Improving bio-oil quality through co-pyrolysis of corn cobs and polypropylene in a stirred tank reactor

Dijan Supramono, author

Abstrak

Bio-oil produced by biomass pyrolysis contains high oxygenates, namely, carboxylic acids, alcohols, and ketones resulting in low calorific fuel, and therefore bio-oil requires upgrading to sequester these oxygenates. By conducting the co-pyrolysis of biomass and plastic feed blend, the donation of hydrogen by plastic free radicals to the oxygen of biomass free radicals may sufficiently reduce oxygenate compounds in the bio-oil and increase its yield. Therefore, the synergetic effects are functional. Currently, co-pyrolysis reactors have high aspect ratios (ratio of height to diameter) of 4 or more and small diameters (maximum 40 mm), in which the heat transfer from the furnace to the feed blend is immaterial even though the plastic material has low thermal conductivity. However, in large-scale reactors, such a design restricts the bio-oil’s capacity due to the heat transfer constraint. To resolve the latter and to improve bio-oil quality, in the present work, the co-pyrolysis of corn cobs and polypropylene (PP) is conducted in a stirred-tank reactor with a low aspect ratio (2). PP composition in the feed blend was varied from 0-100% weight with a 12.5% weight interval, heating rate of 5oC/min, and final temperature of 500oC. The results show that by increasing the PP composition in the feed blend from 37.5% to 87.5%, the bio-oil yield increased from 25.8% to 67.2% feed weight. An analysis of bio-oil quality shows that there was a favorably abrupt increase of non-oxygenate composition in the bio-oil from less than 5% to more than 70% as the PP composition in the feed blend was increased from 37.5% to 50% and more.