INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Thesis Title:
Thermal degradation of packaging plastic waste and its conversion into fuel by pyrolysis

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SHORT ABSTRACT

Non-biodegradable plastic waste (10 – 15% of any municipal solid waste) is a direct result of rapid industrial growth and modern lifestyle of human being. The high calorific value of most of the plastics (manufactured from fossil fuel) urges one to reuse them productively. Pyrolysis is one of the ubiquitous process converting organic materials into various useful forms via thermochemical decomposition at elevated temperature under oxygen starving environment. In this study, three major contributors of plastic (packaging) waste, low and high density polyethylene (LDPE and HDPE) and polypropylene (PP) were used as feedstock to produce alternate liquid fuel by utilizing low temperature (300 – 400 °C) slow pyrolysis by maintaining long holding time of 8 hours or heating with a very slow heating rate of 1 °C/min. The experiments were conducted in TGA scale and also in the lab scale semi-batch reactor under inert conditions at various temperature conditions. The degradation kinetic parameters were calculated using advance isoconversional principle from the TGA data. Around 70 – 80 % of the plastic waste mixture (LDPE, HDPE and PP) was successfully converted into oil by slow pyrolysis. Analysis of the plastic derived oil (PDO) revealed that the quality of the oil varies with isothermal conditions chosen for pyrolysis. 1H NMR analysis depicted that PDO samples are composed of paraffin and olefin as major components and the paraffin concentration decreases with temperature. A reverse trend was observed for olefins. High olefin fraction in the PDO obtained from PP resulting high research octane number (~92). The GC-Simdist analysis concluded that, under low-temperature pyrolysis, the produced oil contains higher percentage of lighter fractions of hydrocarbon (C6 – C20), which is the combined range of gasoline and diesel fuel. Fuel characterization further endorsed the close resemblance between the PDOs and the conventional fuels.