COW TALLOW BIODIESEL PRODUCED IN A PILOT SCALE

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ABSTRACT

In the present work, the process of biodiesel production in a pilot plant has been studied using cow tallow as raw materials with methanol and potassium hydroxide as catalyst. The biodiesel quality is regulated by FTIR method. The method showed that the final product had ester compositions which used as a biodiesel fuel in diesel engine. Furthermore the transesterification of cow tallow with methanol decreases the fat viscosity and produces a biodiesel with high quality.

1. INTRODUCTION

The management of industrial residual materials and the resumption of these materials are newly most important in countries. Unlike the other industries, the residual materials of agricultural industry are not so dangerous for environment and it should be used for reaching to high economic performance. One of the agricultural industry majors is animal industry which the residues for killing them such as horn, hoof, and tallow are very much. Cow tallow is one residual material from slaughterhouses which main destination is the soap industry, but when this market is overloaded, the fats are usually incinerated or disposed in a sanitary landfill. In both cases there is a pollutant impact. Thus the integrated use of industrial residues generated in slaughterhouses can avoid such problems, allowing new alternative jobs and minimizing the environmental impact of the accumulation of these residues.

The development of alternative fuels from renewable resources, like biomass, that can substitute partially or totally fossil fuel, has newly received considerable attention by researchers (Nejafi, 1385; Abdi, 1387). Biodiesel can be defined as fatty acid of ethyl and methyl esters from vegetable oils or animal fats, with high cetane number and generally boil point and viscosity is became available for using as fuels in engines diesel. This fuel is an attractive alternative of fuel

because it is produced from renewable resources and involves lower emissions than petroleum fuel. The use of biodiesel can promote a reasonable reduction in the main pollutant emissions like particulate material, total hydrocarbons and carbon monoxide, but it can increase nitrogen oxides (NOx). In this context, the use of cow tallow for biodiesel production in Iran has gained special interest, since it allows the use of rejected materials from cattle slaughterhouses (Zenozi, 1386; Kim et al., 2004; Ardebili et al., 2011). Methyl esters are the product of transesterification of fat and oils with methanol using an alkaline catalyst. The biodiesel need is continually increasing in Iran, requiring an alternative source that will be technically viable, economically competitive and ecologically correct. This problem is an important challenge to expand the biodiesel industry in Iran (Falahi Panah, 1390).

The objective of the present work is considering the production of the biodiesel using cow tallow gathered from slaughterhouses and finding some new resource in Iran for producing the biodiesel.

2. MATERIALS & METHODS

The cow tallow used in the biodiesel production was acquired from industrial slaughterhouse in the area of Jouneghan city, state of Char Mahal va Bakhtiari, Iran. Its main characteristics were: low water and foreign materials in process environment. To remove the waxy materials, suspended matters and residue water, the collected animal fats were melted by slowly heating to 100 °C. Melted fats were then filtered using strainer with 5µm and keeping up to frozen point for 24 hr to sediment the foreign materials. For the transesterification approximately 5 lit of cow tallow (after melted) were transferred to the biodiesel instrument in pilot plant of Shahrekord university, Department of Agricultural Machinery, then heated at 60 °C while 65 gr of KOH was dissolved in 1100 cc pure methanol (99%) in an auxiliary instrument, and the mixture was added to the cow tallow in instrument. Because of undefined fatty acids in process, 15 gr of KOH was added to experiment for its prosperity. The reactants were stirred for 90 min at 600(±10) rpm and then the stirrer was turned off and the reaction mixture was left in rest for 1440 min to promoting the decantation by gravity of glycerol and methyl esters. After this time, the glycerol phase was discharged and methyl ester phase was washed using water (amount of water was half of the biodiesel instrument capacity) by stirring 800 rpm to removing residual catalyst, glycerol,

methanol and soaps. Then the stirrer was turned off and the reaction mixture was left in rest for 20 min to sediment the water and other residues in bottom of process environment. These processes were repeated (three times) until the gathered water in bottom of process environment was crystalline. After the separation of water phase, biodiesel is heated at 70 °C for 60 min to purify the biodiesel and sent to storage tank (Kim et al., 2004; Falahi Panah, 1390; Hayyan et al., 2010; Ayhan, 2003; Fukuda et al., 2001).

