PYROLYSIS OF PLASTICS: HIGHLIGHTING THE POTENTIAL INTEREST OF A REFLUX TO CONTROL LIQUID PRODUCTS

Anthony DUFOUR, Université de Lorraine, CNRS, ENSIC 54000 Nancy, France
anthony.dufour@univ-lorraine.fr
Richard LAINE, Université de Lorraine, CNRS, ENSIC 54000 Nancy, France
Nabil HASSIBI, Université de Lorraine, CNRS, ENSIC 54000 Nancy, France
Yann LE BRECH, Université de Lorraine, CNRS, ENSIC 54000 Nancy, France
Guillain MAUVIEL, Université de Lorraine, CNRS, ENSIC 54000 Nancy, France
Valérie BURKLE-VITZTHUM, Université de Lorraine, CNRS, EEIGM 54000 Nancy, France

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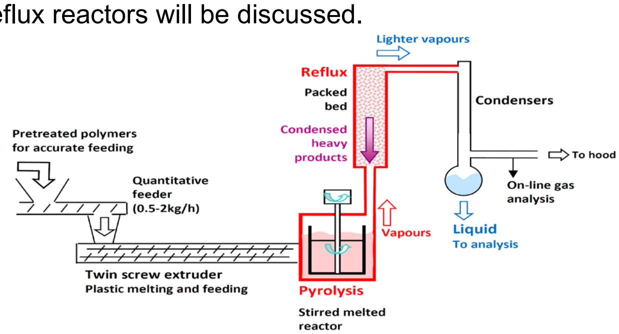
The pyrolysis of plastics is envisioned as a potential technology to produce fuels or depolymerized building blocks (as monomers). Various pyrolysis reactors were tested on a large range of conditions (pressure, temperature, catalyst, etc.): fluidized bed, fixed bed, extruder, melting vessel, etc.[1,2]. One of the main issue of plastic pyrolysis is to control the composition of the liquid products (often presenting a broad distribution of molecular weight) and to reduce waxes. Despite numerous studies and reviews on this topic, the interest to use a reflux combined with the pyrolysis reactor has not been well highlighted. However it has been demonstrated at lab, pilot and industrial scales that a reflux could promote the formation of lighter products by reducing waxes (or oligomers) [3–5]. Indeed, the composition of pyrolysis liquids is controlled by the kinetics of bonds cleavage, their stabilization (notably by H-transfers) and the devolatilisation of the intermediate liquid. The liquid can be evaporated (at the temperature of the pyrolysis reactor) or transported in the form of aerosols. Then it can undergo gas-phase or catalytic conversion. Finally, the products are condensed. A high temperature (400-600°C) is required in the pyrolysis reactor (to promote depolymerization kinetics) which lead to the evaporation of heavy species. A reflux set at a lower temperature than the pyrolysis reactor can condensate the vapours of heavy molecular species which will fall back into the pyrolysis reactor and undergo further depolymerisation reactions. Therefore, the temperature of the reflux may control the molecular weight distribution of the liquids [6]. During this talk, we will present a novel small pilot reactor (at 1-2kg/h) developed at CNRS Nancy combining: an extruder melt feeder, a stirred reactor, a (catalytic) reflux and a condensation train. We will show how the temperature of the reflux can impact the molecular weight distribution of liquid products for 2 complementary examples: PP and PS pyrolysis. Low-cost basic catalysts were also implemented inside the reflux for PS pyrolysis in order to promote the selectivity in styrene production (at the expense of oligomers). The gases were analyzed on-line. The liquids were analyzed by GC/MS-FID and a bench-top NMR. The potential implementation of pyrolysis-reflux reactors will be discussed.



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