

Self-sustaining treatment of digestate waste from semi-dry AD

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1. Introduction – Anaerobic digestion (AD) has been widely proposed for agricultural waste management due to the production of biogas and a nutrient-rich by-product (digestate), which could be potentially used as soil amendment [1]. However, the digestates usually contains toxic compound and pathogens that could cause detrimental effects when directly applied to the soil, requiring a post-treatment step [2]. Self-sustaining smouldering (SSS) combustion is a low-temperature, slow and flameless form of combustion that has been recently used to treat waste at very high moisture contents (75-80%). Unlike incineration, SSS does not require supplementary fuel and it is highly energy efficient due to minimal heat losses. This research aims to present a proof-of-concept for the treatment of semi-dry AD digestate (SADD) by means of SSS.

2. Experimental – SADD is a liquid waste (95 wt% water) obtained from the AD of strawberry waste (mix of plants and fruits). As SSS requires a porous medium for the propagation of the reaction, this has to be mixed with a porous solid. Therefore, the SADD is mixed with a solid waste from the same industry (i.e. coco coir from hydroponics, CC), also with a high moisture content (82 wt%). Both SADD and CC were analysed by calorimetry, and elemental, proximate and thermogravimetric analyses. Smouldering combustion experiments of

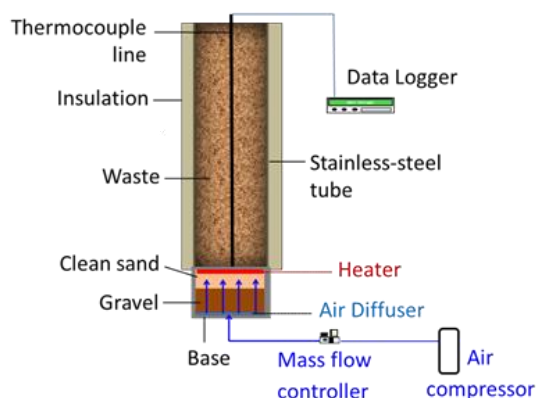


Image 1. Schematic representation of the experimental smouldering reactor.

Smouldering combustion experiments of SADD mixed with CC were performed in a cylindrical smouldering reactor (8.56 cm internal diameter) as shown in Image 1 and described in [3]. The self-sustainability of the smouldering process and combustion rates were evaluated at different SADD/CC mass ratios and airflow rates. The SADD/CC mix was prepared using a food mixer, and the ratio adjusted in order to achieve a desired MC.

Table I. Operative conditions and relevant results of the experiments performed.

Exp.	MC (%)	Airflow (LPM)	SSS?	Comb. rate (g/min)	Comments
1	82 ± 1	30	YES	13.5 ± 1.3	Only CC
2	84 ± 1	30	NO	-	SADD/CC mix. Low airflow
3	84 ± 1	70	YES	19 ± 2	SADD/CC mix.
4	89 ± 1	70	NO	-	SADD/CC mix. MC too high.

3. Results and Discussion – Table I summarizes the operative conditions and main results of the SSS experiments carried out with 1000 grams of solid in every case.

4. Conclusions - Smouldering experiments demonstrated that SSS of digestate mixed with coir is possible at least up to 84 wt% MC (dry basis). At 70 L/min of airflow, the combustion rate was 19 grams of mixture per minute. This corresponds to 30 kg/h in a full-scale reactor of 2 metres in diameter.

5. References

- [1] C. de la Fuente *et al.*, *Biol. Fertil. Soils*, **49**(3), (2013) p. 313.
- [2] J. A. Alburquerque *et al.*, *Biomass and Bioenergy*, **40**, (2012) p. 181.
- [3] L. Yermán *et al.*, “Smouldering combustion as a treatment technology for faeces: Exploring the parameter space,” *Fuel*, **147**(1), (2015) p. 108.