BIOFUEL PRODUCTION FROM WASTE ANIMAL FAT USING PYROLYSIS (THERMAL CRACKING)

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ABSTRACT

The main objective of this study is to produce biofuel from waste animal fat (collected from abattoirs) using the pyrolysis (thermal cracking) method. To achieve this goal, the study investigated the effects of temperature and heating rate on the yield and quality of the bio-oil produced. Also investigated was the effect of zeolite nano-catalyst(s) on the quality of the bio-oil produced.

Animal waste fat (tallow) was pyrolyzed in a laboratory fixed bed reactor of volume 2200 cm^3 at final temperatures (FT), 450^oC, 500^oC, 530^oC and 580^oC using heating rates (HR) of 4^oC/min, 5^oC/min and 6^oC/min. The properties of the resultant bio-oils were tested and analyzed. The maximum bio-oil yield of 82.78 % was achieved at 530^oC FT and 6^oC /min HR while the highest calorific value, 52.41 MJ/kg, was recorded from the bio-oil produced at the FT of 580^oC and 6^oC/min HR. The molecular components of each of the bio-oil samples was analyzed using the Gas Chromatography – Molecular Spectrograph (GC-MS) which indicated the predominant presence of alkanes, alkenes, carboxylic acids and alkyl esters in the bio-oils produced without a catalyst. The introduction of zeolites in nano-form yielded relatively more cyclo-alkanes and aromatics.

A maximum yield of 58% was recorded when 1% of the zeolite nano-catalyst was used to pyrolyse the tallow at 530^oC FT and 6^oC/min HR but with lots of coking and gas formation. The viscosity improved with a 35% reduction for the samples produced with 1% zeolites (C1 and C2). The viscosity of the bio-oil produced with 2% zeolites improved with a resultant 34% reduction in value. For pyrolysis done at 530^oC FT and 6^oC/min HR, the bio-oils with 1% (C1) and 2% zeolite (C3) resulted in a reduction in acid value of 32% and 30%, respectively. Acid value is the mass of potassium hydroxide (KOH) in milligrams that is required to neutralize one gram of chemical substance.