INFLUENCE OF FEEDSTOCK PARTICLE SIZE ON THE DETERMINATION OF POLLUTANTS IN PYROLYSIS OILS

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The actual scarcity of materials the world is facing, driven by the depletion of the reserves and the growing complexity of the geopolitical context, has triggered the search for sustainable and autochthonous raw materials. Complex streams coming from waste treatment processes are, to some extent, still exploitable as feedstock for obtaining valuable products. Such is the case of Waste Electric and Electronic Equipment (WEEE) treatment facilities, which produce rejected streams containing high quantity of plastics along with unrecovered metals and ceramics. These rejects are nowadays headed to landfills, but would be still capable to undergo further valorization steps, such as production of pyrolysis oil through thermochemical recycling, with the inconvenience of having to deal with a variety of pollutants.

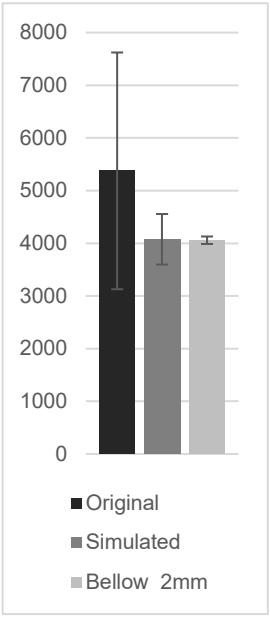

Figure 1– Chlorine concentration in pyrolysis liquids (ppm) and standard deviation

The aim of this work is to highlight the influence of pretreatment (mainly particle size reduction) of such kind of heterogeneous real waste material in the variability of the concentration of pollutants in the pyrolysis oil, in order to have representative concentration values that enable high quality research work outcomes and future industrial implementations. Among all the pollutants, special focus was placed on halogens (chlorine and bromine), that are part of the structure of the polymers or are used in the formulation of plastics, and are transferred to the oil during the thermal process. Halogens are critical parameters for the acceptance of the oils in the industry, with levels are fixed under 10 ppm. Chlorine, as the main pollutant present in the original sample and the liquids, was chosen as representative for the comparison of the deviation caused by the conditioning of the sample. For that purpose pyrolysis experiments were carried out by using the waste sample as received from the WEEE treatment facility (ar, 4-12 mm) after quartering and the waste sample after applying the size reduction and procedure recommended by the European Committee for Standardization (CEN) in the standards regarding the preparation of waste samples for analysis. To assess the influence of the pyrolysis process itself in the variability of chlorine concentration of oils, a control sample containing a known quantity of chlorine was also studied.

The experiments were carried under specific parameters (500 °C reaction temperature, 15 °C min^{-1} heating rate and 1 L min^{-1} N_2 purge flow) fixed by previous studies carried by the authors. The products derived from the ar sample showed an unacceptable deviation (~ 41 %) in the chlorine concentration. The simulated sample products were homogeneous in yields and pollutants concentration, which indicated that the pyrolysis process itself was not the source of the heterogeneity in results. Finally, the liquids from the simulated sample showed a minor deviation (~ 2 %) in chlorine content and stable yields.

The results obtained in this research highlight the importance of applying standardized waste sample preparation procedures even in the industrial field, since an inadequate particle size could lead to the generation of pyrolysis products with wide variability in the concentration of contaminants, which could cause problems when it comes to their commercialization.