Preparation and Characterization of Biodiesel Produced from *Jatropha* Seed Oil Using Sulphated Zirconia as Catalyst

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Abstract

Biodiesel has become beguiling nowadays for it is environmental benefits and it seems an opposite alternative fuel for future. In the current study, the biodiesel was produced from *Jatropha* seed oil using sulphated zirconia as catalyst. The catalyst was characterized using Fourier transform infrared (FTIR), differential scanning calorimetry (DSC), X-ray diffraction (XRD), thermogravimetric analysis (TGA/DTA) and X-ray fluorescence (XRF). The GC-MS result of biodiesel produced shows 8.46% hexadecanoic acid, ntroduction

Fossil fuels are one of the major sources of energy in world today. It can be accounted to easy usabilityo eaT dconsidered as alternatives to fossil fuels [4]. Palm oil, coconut oil among other oil is required in

refned forms to obtained quality biodiesel, in Addition to their food needs, this makes the production of biodiesel from their sources uneconomical [5]. Non-edible oils obtained from plant species such as *Jatropha curcas L.* and *Castor* seeds may provide better de b ati es çde h reay potänti o| iodiesel Oroductionecause cmx: ral/tthood se¦0M M ∫a¡c

Jatropha seed was obtained from Sokoto Energy Research Centre, Usmanu Danfodiyo University Sokoto premises, Sokoto State, Nigeria.

Sample preparation and extraction of oil

T e seed was sundried to remove moisture content and grind powdered form. T e *Jatropha* oil extraction was carried out by so extraction method as reported by Farag et al. [7].

Preparation of catalyst

T e catalyst was prepared heterogeneously by a method o Ameliorated method below.

Preparation of S-ZrO_2 powder

T e fne S-ZrO_2 powder was prepared by ameliorated me which was based on the method reported by Hara and Miyayam Zirconium oxychloride hydrate ($ZrOCL_2.8H_2O$), amm ($NH_3.H_2O$) and sulphuric acid (H_2SO_4) were used as starting mat precipitating agent and sulphating agent, respectively 20% NH_3 ac gradually dropped into $ZrOCL_2.8H_2O$ solution (0.20M) and th value was adjusted to 10, hydrated Mz an

T e $ZrO_2.nH_2O$ hydrogel was changed into its alcogel by washing several times with anhy ethanol. T e fne ZrO_2 powder was obtained from the ZrO_2.n alcogel by washing several times with anhydrous ethanol. T e ZrO_2 powder was obtained from the $ZrO_2.nH_2O$ alcogel supercr drying method at 260°C and 7MPa. T e ZrO_2 powder was add 0.20M H_2SO_4 under vigorously stirring for 30 minutes, minu S- powder.

$ZrOCl_2(H_2O)4(s)+4NH_3(aq) \rightarrow ZrO_2(NH_3)_4(s)+2H_2O+2Cl^-$…

$ZrO(NH_3)_4(s)+2H_2SO_4(aq) \rightarrow ZrO_2(SO_3)_2+2H_2O+4NH_3$ ……

T e product will be:

Sulphated Zirconia $ZrO_2\ (SO_3)_2$.

Characterization of catalyst

T e S-ZrO_2

represent ZrO_2 the stretching vibration, the peak absorption at and the absorption peaks at 2363 and 2325 and are due to S-H stretching, the characteristic absorption of sulphated zirconia observed correspond to the absorption of SO_{42}^-/ZrO_2 reported by Yunfeng et al. [15].

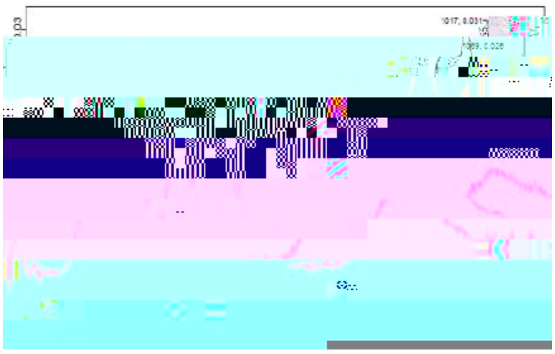

Figure 1: FT-IR of Sulphated Zirconia.

DSC analysis: T e DSC (di f raction scanning colometry), analysis of S-ZrO_2 as indicated in Figure 2, show glass transition temperature (the temperature at which the catalyst undergone change in heat capacity without change of state) as 74.82°C, the crystallization temperature (the temperature at which catalyst amorphous solid change to biodiesel yield results may be due to the di ferent methods of the catalyst preparations, catalyst loads, temperatures and oil to methanol ratios.

Physicochemical properties of biodiesel produced

Acid value: T e acid value of the biodiesel determines the level of free fatty acids present in the biodiesel. T e acid value of biodiesel produced was 2.02 mgKOH/g, as presented in Table 1 is higher than 0.5 maximum ASTM standards. T is can be corrected by neutralizing the oil before use to suits engines in order to avoid corrosion and wear in fuel systems and storage tanks.

Iodine value: T e iodine value of biodiesel produced is 104 gl2/100 g as presented in Table 1, which is within the range of 130 maximum ASTM standards. T e value shows low degree of unsaturated compound in the biodiesel produced, this is upholding by GC-MS analysis of the biodiesel produced which indicate low degree of unsaturated methyl esters i.e., (8.23%) hexadecanoic acid, methyl ester, (12.14%) 9,12-octadecadienoic acid, methyl ester and (10.82%) 11-octadecanoic acid, methyl ester.

Saponi fcation value: T e saponi fcation value of *Jatropha* biodiesel is 186.00 ± 2.00 mgKOH/g, as shown in Table 1, similar result (190.00 mgKOH/g) was obtained by Singh et al. [18]. T e saponi fcation value suggests that the biodiesel has higher molecular weight that may be responsible for its higher speci fc gravity (0.85) of the biodiesel produced. T e high saponi fcation value indicates higher methyl ester contents, as ester value is the

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