Abstract

In the doctoral thesis, entitled *Transport phenomena in- and scale-up of pyrolysis reactor for waste tires and plastics*, the pyrolysis process in a vacuum batch reactor was studied by determining the scale-up criteria for the construction of industrial plant. In doctoral thesis, the most important aspects of understand real-scale pyrolysis were taken under consideration, and paralleled with the literature. Firstly, the pyrolysis experiments in the laboratory scale, using thermogravimetric (TG) analysis and differential scanning calorimetry (DSC), were carried out. The reaction kinetics and transport phenomena, pertinent to individual samples (waste tire composites and plastics), were consequently studied, the samples having the size of 1–2 mm. The values of kinetic parameters determined utilizing appropriate software and regression methods. The setting up of simulation model was facilitated through the pre-existing mathematical models of apparent reaction kinetics, found in the literature. Beside the reaction kinetics, heat and mass transfer were also considered in the model, whereas the latter was shown to be negligible in laboratory scale. The advantages and disadvantages of each model were listed and emphasized which parameters, included in kinetic models, had the greatest impact on process. The next step was pyrolysis experiments in laboratory (1.45 L) and pilot/industrial (3.27 m^3) reactor. Experiments were performed under different conditions (ambient pressure/vacuum, temperature, heating rate, particle size and the rate of stripping flow). In the process, also the problem of efficient separation (condensation, fractional distillation, magnetic separation, *etc.*) arises, and the appropriate purification of the products before they are further used, as well as the decrease of the flue gas emissions from the combustion of gas and liquid products, is essential. Therefore, it is necessary to develop a new or choose an existing suitable equipment for the condensation of the volatile substances to different oil fractions in order to purify gas fraction and separate the steel wires from solid residue/charcoal. Solving these issues is necessary for the environmental acceptability of pyrolysis products and process itself. Substances, that are potentially harmful to the environment, may occur in any product/fraction and in several forms (pure elemental form, compound, *etc.*). For the majority of substances, purification methods and technologies were listed and described.

Key words: thermochemical decomposition, pyrolysis and gasification, kinetics, transport phenomena, polymer waste processing