

PRELIMINARY ACTIVITY ON THE PYROLYSIS OF A PLASTIC BASED SOLID RECOVERED FUEL

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Plastic is a versatile, lightweight, resistant, and inexpensive material, and an increase of its global demand has been observed in the last years (from 299 million tonnes in 2013 to 348 in 2017) [1], with the dominant role played by the packaging sector, which absorbs almost 40% of the overall production. Management of post-consumer plastic packaging waste poses a serious environmental problem, and a number of strategies have been devised to reuse/recover these materials, mainly with the aim of recovering useful materials and avoiding landfilling. Among these strategies, pyrolysis can play a significant role for recovering useful products and energy from the post-selection mixed packaging waste, that is not amenable to other uses [1]. A large amount of studies has been developed to assess the possibility to convert waste plastic to oil by pyrolysis processes [1] either catalytic or non catalytic. Nevertheless, only a limited numbers of papers refer to the use of real plastic waste rather than simulated mixtures [2] even if the performances obtained are strongly influenced by the feedstock characteristics.



Figure 1 – Batch of SRF

In this work, a real SRF (Solid Recovered Fuel), mainly made by plastic resulting from the process of the plastics recycling has been used to perform pyrolysis experiments. The effect of temperature on the yield of gas, condensable and solid has been evaluated in addition to the use of high surface g-alumina as catalyst to upgrade the pyrolysis products. The SRF used for this work has been gently supplied by P.R.T. srl. The feedstock has been characterized by means of proximate and ultimate analysis carried out by LECO TGA 701, LECO CHN 628, LECO SC 144 DR, Metrohm 883 Basic IC plus ionic chromatograph, and by PARR 6200

calorimetric bomb for the determination of HHV. Pyrolysis experiments were carried out at different temperatures in the range 500-800 °C under nitrogen flow (60NI/h), using a fixed bed quartz micro-reactor having an ID of 26mm. For each test, a mass of about 3 g of sample has been loaded in the reactor and heated up to the required temperature with a heating rate of 30°C/min and maintaining the chosen final temperature until no further gas production was detected. For the catalytic tests, a weight ratio of about 6 has been adopted between the g-alumina and the SRF batch. The produced gas was vented from the end of the reactor into a set of condenser cooled at -12°C where the condensed compounds (oil and wax) were collected and weighted in order to evaluate their yield. The oil and wax have been characterized by means of GC-MS Agilent 7890A, a TGA-DSC Perkin Helmer STA 6000 and LECO CHN 628. The permanent gas leaving the condensation block was sent to a set of on line analyzers to measure in continuous the concentration of CH₄, CO, CO₂ and H₂. Further analysis of gas has been performed collecting a batch of gas, at the exit of condenser, in a Tedlar bags, at different reaction time, and analyzed by means of a micro-GC Agilent 3000, for the determination of light hydrocarbon (up to C₅). At the end of the test, the reactor was cooled at room temperature under nitrogen flow and the solid residue was weighted to calculate the solid yield and subsequently analysed by a LECO CHN 628. The results show that, as expected, the gas yield is strongly enhanced by both the increases of temperature and the presence of catalyst; the quality of the condensed compounds is affected by the presence of the catalysts. In particular, a higher fraction of gasoline (C₅-C₁₁) and diesel fraction (C₁₁-C₂₀) and the formation of cyclic and aromatic hydrocarbons is obtained in presence of alumina. Finally, a coke deposition is also observed.

References

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