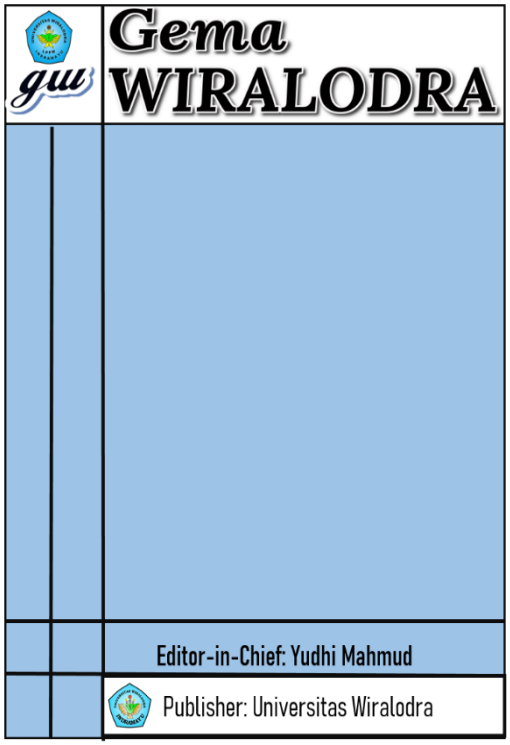
Gema Wiralodra

Publication details, including instructions for authors and subscription information:
https://gemawiralodra.unwir.ac.id
(PERTAMINA, 2014) (PERTAMINA, 2014) (Placeholder1) (PERTAMINA, 2014)



Evaluation of optimal time blending process on medripal 412 And Prima XP SAE 20W – 50 samples with homogenity test

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To cite this article:
Asminah,N., Prasetyo, E & Dhamayanthie, I. (2023). Evaluation of optimal time blending process on medripal 412 and Prima XP SAE 20W – 50 samples with homogenity test.*Gema Wiralodra*, *14*(2), 681-687.
To link to this article:
https://gemawiralodra.unwir.ac.id/index.php/gemawiralodra/issue/view/22
Published by:
Universitas Wiralodra
Jln. Ir. H. Juanda Km 3 Indramayu, West Java, Indonesia

Gema Wiralodra, 14(2), 681-687
https://gemawiralodra.unwir.ac.id/index.php/gemawiralodra
p-ISSN: **1693-7945**
e –ISSN: **2622 - 1969**

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Evaluation of optimal time blending process on Medripal 412 and Prima XP SAE 20W – 50 samples with homogenity test

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Submit 29-03-2023, accepted 03-07-20203, published 05-07-2023

Abstract
Prima XP SAE 20W - 50 is a multigrade lubricant used for gasoline and Medripal 412 engine lubricants used for marine industry engines which are non-carcinogenic and environmentally friendly. The main factor in testing lubricants is the Blending process, which is the process of mixing base oil with additives. In the blending process, an inhomogeneous lubricant was found which caused the lubricant test not to comply with specifications. This experiment aims to determine the optimal time of the blending process with the KAN homogeneity test method. Homogeneity testing can be seen from the viscosity value of the lubricant. So the optimum time for the blending process is needed for the continuity of the production process of this lubricant. Medripal 412 products have an optimum blending time of 30 minutes with a viscosity value at 100 C ranging from 14.79 mm^2 / s based on the SNI 7069.1 Th. 2012, the product specification value of Medripal 412 is 12.5 - <16.3 mm^2 / s and the Prima XP SAE 20W - 50 product has an optimum blending time of 45 minutes with a viscosity value at 100°C of 20.28 mm^2 / s based on the SNI 7069.1 Th. 2012, the value of the Prima XP SAE 20W - 50 product specification is 5.6 - <21.9 mm^2 / s. This shows that the lubricant is by the standard quality standards set by the company and the government so that the lubricant product is still suitable for use.
Keywords: Homogenity, Viscosity, Blending, Prima, Medripal

1. Introduction

Prima XP SAE 20W – 50 is a gasoline engine oil formulated from selected high-quality base materials of the HVI type with additives resulting from the latest technology in optimal quantities, types and compositions including detergent dispersant, anti-oxidation, anti-wear and (VII) Viscosity Index Improver which are all able to provide maximum protection for lubricated engine parts. This lubricant has the main advantage of having a double viscosity (multigrade), stable at high and low temperatures so that the engine is easy to start at low temperatures and the lubricant still has a viscosity suitable for lubrication at high temperatures and speeds.

