

Clean technology of spouted bed for thermal exploitation of sewage sludge wastes in a conical combustor

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1. Introduction –Biomass is the fourth most used renewable energy source, which already supplies 14% of the world's primary energy consumption, and about 5% of the primary energy used in the United States in 2016 [1]. Besides, biomass energy technologies can minimize the greenhouse gas emissions. The exploitation of a renewable energy source as sewage sludge wastes by spouted beds clean technology is a sustainable alternative. This technology in a conical geometry has been previously successfully applied for thermal treatment of biomass wastes by drying [2-3] and by combustion [4-6]. In this paper, a conical spouted bed combustor has been used for thermal exploitation of sewage sludge by combustion. The behaviour of the conical combustor has been analyzed by means of hydrodynamic and thermal studies in beds of sewage sludge. Combustion of sewage sludge has been performed in a conical spouted bed combustor under operating conditions to improve the combustion efficiency.

2. Experimental - The experimental unit mainly consists of a conical combustor of stainless steel, which has an angle of 36°. Biomass wastes studied have been sewage sludge from industrial water treatment plant, Image 1, (LoW code 19 08 05) [7]. This sludge has a moisture content between 50 y 62% wt% (moist basis) measured by Mettler Toledo HB43-S Halogen hygrometer, particle diameter ranging from 1 to 4 mm, density 1252 kg/m³. Beds mass is in the 100-400 g range. The minimum gas velocity to achieve combustion of beds of sewage sludge has been determined by pressure drop fluctuations [8]. The combustion has been conducted in a conical spouted bed combustor in the temperature range up to 550 °C and the evolution of exhaust gases has been monitorized by Testo 350 gas analyzer. Combustion efficiency has been calculated from the concentration of CO₂, CO (% volume)) in the [4-6].

3. Results and Discussion - Operating conditions for the combustions of sewage sludge in the spouted bed regime have been obtained. The values of combustion efficiency obtained are higher than 80%.

4. Conclusions -. The high combustion efficiency values obtained prove the good applicability of the spouted bed combustor for thermal treatment of sewage sludge wastes.

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5. References [1] U.S. Energy Information Administration, 2017. International Energy Outlook 2017. [2] M.J. San José, S. Alvarez, L.B. López, M. Olazar, J. Bilbao, In *Drying 2010* (Vol B), 2010, 1242. [3] M.J. San José, S. Alvarez, F.J. Peñas, I. García, *Chem. Eng. Sci.* (2013), 100, p. 413. [4] M.J. San José, S. Alvarez, I. García, F.J. Peñas, *Fuel*, 110(1) (2013) p. 178. [5] M.J. San José, S. Alvarez, F.J. Peñas, I. García, *Chem. Eng. J.* 238(15) (2014) p. 227. [6] M.J. San José, S. Alvarez, I. García, F.J. Peñas, *Chem. Eng. Res. Des.*, 92 (2014) p. 672. [7] European Commission. Official Journal of the European Commission, 2014, L226, 43, 3-24. [8] M.J. San José, S. Alvarez, *Chem. Eng. Technol.* 38(4) (2015) p. 709.