Feedstock recycle of waste plastics

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Abstract:

The pyrolysis of mixed plastics is one of the useful feedstock recycling techniques. Waste plastics consist mainly of poly(ethylene) (PE), poly(propylene) (PP), poly(styrene) (PS), and poly(ethylene terephthalate) (PET). Polyolefines, such as PE, and PP, and PS, can be converted into oil via thermal decomposition. However, the thermal decomposition of PET causes not only corrosion and blocked pipes, but also the reduction of the oil yield by the generation of sublimating substances, such as terephthalic acid (TPA) and benzoic acid. As a countermeasure against these difficulties, hydrated lime ($Ca(OH)_2$) was introduced into the process in order to avoid the problems mentioned above. On the other hand, the pyrolysis of PET in a steam atmosphere in contact with $Ca(OH)_2$ or CaO at above 520°C led to a high yield of benzene without the production of sublimating substances [1,2]. We suggest that the application of this reaction to the pyrolysis of mixed plastics, using a fluidized bed reactor with hard burnt lime (HBL) as bed material, might also be able to eliminate the problems, caused by sublimating materials.

A mixture consisting of PS, PE, PP and PET were pyrolyzed in the presence of both steam and nitrogen, using a fluidized bed reactor with hard burnt lime (HBL) as bed material. In opposite to soft burnt lime, HBL showed good fluidizing properties and little erosion. Since both CaO and $Ca(OH)_2$ are widely used as aggregates in order to fix HCl and catalyze the degradation of organic acids, the purpose of this research was the investigation of the impact on the product distribution and the ability of HBL to support the degradation of PET. Compared with experiments applied in the presence of quartz sand, the gas yield increased, while the wax fraction was strongly reduced. In the presence of HBL, the benzene yield rose
strongly due to the decarboxylation of PET.

Keywords:

Feedstock recycling, Waste plastics, Liquefaction, Hydrated lime, Calcium oxide