This lubricant formula was developed specifically to provide protection against deposit formation and has resistance to degradation and has very small evaporation rate characteristics so that lubricant consumption is more efficient. Prima XP SAE 20W-50 is the latest generation of lubricant as an effort to improve the quality of the previous generation of Mesran Prima lubricants. This lubricant is approved and certified by The American Petroleum Institute (API) Engine Oil Licensing and Certification System (EOLCS) (PERTAMINA, 2014).

Medripal 412 is a multigrade lubricant used for gasoline engine lubricants and Medripal 412 is used for marine industry engines that are non-carcinogenic and environmentally friendly. The main factor in lubricant testing is the Blending process, which is the process of mixing base oil with additives. In the Blending process, inhomogeneous lubricants are found which causes lubricant testing not to comply with specifications. This experiment aims to determine the optimal time of the Blending process with the Homogeneity Test Method from KAN (Komite Akreditasi Nasional, 2004).

PT. Pertamina Lubricants does not yet have a specific time reference in carrying out the blending process on each lubricant product. This causes lubricants to often be inhomogeneous which causes the results of lubricant quality testing in the Cilacap Unit Production Laboratory

p-ISSN: **1693-7945**
e –ISSN: **2622 - 1969**

sometimes not included in the specifications set by the company, so it is necessary to re-sample for retesting. Homogeneity test using statistical methods on the measurement results of several lubricant quality parameters with optimal blending time variations to produce homogeneous lubricants, so as to minimize these problems. The method used for homogeneity test refers to the statistical calculation guidelines for proficiency tests (DP.01.34) of the National Accreditation Committee (KAN) (Komite Akreditasi Nasional, 2004).

The main parameter that can indicate the homogeneity of the lubricant is viscosity. The viscosity specified is the kinematic viscosity in centistokes (cSt). Viscosity determination is carried out at a temperature of 100o C which refers to ASTM D 7279. The viscosity parameter is chosen because viscosity indicates the classification of the usefulness of a lubricant. The test results on viscosity parameters can be used as a reference for the homogeneity of a blended lubricant (Komite Akreditasi Nasional, 2004).

Lubricant is a chemical substance that is generally in the form of a liquid, which is given between two moving objects with the aim of reducing frictional forces. The lubricant is made from a 70-90% mixture of base lubricating oils and added with additives to improve its properties. Basic lubricating oils can be grouped into 3, namely mineral lubricating oils, synthetic lubricating oils and vegetable lubricating oils. Mineral lubricants are lubricants made with raw materials of mineral base lubricating oils (groups I and II) and synthetic lubricants are lubricants made from synthetic base lubricating oils (groups III, IV and V). The higher the class of lubricant base materials, the better the quality of the lubricant. The resistance of lubricants to temperature changes is greatly influenced by the type of lubricant base material (Siskayanti, 2017).

Based on the background above, this study aims to evaluate the optimum time of homogeneity of the blending process based on Medripal 412 and Prima XP SAE 20W – 50 samples, as well as evaluate viscosity values and homogeneous time in Medripal 412 and Prima XP SAE 20W – 50 samples.

2. Method

Equipment and Materials

The materials used in this test are Ethanol, Toluene, Naphtha solvent, 2-Propanon, Medripal Sample 412, Prima XP SAE Sample 20W – 50 and Tissue. The tools used are Houillon Viscometer (ASTM, 2013), Vial Bottle, Beaker Glass, Microsyringe, and Thermometer.

Homogenity Test

According to Totten (2016), homogeneity test is a test of the same or not the variance of two or more pieces. In the homogeneity test, the sample is taken representatively, which means that the sampling must represent the actual conditions. Medripal 412/Prima XP SAE 20W homogeneity test was measured using a Houillon viscometer at 100^{o}C. Sample testing with blending times of 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60 is measured with one capillary pipe, so the constant and capillary pipe correction factor are the same. Another thing to note is the absence of bubbles when injecting the sample into the capillary pipe, so as to minimize the error factor. Testing of Medripal 412 and Prima XP samples from each sample was carried out duplo with a maximum of seven repeats.

