# Review of biodiesel standard development in Malaysia

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**ABSTRACT** – Biodiesel is one of the potential fuels of the future to overcome petroleum fuel depletion. At present, various standards were referred for Biodiesel fuel properties and testing method. Not all of these standards were found suitable for the tropical conditions in Malaysia, therefore called for development of Malaysian owned Biodiesel Standard. Previous research shows that several biodiesel properties such as density, kinematics viscosity, flash point, acid value and water content at ambient temperature at 25°C were worth investigated where contributed significantly to engine failure if not being properly addressed. A study on comparison of European EN 14214, American ASTM D6751, Japanese JIS K 2390 against Malaysian Standard MS 2008 were conducted. Results shows that Flash point, Density and Acid Value were found very similar while Kinematic Viscosity and Water Contents deviate away from all of the three European, American and Japanese Standards. However analysis on two properties sample (Flash Point and Density) found interesting differences in response of Higher Blend Ratio (HBR) Biodiesel, which need to be further, explored. Recommendations of Malaysian Standard were proposed to better suit Malaysian Scope, however need further investigation and clarification.

## 1. INTRODUCTION

The global awareness on the important of renewable energy has tremendously driven the effort on finding sustainable energy solution. The potential of biodiesel becoming as fuel of the future has driven enormous amount of research work focusing in this area. Palm oil-based biodiesel, become the best candidate in the Asian region due to the high yield and more economical as compared to other feedstock [1-3]. In Malaysia, the agency responsible for biodiesel R&D and standard development is Malaysian Palm Oil Board (MPOB). Currently, most biodiesel testing and specification were referred to European, American and Japanese standard. However, major concerns from most of these standard were for cold weather application. Therefore, there is a need for Malaysian government to develop its own Biodiesel standard, which reflect its tropical climate condition.

## 2. METHODOLOGY

In development of Malaysian Biodiesel Standard, one has to review the existing governing standard especially from American Society for Testing of Material (ASTM), European Standards (EN), Japanese Industrial Standards (JIS), and others. However, it was noticed that not all of these available standard really reflect the Malaysia weather conditions. The main concerns of the existing standard emphasized on cold weather application, where potential problem appears to be more crucial as compared to hot weather especially in the normal operating condition of the diesel engine.

For this research, the existing ASTM, EN, JIS and MS standards have been used as the guideline to perform any experimental work on biodiesel. Some comparison will be made among these four (4) international standards to study their compatibility for experimental work in Malaysia which using Malaysian standards developed by Department of Standards Malaysia (DPM).

In this paper, the emphasis is on the collaboration work between Universities and Industries in Malaysia for activities involving biodiesel experimentation. Some of the investigation performed at the universities could be compensated and validated against the analysis done by industries and other agency such as MPOB. Currently, MPOB have conducted a very substantial investigation especially in qualifying low pour point or winter grade biodiesel in thrust for export.

This study is conducted to compliment the initial study by MPOB in providing better understanding of existing regulatory standard around the globe. Researchers in UTeM, alongside with their Malaysian Technical University Network (MTUN) counterparts with UM collaboration, performed fundamental studies for better understanding of the behavior in term of Acid Value, Flashpoint (°C), Density (g/ml), Kinematic Viscosity and Water Content changes over a certain period.

Humairak et al. [4] and Khalid et al. [5-6] conducted experiment to study several biodiesel properties such as density, kinematics viscosity, flash point and water content at ambient temperature at 25°C for a duration of 60 to 63 days. The palm oil biodiesel have been blended to various blending ratio of B5(5% biodiesel fuel 95% petroleum diesel fuel), B10, B15, B20, B25, B30, B35, and B40 in order to make a

comparison between data collected from each properties. The condition of biodiesel fuel itself will affect each of the chemical and physical properties. It was shown that when the blending ratio of the biodiesel fuel increases the value of almost properties will increases also due to the different percentage ratio of biodiesel-diesel used in that experiment.

Several equipment were utilized in this study according to the governing standard established from ASTM, EN and JIS. The Biodiesel test equipment are shown in Table 1.

Table 1 Biodiesel properties equipment

| Parameters | Equipment for testing |
|---|---|
| Flash point (°C) | SETA Flash Point series 3 |
| Density (kg/m³) | Hydrometer |
| Water content (ppm) | Trivector Analyzer |
| Acid value (mgNaOH/g) | Titration process |
| Kinematic viscosity (mm²/s) | Viscometer with water bath. |

Four-biodiesel blend were tested including Standard Diesel, B70, B80 and B90. Three storage containers were design for Ambient, Hot and Cold Storage conditions. The ambient container temperature was around 23-24 $^{O}$C. The Hot containers temperature was around 40 $^{O}$C while the cold containers temperature approximately 12$^{o}$C with a tolerance of +/- 2$^{o}$C.

