Comparison of torrefaction and hydrothermal carbonization of olive mill waste

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Accepted for publication on 1st June 2016

Numerous research studies have recently highlighted the benefit of using char obtained from agro-industrial wastes for energy purposes. The carbonization of biomass residuals to char can be accomplished via dry or wet pyrolysis treatments like torrefaction (TF) and hydrothermal carbonization (HTC). Both TF and HTC processes are thermochemical pre-treatments that take place at mild temperatures (180-300ºC), but they compared in that HTC occurs with water under saturated pressure conditions, so the TF-char and HTC-char properties are likely to be different. In this study, TF and HTC pre-treatments were studied as possible alternative technologies to manage olive mill wastes (OMW). Additionally, the LCA methodology was applied to assess the environmental impacts of TF and HTC.

Results pointed out that the carbonization of OMW via TF or HTC exhibits some differences. It was found that the solid yield (%) was lower when OMW are hydrothermally carbonized. It was found that the C content of OMW rose up to 20% and 30% when applying TF and HTC, respectively. Therefore, the high heating values (HHV) of HTC chars were higher than those of TF-chars, reaching typical values of subbituminous/bituminous coals in both cases. However, the energy recovery (%) in HTC was 15-40% lower than that achieved in TF due to the lower solid yields obtained. Another important finding is that the ash content of OMW decreased when it is carbonized via HTC, indicating a better behaviour of the ashes during the combustion of the hydrothermally carbonized materials. The LCA analysis showed that TF and HTC of OMW and the subsequent energy production from the char resulted in more environmental benefits than anaerobic digestion and in almost as GWP savings as current incineration techniques. Therefore, TF and HTC followed by energy production appear to be potential alternatives to current management treatment options of OMW.

Keywords: energy, torrefaction, hydrothermal carbonization, agro-industrial wastes