PARAMETRIC STUDY OF LAB-SCALE AND PILOT-SCALE BIOMASS TORREFACTION FOR THE PRODUCTION OF WOODSTOVE BRIQUETTES

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Conversion of torrefied olive residues to high-density briquettes is a potential solution to solid waste problems as well as to the lack of locally available fuel wood in Ireland. In this study, olive stones were torrefied at various temperatures and holding times in a fixed-bed reactor. Effects of process parameters such as heat treatment temperature from 200 to 300℃, residence time from 30 to 60 min, and particle size from 0.18 to 3 mm on the yield and composition of products were investigated and the results were compared with the mass balances from industrial-scale torrefaction plant at the Arigna Fuels (Carrick-on-Shannon, Ireland). The olive stones of larger particle size produced more liquid and gaseous products than smaller particles in a fixed bed reactor, whereas particle size had significantly less influence on the product yields than residence time and heat treatment temperature. The analysis of liquid products of the industrial-scale plant showed a greater content of heavy molecular products compared to the lab-scale pyrolysis using high-performance liquid chromatography and size exclusion chromatography techniques. New value-added products were developed from the tar compounds produced at the industrial-scale torrefaction plant. In addition, the lab-scale experiments showed that the ash content of torrefied biomass significantly increased with the increased feedstock particle size. The torrefied olive stones briquettes using different binders were tested in a conventional woodstove. Torrefaction of olive stones has been found to reduce the emissions by approximately 60% compared to the non-treated feedstock. This demonstrates that torrefaction has good potential as a cost-effective and sustainable process for the production of woodstove briquettes from low-quality feedstocks.