## 3. BIODIESEL STANDARDS COMPARISON

Table 2 shows the data for biodiesel standard as compared with the data in this study. Sample from two of the properties investigated (flash point and density) were further analyze to understand its response behavior. The results for fuel density (g/ml) were tabulated and presented in Figure 1. It was observed that the standard fuel density remains unchanged over different temperatures over a period of 5 weeks storage time (in red). The results for higher blend ratio (HBR) Biodiesel were obviously much higher as compared to the standard diesel. Generally, the density is increasing against higher the blend ratio biodiesel. However, it was also noted that the stability of HBR were not obtained within duration of 5 weeks. It can also be concluded that the stability of HBR reduces as the HBR Biodiesel increased.

Table 2 Comparison experimental data with existing biodiesel standard.

| Properties | Unit | ASTM D6751 | EN 14214 | JIS K2390 | MS 2008 | Experimental data |
|---|---|---|---|---|---|---|
| Flash point | °C | 130 min | 120 min | 120 min | 120 min | 138.71 |
| Density at 15°C | $kgm^{-3}$ | - | 0.86-0.90 | 0.86-0.90 | 0.86-0.90 | 0.86 |
| Kinematic viscosity at 40°C | $mm^2s^{-1}$ | 1.9 - 6.0 | 3.5 - 5.0 | 3.5 - 5.0 | 3.5 - 5.0 | 6.04 - 6.33 |
| Acid value | mgKOH/g | 0.8 max | 0.5 max | 0.5 max | 0.5 max | 0.45 |
| Water content | % ppm | - | 0.50 | 0.50 | 0.50 | 0.28 |

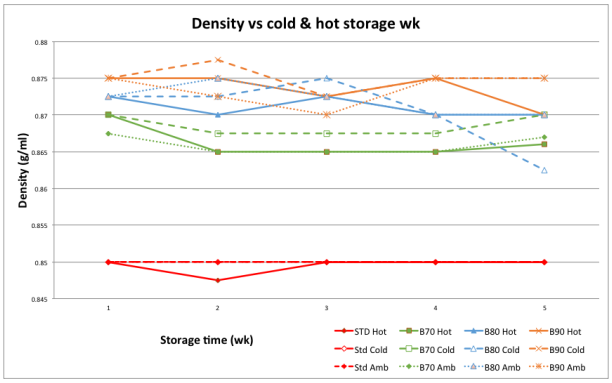


Figure 1 Fuel Density versus various storage conditions over time.

Increasing density could possibly indicates few hypothesis in HBR Biodiesel including formation of residual glycerin, catalyst, alcohol, increasing cloud point and even bacterial growth within the fuel storage system. However these hypotheses need further investigation to proof its validity. The potential engine problem associated with these concern may perhaps reduce life of a diesel engine due to injector choking, filter plugging, sediment formation and reduce fuel flow in the fuel lines.

## 4. FLASH POINT OBSERVATION

Flashpoint refers to the lowest temperature at which the fuel will ignite if exposed to flame or high compression in the case of CI engine. The experimental results for flashpoint against various temperatures and storage time (in week) are shown in Figure 2. In this figure, it was obvious that each HBR biofuel and standard diesel have less variation in each range of flashpoints. The measurement shows a very consistence reading.

Another significant finding in Figure 2 is that as HBR biodiesel blend increased, the flashpoint also increased accordingly. The flashpoint is less responsive to the storage time in week. It is more sensitive to the composition of HBR of biodiesel.

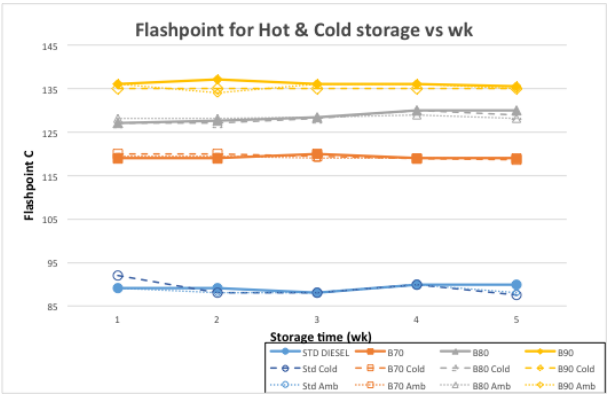


Figure 2 Flash point ($^{o}$C) versus various storage conditions over time.

In this case, it can be concluded that, the higher HBR biodiesel blends, it is more difficult for combustion to occur in the diesel engine. However, the higher the HBR biodiesel, the safer it get for storage in

the vehicle as well as in emergency situation such as accidents or fuel leakage. This information is important to various automotive Original Equipment Manufacturer (OEM) in designing suitable storage tanks and supporting system for diesel vehicle.

## 5. CONCLUSION AND DISCUSSION

Based on the two properties investigated, it could be concluded that, the density is more sensitive to temperature variation as compared to the flashpoints. The density is an important property, with impact to fuel quality and injection systems, pumps, and injectors must deliver an amount of fuel precisely adjusted to provide proper combustion.

From this investigation, a better understanding for some of the biodiesel properties is established. This information is important in the development of a more specific biodiesel standard relevant to Malaysian context, aligned with its tropical weather conditions. This standard could be named as Malaysian Biodiesel Standard and would be the main reference points for all activities related to biodiesel production and application in Malaysia. The public awareness should be further enhanced to avoid compliance requirements to unrealistic and irrelevant Biodiesel standard developed by the American, European or Japanese.

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