Investigations on Extending of Stable Emulsion using Waste Cook oil as Base Fuel for Diesel Engine

P.Balu[1], M.Senthil Kumar[2], D.Raguraman[3], K.Arul [4]

[1 2 3 4]Department of Automobile Engineering, Bharath Institute of Higher Education & Research, Chennai - 600073.

Corresponding author: balu.auto@bharathuniv.ac.in Tel: +91 9842456848

ABSTRACT:

Making of stable emulsion of waste cook oil as diesel engine fuel which consist of base fuel as waste cook oil and water with surfactant are reviewed. Waste cook oil emulsion is considered as suitable fuels for diesel engine. Micro- explosion is an effective method to use emulsion in diesel engine. In this work is focused on studying and analyzing the stability of waste cook oil emulsion ,Results of stability test of span 80, the WCO emulsion proportion of waste cook oil, water, surfactant and co-surfactant and phase diagram of emulsion are presented in chemix ternary diagrams. According to the stability, viscosity and economical aspects, the optimum emulsion is found as the emulsion with 6% of ethanol, 4% of SPAN 80, 5% of water and 85% of waste cook oil by volume.

Index Terms – Bio-oil, Mosambi peel bio-mass, Orange oil, Diesel Engine, Performance, Emission.

1. Introduction

An emulsion is a mixture of two immiscible (i.e. not able to be blended) substances. Emulsification method is the one of the most potentially effective techniques to reduce exhaust emission from diesel engines. Oil emulsions appear to be the most appropriate because they require no engine retrofitting.

Today, the amount of waste produced by the food industry, such as animal fat and vegetables oil, is continuously growing up. These residues have a very important energy potential similar to conventional fuels such as diesel. However, these products have a fatty acid content of up to 70% by mass[1]. Their direct utilization in furnaces or engines is impracticable due to the chemical–physical properties (e.g. high viscosity and thermal instability)

Emulsification, in particular water in oil emulsions (W/O), is considered as an effective alternative to efficiently utilize waste cook oils. WCO emulsions are prepared by mixing the waste cook oil with water, surfactant and co-surfactant. Ethanol is chosen as the co-surfactant because of its dilution ability [2]. SPAN 80 also called Sorbitan monooliate is used as the surface active agent because it well stabilizes and forms stable WCO emulsions

1PHOTOS OF EMULSION REPARATION

Figure 1.1

Figures 1.2

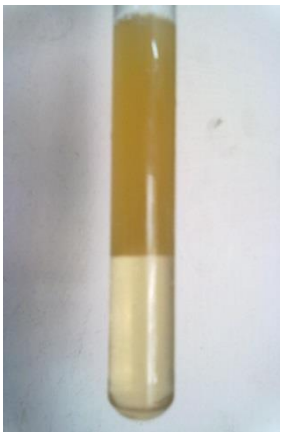

Figure 1.3

Figures 1.4

Figure 1.3 shows one of the trails. In this trial after adding the substances in the proportionate ratio, which is under well shake by hand up to 20 minutes. After that, it has been kept at stable place. More than one layer is denote the un stability and this fig 1.3 is showing the clear separation of water & oil.

Figure 1.4 is showing the result of formation of emulsion, in this trial during the stability test single layer is formed and the colour is milky white. The stability of the emulsion period is up to 7 days.

2 TERNARY PHASE DIAGRAMS

Ternary phase diagrams are constructed by projecting the liquid surfaces of a three dimensional diagram (a triangular prism which is plotted on the vertical axis against the compositions of three components on the base of the prism) onto the compositional ternary diagram. The intersection of two liquid surfaces is also projected on the same compositional ternary and is known as a boundary curve.

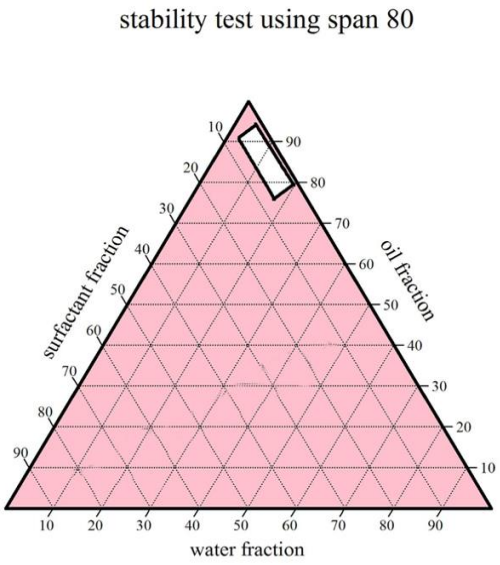

Figure 2.1

Fig 2.1 shows the detailed mixture proportions and stability of the emulsions formed by water and waste cook oil using span 80 as surfactants. The results obtained with tested surfactants (span80) are summarized in ternary diagrams. The main criterion for stable emulsion is the presence of only one phase. If more than one layer is seen, then it must be considered as unstable. To analyze the emulsion stability during 6 hours in the case of a water-in oil emulsion.