Biodiesel of cow tallow produced in experiment were characterized using FTIR method in university of Esfahan to approve that arrived biodiesel had the methyl ester compositions. Furthermore the biodiesel viscosity was compared with cow fat.

3. RESULTS

Figure 1 presents quantitative composition of the biodiesel characterized in Esfahan university. The limitation of suction spectrum showed that the final arrived liquid had ester composition and after smelling it approved this fact. As it is looking for in some references, many of researchers have fallowed the fuels that have the most consistency with engines and these fuels cause the lowest changes in engine. One of the fuels that had used as a diesel engine fuel was crude oil but this fuel not only had high viscosity but also had free fatty acid compositions that may be polymerized in fuel system and barred it (Zenozi, 1386; Kim et al., 2004; Ardebili et al., 2011; Falahi Panah, 1390). The researchers tried to decline the viscosity using some methods such as paralysis, microemulsion, transesterification and after comparison among the methods, the transesterification was available (Kim et al., 2004).

The viscosity is the measure of the resistance to flow of the fuel and can also be used to select the profile of fatty acids in the raw material used for the production of the bio-fuel. As it was told the viscosity of natural cow tallow was very high and it was solid but after transesterification the viscosity of cow tallow decreased and it was naturally been liquid. The viscosity measured in laboratory of Shahrekord university for the biodiesel in 40 °C was 5.3 mm^2s^{-1} and after comparison with standard **ASTM D-445** (range of biodiesel viscosity should be in 1.9 – 6 mm^2s^{-1}), and comparable with diesel of petroleum (the viscosity was differ 3 – 12 mm^2s^{-1}), it was in range.

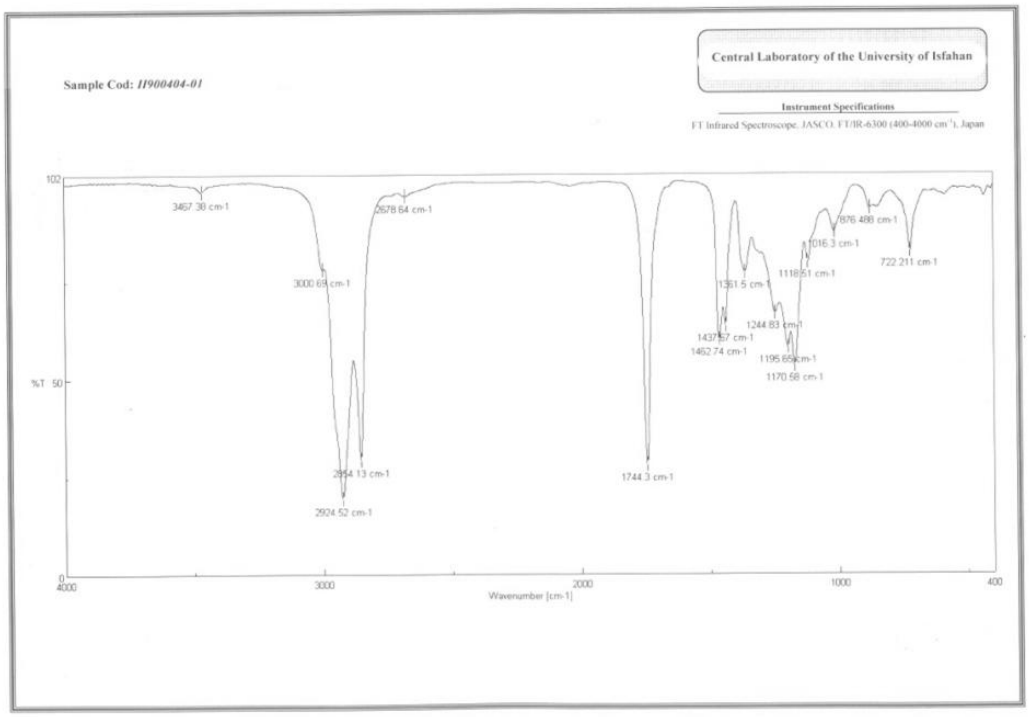

Figure 1, Limitation of suction spectrum of biodiesel produced from cow tallow measured in central laboratory of the university of Esfahan.

4. CONCLUSIONS

The transesterification is available method to decrease the viscosity of cow fats and approve to use as a fuel for diesel engine cycles. Furthermore cow tallow is one residual material from slaughterhouses therefore the slaughterhouses can be available source to product biodiesel.

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