

## Evaluation of biogas digestate as solid fuel

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### Abstract

Digestate is a byproduct of biogas production through anaerobic digestion, which, within the EU, is typically utilized in agriculture due to its content in nutrients, mostly for nitrogen, phosphorous, and potassium. Although digestate could replace conventional fertilizers, its application in agriculture is limited by disposal limits for nutrients and metals. Another application of digestate could be the use of digestate as solid fuel after dewatering. Here, two different digestates were tested as fuel. Digestate 1S was sourced from the anaerobic digestion unit of the Municipal Sewage Treatment Plant (MSTP) of Heraklion (population 175,000), and digested 2S was obtained from an industrial biogas plant which treats agricultural residues in Greece. Gasification tests were carried out at three different temperatures (830 °C, 870 °C and 950 °C) and three different percentages of oxygen (5%, 10% and 15% w/w) in the feed gas to determine the optimal conditions that maximize the produced syngas. At the outlet of the fixed bed reactor, the produced gas was cooled, and the liquid and condensable products were separated from the gas using two silica gel beds. After the two beds, the gas was collected in bags and analyzed in a gas chromatograph. Net calorific value for both digestates was between 16.8 MJ/kg and 17.7 MJ/kg, with water content of 7.9% and 9.4% and ash content was between 13.6% and 33.0%. The optimal conditions for maximum production of syngas for both digestates was 950 °C and 15% v/v O<sub>2</sub> in the feed gas. For optimal conditions, the maximum yield of 1S was 22.5% w/w while 2S yield 30.5% w/w. An additional advantage of 2S compared to 1S is the lower cost for flue gas cleaning due to lower percentage of sulfur in digestate 2S (0.44% w/w) compared to digestate 1S (0.85% w/w). In conclusion, digestate 2S showed better results compared to 1S in all experimental conditions, nevertheless, both solid fuels are suitable for syngas production in combinations with other solid fuels as they both have low yield.

**Keywords:** Biogas, digestate, solid fuel, gasification

**Acknowledgments:** This research has been co-financed by the European Union and Greek national funds through the Operational Program Competitiveness, Entrepreneurship and Innovation, under the call RESEARCH—CREATE—INNOVATE (project code: T1EDK-02460, Solar Drying as a Tool for Organic Wastes Anaerobic Digestions' Economic and Environmental Upgrade)