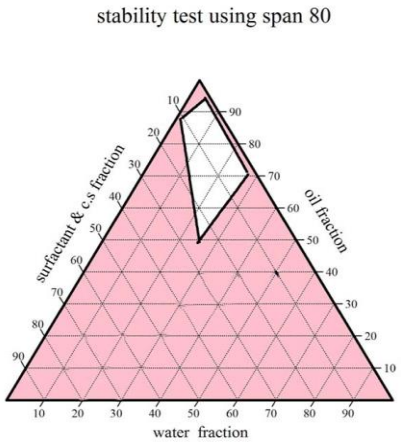

Figure 2.2

Fig 2.2 shows the detailed mixture proportions and stability of the emulsions formed by water and waste cook oil using span 80 as surfactant and ethanol act as a co-surfactant. When adding ethanol, the stability of emulsion improved and it is stable up to 7 days.

As seen from the results, the emulsions stability zone is always limited by the lower and upper limits of water content. The lower limit of water indicates that the emulsion is too diluted. On the other hand, the upper limit of water content in the emulsions forms too much water in the continuous phase. The water droplets have the trend to coalesce and rapidly form a separated water layer.

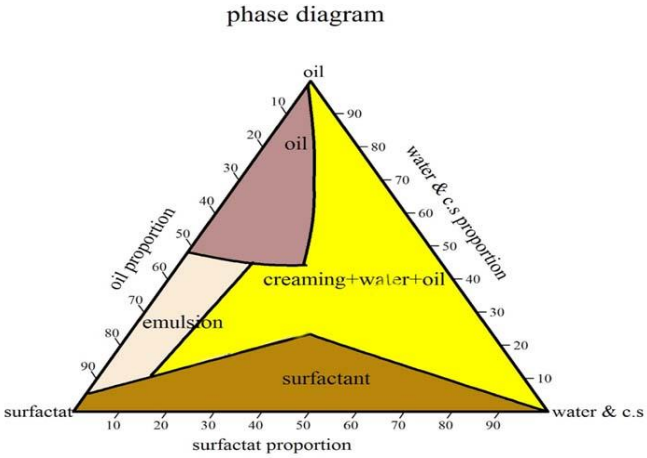

Figure 2.3

Fig 2.3 shows the phase diagram of emulsion, in this figure shows the detailed proportion of water, oil, span 80 and ethanol. Dark brown indicate the surfactant, yellow color indicate the creaming formation with small amount of water and oil. Pink color indicated the area of oil present and the waste cook oil emulsion presented in the area of milky rose.

3. Conclusion

- Find out physical and chemical properties of the stable emulsion
- Experimental investigation on WCO emulsion as diesel engine fuel
- Generating the pressure crank angle diagram for both diesel and WCO emulsion.
- Comparing the performance, combustion , and emission characteristics of diesel and WCO emulsion

4. References

1. E. Mura a, P. Massoli 'Study of the micro-explosion temperature of water in oil emulsion droplets during the Leidenfrost effect' Experimental Thermal and Fluid Science 43 (2012) 63–70

2. A. Kerihuel, M. Senthil Kumar ' Ethanol animal fat emulsions as a diesel engine fuel – Part 1: Formulations and influential parameters' Fuel 85 (2006) 2640–2645

3. A.Alahmer and J.Yamin, 'Engine performance using emulsified diesel fuel', Energy conversion and management, 51 (2010) 1708–1713.

4. A. Kerihuel, M. Senthil Kumar ' Use of animal fats as CI engine fuel by making stable emulsions with water and methanol' Fuel 84 (2005) 1713–1716.

5. M.Senthil Kumar, A. Kerihuel ' Experimental investigations on the use of preheated animal fat as fuel in a compression ignition engine' Renewable Energy 30 (2005) 1443–1456