Based on statistical calculations of KAN (Komite Akreditasi Nasional, 2004).the two values are obtained from MSB (Mean Square Between) and MSW (Mean SquareWithin) respectively.

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$$MSB = \frac{\Sigma [(a_i + b_i) - \bar{X}_{(ai+bi)}]^2}{2(n-1)}$$

$$MSW = \frac{\Sigma [(a_i - b_i) - \bar{X}_{(ai-bi)}]^2}{2n}$$ ..... equation 1

(Statistik Komite Akreditasi Nasional, 2004)

Information:
MSB = Mean Square Between
ai = Value Testing of first sample
bi = Value Testing of second sample
X = Average testing
n = Summary of Testing
MSW = Mean Square Within
Value F_{test} using formula:

$$F = \frac{MSB}{MSW}$$ ..... equation 2

(Statistik Komite Akreditasi Nasional, 2004)

If $F_{hitung} < F_{tabel}$ (db_1 and db_2) then the sample is declared homogeneous.

Viscocity test

The viscosity testing process for Medripal 412 and Prima XP samples was measured using the Houillon viscometer at 100^{o}C. Testing samples with the same blending time are measured with one capillary pipe, so the capillary pipe correction constant and correction factor are the same. Another thing to note is the absence of bubbles when injecting the sample into the capillary pipe, so as to minimize the error factor. Sampling is carried out when the tank condition is full so that the collection point is carried out at 3 points, namely the top of the tank, the middle of the tank and the bottom of the tank. This is done so that the test results are more accurate. Medripal 412 and Prima XP viscosity testing process at 100^{o}C, Blending time 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60 minutes.

According to Darmanto (2011), viscosity has units of mm / s^2 or centistokes (cSt), the higher the viscosity value of the lubricant will be more viscous. Lubricant viscosity can also be expressed as the time required by a weight of lubricant to flow in a capillary pipe so that viscosity is known as kinematic viscosity. Kinematic viscosity is the product of multiplication of flow time measured by the capillary pipe factor of the viscometer or can be expressed by the formula:

$$\mathbf{V = C \times t}$$ ..…..... equation 3

(ASTM, 2013).

Information:
V = Kinematics Viscosity(cSt)
C = The capillary pipe factor (cSt/detik)
t = Flow time measured (detik)

Data Analysis

Data analysis was carried out using the statistical method of the F_{test} by comparing the MSB and MSW values so that the F_{count} value was produced. A sample is said to be homogeneous if the F_{count} value is smaller than the F_{table} value at a 95% confidence level.

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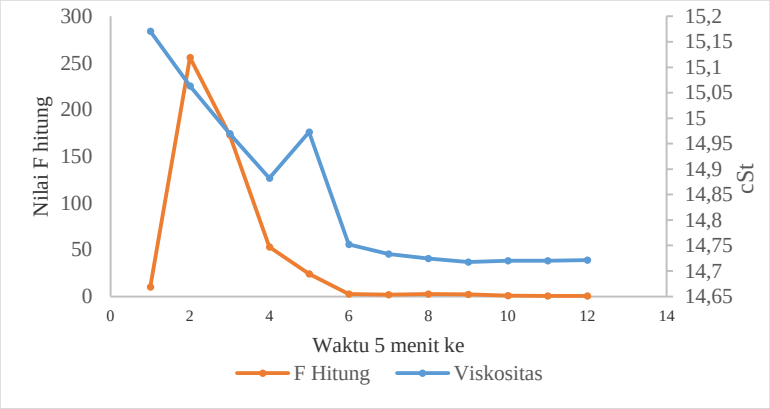
3. Results and Discussion

Based on the results of the Medripal 412 homogeneity test at a temperature of 100^{o}C with a blending time of 5, 10, 15, 20, 25 minutes, the F_{cout} value is greater than Ftable, so that the sample viscosity is not homogeneous. Samples with times of 30, 35, 40, 45, 50, 55, and 60 minutes F_{count} values smaller than F_{table}. Based on the Journal of Statistics of the National Accreditation Committee, 2004 said that the sample can be said to be homogeneous if the value of $F_{count} < F_{tabel}$ which can be calculated by the F Test that has been determined by the Indonesian National Accreditation Committee institution.

