Energy recovery of waste from biodiesel production using Jatropha Curcas seeds

A. Brito[(1)], A. Chocho, C. Díaz, D. J.Escalante, L.A. González

[(1)] Chemical Engineering Department, University of La Laguna; Avda. Astrofísico Fco. Sánchez s/n, La Laguna, Tenerife, Canary Island, 38200, Spain

1. Introduction – Production of Biodiesel from *Jatropha Curcas* involves: separating the seed from the fruit, extracting the oil from the seeds and obtaining biodiesel by transesterification of the oil with methanol, given glycerol as a by-product. Throughout this process a series of waste are obtained: discarded fruit (pulp), shell of the seeds and the cake produced in the process of extracting the oil from the seed with solvent. An added value should be given to all these waste within the idea of circular economy. The aim of this work is to study the possibility of energy recovery of the waste generated in biodiesel production using *Jatropha Curcas* seeds, both directly and in the form of biogas/BioDME, considering as well the glycerol obtained in the process as by-product.

2. Experimental – The biogas was obtained by anaerobic digestion at 32 °C, without inoculum, using only pulp (P), only cake (C), as well as mixtures: 60% C-40% P, 60% C-40% Glycerol (G) and 60% C-40% Shell (S). The total and volatile solids of the waste have been measured before and after digestion. An estimate has been made of the possibility of direct energy recovery of both the cake and the seed shell. The higher heating values of the wastes have been calculated by means of several correlations found in the literature [1-2] using data obtained from the waste thermogravimetric analysis (TGA).

3. Results and Discussion – The anaerobic digestion at 32ºC of the waste gave rise to a greater production of gas in the first ten days, thereafter increased slightly or remained practically constant (Fig. 1). The highest gas production occurs for the cake, 38 L/ kg, and the lowest when pulp is used alone, 7.2 L/kg, for the mixtures the gas generation ranges between 26 and 32 L/kg. Only the pulp gives rise to biogas with 60% methane, the rest of the wastes produce practically only CO_2 which makes them suitable to obtain BioDME by catalytic hydrogenation processes. The TG analysis of the samples with highest solids content (T, C) gives an indication of their direct energy recovery capacity. The waste higher heating values were calculated by means of different correlations such as HHVs = 16.5917 + 0.0191 · [Holocellulose] [1]. When all the correlations are used the average values obtained are 17.75kJ /g for the cake and 18 kJ /g for the shell, with a difference respect to the wood in the range of 2.2% to 4%.

4. Conclusions – The pulp, cake and glycerol generated in the biodiesel production process can be converted in Biogas and BioDME, while the shell and cake can also be used directly for their higher heating values. The mixtures could be digested with inoculum to stimulate the presence of methane and direct all production towards Biogas.

5. References

[1] A. Álvarez, C. Pizarro, M.B. Folgueras, (2012) Dpto. de Energía. Universidad de Oviedo. http://digibuo.uniovi.es/dspace/bitstream/10651/17777/6/TFM_Ana_AlvarezProteg.pdf.
[2] A. Demirba Energy Source A, (2003), 25, 629-35.