed rate, and the heating values of the MSW with which it will be burned.

The technology was successfully tested at a pilot plant in Massachusetts.

In January 1992, scientists from Air Products began a pilot test of oxygen-enriched cocombustion at the Riley-Stoker

Research Center pilot facility in Worcester, Massachusetts. The Riley-Stoker pilot unit is designed to mass-burn 450 lb/h (205 kg/h) of processed MSW. Existing instrumentation at the plant was augmented for the project's specific data-gathering needs, and minor modifications were made to accommodate oxygen injection, the sludge feed, and the project's analytical equipment.

Researchers first collected baseline data on the facility's operation by measuring parameters such as MSW feed rate, air flow rate, flue gas flow rate and composition, and furnace flame temperature. Then the oxygen content of the air was enriched from 21% to 25% by injecting oxygen into the combustion unit. Subsequent tests allowed researchers to characterize the effect on plant operations and to determine the optimal location for injecting the oxygen.

Finally, researchers introduced dewatered sewage sludge into the combustion chamber and characterized its effect on plant efficiency. The crucial parameters measured during this phase included MSW and sludge throughput, air and oxygen in the flue gas, flame temperature, and residual unburned carbon and heavy metals in the ash.

Results from the pilot test verified the relationships between MSW, sewage sludge, and oxygen that were predicted by heat and material balance calculations. Cocombustion of sludge and MSW with oxygen-enriched combustion air did not affect the removal of carbon or important operating conditions such as combustion temperature, flue gas flow rate, or flue gas excess oxygen concentration. The combination of enhanced combustion kinetics and combustion temperature control enabled cocombustion at sludge/MSW ratios of up to 10%, a full five-fold increase in sludge compared to current practices.

Oxygen-enriched cocombustion is attractive to municipalities that must develop an environmentally safe method of sludge disposal.

Oxygen-enriched cocombustion of sewage sludge and MSW has great potential to be a viable sludge disposal technology. The process is highly attractive to municipalities that must develop plans for environmentally safe disposal of their sludge. For communities with existing waste-to-energy plants, use of this technology will provide for treatment of garbage and sludge in one disposal facility, which can decrease the overall cost of waste management while generating electric power. It also will avoid the problems of siting a new facility and creating a new source of emissions.

For More Information

Municipal Waste Resource Management Program
National Renewable Energy Laboratory
1617 Cole Blvd.
Golden, CO 80401-3393
(303) 231-1097

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