Figure 1

Correlation Value Fcount, Viscocity, and Homogenity time Medripal 412



The graph in Figure 1 explains that the blending time, Viscosity and F count are related. The longer the blending process, the value of F is calculated more constant and the viscosity is also constant. Figure 1 shows an increase in the calculated F value in the 10th minute with a value of 256.024 and begins to decrease in the 15th minute with a calculated F value of 173.098, then drops back in the 20th minute with a calculated F value of 52.928 but the calculated F value is still greater than the F value of the table. In the 25th minute also experienced a decrease in the value of F count, it can be assumed that in minutes 5 to 25 there was a diffusion phenomenon between Base Oil and Additives during the Blending process. Based on testing conducted by PT. Pertamina Lubricants – Production Unit Cilacap the viscosity value of Additives is 1000 – 5000 cSt at a temperature of 100^{o}C and the viscosity value of Base Oil is 14 – 15 cSt. This shows the mass transfer from additives to Base Oil where mass transfer occurs when high concentrations go to lower concentrations in accordance with Fick's law (Griskey, 2006).

In this research, it was shown by the high F value when the sample was not mixed well at minutes 5-25, so it can be said that the lubricant has not been homogeneous, which means that there is still a diffusion process between Base Oil and Additives. However, in the 30th minute the value of the F_{count} is less than the F_{table} which is 2.698 and in the next minute the value of F_{count} still increases and decreases but the value is still below the F table where this shows that the diffusion process has stopped so that the viscosity value of the sample is homogeneous and enters the specifications set by the company starting from minute 30 to minute 60. In Medripal 412 products, the composition of Base Oil used is a type of Base Oil from Group III is a type of Synthetic Lubricant which has a viscosity value range at a temperature of 100^{o}C 14.00 – 15.00 cSt.

In Figure 1 shows that the longer the time of the Blending Process will produce a constant or homogeneous value in the lubricant product and close to the specification value of

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e –ISSN: **2622 - 1969**

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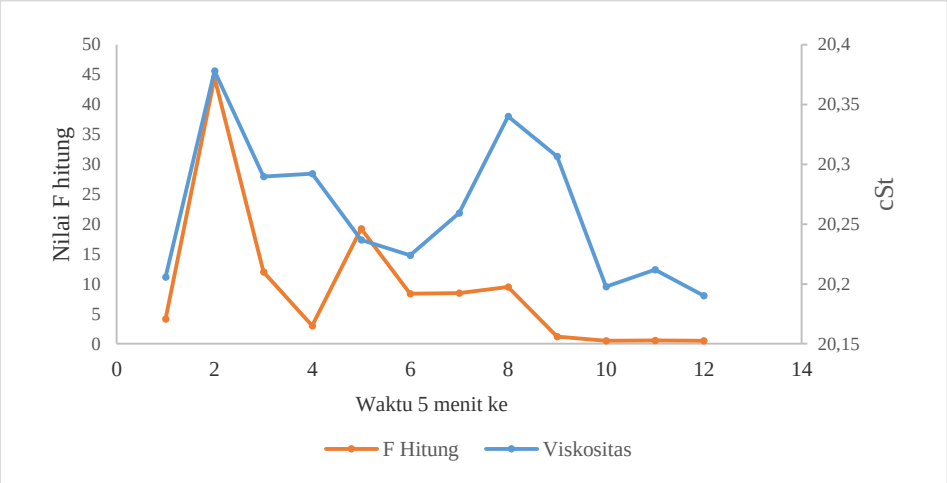
Viscosity at a temperature of 100ºC set by PT Pertamina Lubricants Cilacap which is 14.00 – 15.00 cSt and the specifications that have been set by the Indonesian National Standard 7069.1 Th. 2012 which is 12.5 - < 16.3 mm^2 / s and the results that have been obtained by this test, in the 30th minute have shown the number that entered into the company's specifications with an average viscosity value for all parts (Top, Middle, Bottom Tank) which is 14.79 cST.

