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### Effect of operational parameters on the gas composition from self-sustaining smoldering of biomass

**Torres Brunengo, M.<sup>1</sup>, Yermán, L.<sup>2</sup>**

1- *Area Físicoquímica, DETEMA, Facultad de Química, Universidad de la República, Gral. Flores 2124 CC 1157, 11800 Montevideo, Uruguay*

2- *School of Civil Engineering, The University of Queensland, Brisbane, 4072, Australia*  
[mtobru@fq.edu.uy](mailto:mtobru@fq.edu.uy)

Smoldering is a low-temperature, flameless combustion that burns slowly. Self-sustaining smoldering (SSS) is defined as when the heat produced by exothermic oxidation with O<sub>2</sub> overcomes the heat losses. Under adequate conditions, the process can have high energy efficiency, being self-sustaining even with solid fuels with very high moisture content (MC) (75%) without the need of additional energy. SSS combustion is a potential alternative for low-cost and on-site management of organic materials with high moisture content as well as it has been used to produce value-added products [1].

A recent work published by Serrano et. al. [2] has evaluated the application of SSS as a possible alternative for the treatment of anaerobic digestate. The authors found that SSS is suitable to accomplish nearly full digestate inertization ensuring pathogen destruction. That work evaluated the practical limits of two main operational parameters: Darcy air flux and biomass moisture content, and they found the threshold limits where SSS of digestate mixed with agricultural waste is possible. Concerning the gas composition, it has been found that this contains as the main component CO<sub>2</sub> (60 to 70%), in addition, CO and H<sub>2</sub> were presented in the combustion gas products in percentages around 25 and 10%, respectively.

Based on these previous results, this work aims to study the sensitivity of the biomass moisture content and the air flux on the gas product composition during the smoldering of anaerobic digestate mixed with agricultural waste. Nine conditions were studied (3 MCs and 3 air Darcy flux). Gases were collected and stored in airtight glass vials and the concentrations of H<sub>2</sub>, CO<sub>2</sub>, O<sub>2</sub>, N<sub>2</sub>, CH<sub>4</sub>, and CO were measured using gas chromatography. The temperature of the reaction was measured inside the reactor at different heights and averaged.

Results showed that the concentration CO and H<sub>2</sub> increase at higher Darcy air flux and lower MCs. The highest HHV was obtained with a moisture content of 50 % and a Darcy air flux of 14.6 cm/s, resulting in the gas composition of 15, 24, 60, 1% for H<sub>2</sub>, CO, CO<sub>2</sub>, and CH<sub>4</sub>, respectively. The temperature obtained for the aforementioned experimental conditions was 960 °C, which was the highest recorded.

#### References

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2. Serrano, A., Wyn, H., Dupont, L., Villa-Gomez, D. K., & Yermán, L. (2020). Self-sustaining treatment as a novel alternative for the stabilization of anaerobic digestate. *Journal of Environmental Management*, 264, 110544.