

Yield and Composition of Bio-Oil from Co-Pyrolysis of Corn Cobs and Plastic Waste of HDPE in a Fixed Bed Reactor

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Abstract : Pyrolysis, a thermal cracking process in inert environment, may be used to produce bio-oil from biomass and plastic waste thus accommodating the use of renewable energy. Abundant amount of biomass waste in Indonesia are not utilised and plastic wastes are not well processed for clean environment. The aim of present work was to evaluate effect of mass ratio of plastic material to biomass in the feed blend of corn cobs and high density polyethylene (HDPE) of co-pyrolysis on bio-oil yield and chemical composition of bio-oil products. The heating rate of the co-pyrolysis was kept low and residence time was in the order of seconds to accommodate high yield of oil originating from plastic pyrolysis. Corn cobs have high cellulose and hemicellulose content (84%) which is potential to produce bio-oil. The pyrolysis was conducted in a laboratory-scale using a fixed bed reactor with final temperature of 500°C, heating rate 5 °C/min, flow rate N₂ 750 mL/min, total weight of biomass and plastic material of 20 g, and hold time after peak temperature of 30 min. Set up of conditions of co-pyrolysis should lead to accommodating the production of oil originating from HDPE due to constraint of HDPE pyrolysis residence time. Mass ratio of plastics to biomass in the feed blend was varied 0:100, 25:75, 50:50, 75:25 and 100:0. It was found that by increasing HDPE content up to 100% in the feed blend, the yield of bio-oil at different mass ratios prescribed above were 28.05, 21.55, 14.55, 9.5, and 6.3wt%, respectively. Therefore, in the fixed bed reactor, producing bio-oil is constrained by low contribution of plastic feedstock to the pyrolysis liquid yield. Furthermore, for the same variation of the mass ratio, yields of the mixture of paraffins, olefins and cycloalkanes contained in bio-oil were of 0, 28.35, 40.75, 47.17, and 67.05wt%, respectively. Olefins and cycloalkanes are easily hydrogenised to produce paraffins, suitable to be used as bio-fuel. By increasing composition of HDPE in the feed blend, viscosity and pH of bio-oil change approaching to those of commercial diesel oil.

Keywords : co-pyrolysis, corn cobs, fixed bed reactor, HDPE

Conference Title : ICSRD 2020 : International Conference on Scientific Research and Development

Conference Location : Chicago, United States

Conference Dates : December 12-13, 2020