To find out the correlation between blending time, F calculation and viscosity, the analysis is based on the correlation graph shown in Figure 2. Overall the graph below explains that the blending time, Viscosity and F count are related. Figure 2 is more volatile than the graph in Figure 1. The longer the blending process, the value of F is calculated to be more constant and the viscosity is also constant.

Figure 2

Correlation F value, viscocity, and Homogenity Time Prima XP



For the Prima XP SAE 20W – 50 sample, the F count is quite good, but there is still a fairly awkward F count at the 10th minute. Similar to the Medripal 412 sample, it can be assumed that minute 10 begins to occur the phenomenon of diffusion between Base Oil and Additives during the blending process. This diffusion phenomenon has been described in Medripal's analysis. The existence of this diffusion phenomenon causes the calculated F value to be large as in the Medripal 412 sample. By the 45th minute onwards the phenomenon of diffusion has stopped so that the Medripal Viscosity value is constant. When the viscosity value of the sample is constant, the deviation values of the first repetition and the second repeat are constant and the calculated F becomes constant.

The Prima XP sample experienced homogeneity longer, namely at minute 45 compared to the Medripal 412 sample at minute 30, due to the composition of Base Oil from the product Prima XP SAE 20W – 50, which is a type of Mineral Lubricant from Group II with type HVI 650 which has a viscosity value at a temperature of 100ºC 20.00 – 21 cSt, this makes the homogeneous time of lubricant relatively longer than the product Medripal 412 due to differences in composition from the Base Oil is added with Additives that have a viscosity of 1000 – 5000 cSt from multigrade lubricants more than monograde lubricants (in this case Medripal 412). This shows that the homogeneous lubricant at minute 45 indicated by the value of $F_{Count} < F_{Table}$ and in the next minute the value of F_{count} is consistent, not experiencing significant changes.

Figure 2 shows that the longer the time of the Blending Process will produce a constant or homogeneous value in the lubricant product and close to the Viscosity specification value at a temperature of 100ºC set by PT Pertamina Lubricants Cilacap and the results that have been obtained by this test, in the 45th minute have shown the number that enters the company's

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e –ISSN: **2622 - 1969**

specifications with the average viscosity value for all parts (Top, Middle, Bottom Tank) which is 20.28 cST. A solution or fluid with a high concentration will have a high viscosity as well, because the concentration of the solution expresses the number of particles of solute per unit volume (Lumbantoruan & Erislah, 2016). The more particles that are dissolved, the friction between particles is higher and the shear stress is higher. The existence of this diffusion phenomenon causes the shear stress value of the fluid sample (Medripal 412) to be high so that it takes a long time when the fluid passes through the capillary pipe during measurement. With a long time, the Medripal viscosity value also increases, when the sample viscosity value is getting bigger, the deviation between the viscosity value of the first test sample and the second test sample is getting bigger and resulting in the calculated F value being large. By the 30th minute onwards the phenomenon of diffusion has stopped so that the value of Medripal Viscosity is constant.

When the viscosity value of the sample is constant, the deviation values of the first repetition and the second repeat are constant and the calculated F becomes constant. F is calculated based on a homogeneity curve, where the curve depends on the degrees of freedom of the sample. The more degrees of freedom (df), the higher the peak of the distribution curve F moves to the right followed by the cessation of the diffusivity phenomenon so that the slope decreases. When the slope decreases, the calculated F value decreases where F count is the ratio of two types of samples, namely the variety between samples (MSB) and the variety in samples (MSW) (Komite Akreditasi Nasional, 2004).

4. Conclusion

The viscosity value of Prima XP is greater than the viscosity value of Medripal 412, which is 20.28 cSt for Prima XP and 14.79 cSt for Medripal 412. The optimum time to achieve Prima XP homogeneity = 45 minutes is longer when compared to Medripal 412 which is 30 minutes.

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p-ISSN: **1693-7945**
e –ISSN: **2622 - 1969**

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