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The aim of this work was to optimise pyrolysis experimental conditions of three types of waste in a batch reactor, particularly the influence of the reaction time, temperature, initial pressure and waste mixture composition in the yield and composition of liquid products. The wastes studied were. biomass (pine), used tyres and recycled plastic, whose main components were polyethylene (PE), polypropylene (PP) and polystyrene (PS).

Experimental tests were made in a 1L stainless steel autoclave, in which the experimental conditions like: initial pressure, waste mixture composition, temperature and time of reaction were varied and optimized. The three product fractions obtained (liquids, solids and gases) were collected and analyzed. Two immiscible liquid phases were formed whenever pine was pyrolysed, one being mainly water with traces of compounds commonly produced by fast biomass pyrolysis, and the other being a less dense organic phase. Liquids were distilled into three fractions. The lighter one distilled between 35 and 150 °C, the next fraction distilled between 150 and 270 °C, whilst the other presented a distillation range higher than 270 °C. Each fraction was analyzed by Gas Chromatography (GC) and GC/MS (Mass Spectrometry) to identify their main compounds. Gases were also analyzed by GC and its density was also measured. The remaining liquid in the solid phase was extracted with solvents and analyzed by GC.

Liquid products yield and composition were affected by experimental conditions. Previous studies (1) showed that the rise of reaction temperature decreased liquid yields, by increasing solids and gases yields. The increase of initial pressure did not lead to significant variations in products yields and composition. The increase or pyrolysis reaction time led to a small decrease in liquids formation, favouring the production of lighter liquid compounds. The optimisation of experimental parameters was done by response surface methodology (RSM), which allowed identifying the inter-relations between the experimental variables and optimising simultaneously the three variables studied. Experiment Factorial Design was used and the experimental results for the yield of liquids were fitted with a linear model by the method of least squares with good correlation and high statistical significance. According to the model, the production of pyrolysis liquids is maximized when the following conditions are used: reaction temperature of 450ºC, reaction time of 23 minutes and initial pressure of 0.51MPa for a waste mixture consisting of 80% plastics, 10% pine and 10% tires.

(1) Filipe Paradela, Filomena Pinto, Ana M. Ramos, I. Gulyurtlu, I. Cabrita, J. Anal. Appl. Pyrolysis 85 (2009) 392–398.