MUNICIPAL SOLID WASTE VALORIZATION THROUGH CATALYTIC FAST HYDROPYROLYSIS OVER NATURAL ZEOLITES

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The generation of municipal solid waste (MSW) is expected to increase by 70% by 2050, reaching 3.4 billion tons [1]. Pyrolysis has gained attention in the recent years in waste management due to its high efficiency and flexibility in producing a combination of solid, liquid and gaseous products. However, one of the main drawbacks of pyrolysis is the low quality of the products, which could be upgraded by controlling the operation parameters and/or employing catalysts. Among the catalysts, zeolites have received a lot of interest for their application in catalytic fast pyrolysis to improve the quality of bio-oil [2]. However, the application of modified natural zeolites as a catalyst in municipal solid waste hydropyrolysis processes has not previously been studied. Therefore, the aims of this study are: Compare the effects of the reaction atmosphere composition and temperature on the product distribution obtained through hydropyrolysis of MSW, and to validate the capacity of modified natural zeolites, as potential catalyst for pyro-oil upgrading. MSW was supplied by a waste treatment company based in Madrid, Spain (ECONWARD) in the framework of the RETOPROSOST2-CM project. The sample was characterized using UNE-EN Standars, including proximate and ultimate analyses, moisture content, heating value and ash composition. A thermal analysis system TGA 2 (Mettler Toledo Corporation, Switzerland) was used to simulate the pyrolysis process. Pyrolysis gas chromatography−mass spectrometry (Py-GC/MS) using a CDS Analytical Pyroprobe (5200 HPR) coupled to a PerkinElmer gas chromatography (Clarus 690)−mass spectrometry (Clarus SQ8T) system was used to analyze the products of MSW catalytic hydropyrolysis and pyrolysis. The catalytic experiments were carried out with four chemically modified natural zeolite (NZ) samples. Catalysts were prepared by incipient wetness impregnation of the support (NZ) with precursor salts, to obtain 15 %wt. metal loading (Ni, Cu). Then, they were calcined under static air (550 ºC, 2 ºC/min) and reduced in constant H2 flow (15 ml/min, 99,999% Air Liquide, Chile) at 400 ºC (10 ºC/min, 2 h dwell time). The modified zeolite samples were characterized by the following methods: nitrogen absorption at 77 K, XRD, XRF, SEM/EDX and TPD-ammonia. Reaction atmosphere (hydropyrolysis and pyrolysis under He), pyrolysis temperature, catalyst, and residue-to-catalyst ratio, were all factors considered during the research.

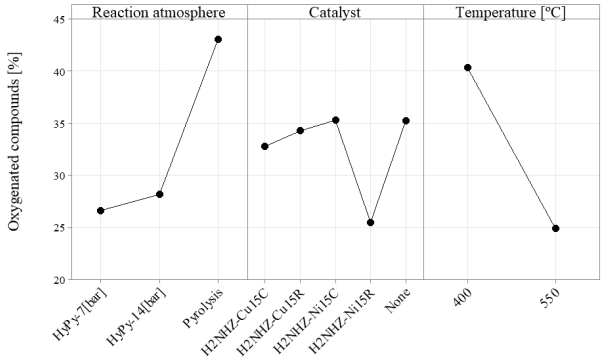

Figure 1 – Variables interaction for oxygenated compounds production

The thermogravimetric study determined the final pyrolysis temperature based on the two degradation stages, decomposition of the lignocellulose compounds and plastics, which were observed at 400 °C and 550 °C, respectively. Compared to conventional pyrolysis, the results show that the hydropyrolysis technique can reduce oxygenated molecules. In the production of hydrocarbons, particularly aromatics, H2NHZ-Ni15R catalyst provides the best performance.

References

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