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Catalytically induced pyrolysis of LDPE to liquid fuel

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Plastics are used in a wide range of applications because of their durability, lightweight, easy fabrication, and desired chemical and physical properties. Usually, plastic products are discarded after use to the environment as solid waste. Therefore, the low degradability of plastics and the high demand for plastic products have created a serious environmental issue. Recycling is one of the methods used in plastic waste management. As a recycling method, energy recycling or producing fuel oil from plastic waste has gained a promising interest. In this study, it was expected to convert selected used plastics to fuel oils through a pyrolysis process using a catalyst. A laboratory-scale pyrolysis system was developed and a low-cost conversation process for plastics to fuel oil was investigated in an environmentally friendly manner. Initially, virgin low-density polyethylene (LDPE) was used in this conversion as the control sample. Then waste wrapping materials made of LDPE were subjected to pyrolysis. A two-neck round bottom flask was used as the reactor while the heat was supplied by a LP gas burner. To control overheating and possible heat losses, the reactor was dipped in a soil bath during heating. A constant heating rate and a constant inert gas flow rate to the reactor were maintained throughout the experiment. The gases evolved by the pyrolysis were condensed. The distillate was collected while the uncondensed fraction was trapped first in a non-polar organic solvent and further in a basic aqueous solution to prevent possible hazardous emissions. A locally abundant mineral was tested as a possible catalyst for the pyrolysis to improve the quality of the resulting products. It was observed that the purity of the resulting fuel oil had been improved with the use of the catalyst. The resultant liquid fraction was conveyed for factional distillation and the fractions were characterized with GC-MS and FTIR techniques.

According to the GC-MS analysis, the major constituents in the fraction obtained from virgin LDPE through uncatalyzed pyrolysis were decane, undecane and 1-tetradecene. The major constituents obtained through the catalytic pyrolysis of virgin LDPE were cyclopropane, 1-decene, undecane and pentadecane. The pyrolysis of waste LDPE resulted in cyclopentane, decane, undecane and 1-pentadecene as fractional distillates. The mineral tested as the catalyst has given significant improvement in the purity of the oil fractions produced. The *combustion characteristics and v*iscosities of the resultant oils are to be determined and those will be compared with the commercially available fuel oils. The study will be extended for other plastic waste types including mixed waste.

Keywords: Recycling, waste LDPE, Pyrolysis, Mineral catalyst, Fractional distillation

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