INNOVATIVE: Journal Of Social Science Research
Volume 4 Nomor 5 Tahun 2024 Page 2010-2020
E-ISSN 2807-4238 and P-ISSN 2807-4246
Website: https://j-innovative.org/index.php/Innovative

Study Of The Addition Of Zno (Zinc Oxide) To The Viscosity Value Of Lubricant Products In The Storage Process

Fanya Aulia Revalina[1✉], Marietta Casta Neda[2], Gallant Maulana Akhdan[3], Farida Khairunnisa[4]
Polytechnic Energy and Mineral AKAMIGAS Logistic Oil and Gas Departement
Email: fanyarevalina1987@gmail.com[1✉]

Abstrak

Penelitian ini bertujuan untuk menganalisis efek penambahan Zinc Oxide (ZnO) pada pelumas terhadap perubahan viskositas yang terjadi. Dalam konteks pelumas mesin, viskositas adalah faktor krusial dalam menentukan kualitas dan kinerja pelumas. Penelitian ini menggunakan Anton Paar svm 3001 Viscometer untuk mengukur viskositas pada suhu 40ºC dan 100ºC, serta indeks viskositas menggunakan metode uji ASTM (ASTM D445 dan ASTM D2270). Diharapkan hasil penelitian ini akan memberikan pemahaman yang lebih baik tentang kualitas pelumas mesin berdasarkan indeks viskositas, serta memberikan panduan dalam memilih aditif pelumas yang sesuai untuk memenuhi standar kualitas pelumas yang ditetapkan. Dengan demikian, penelitian ini dapat memberikan kontribusi penting dalam meningkatkan kualitas dan kinerja pelumas yang tersedia di pasar, serta memastikan distribusi pelumas yang memenuhi standar kualitas.

Kata Kunci:: *Zinc Oxide, Viskositas, Castrol, Penyimpanan, Kualitas*.

Abstract

This research aims to analyze the effect of adding Zinc Oxide (ZnO) to lubricants on the viscosity changes that occur. In the context of engine lubricants, viscosity is a crucial factor in determining the quality and performance of the lubricant. This study uses the Anton Paar svm 3001 Viscometer to measure viscosity at temperatures of 40ºC and 100ºC, as well as the viscosity index using the ASTM test method (ASTM D445 and ASTM D2270). It is hoped that the results of this research will provide a better understanding of the quality of engine lubricants based on the viscosity index, as well as provide guidance in selecting appropriate lubricant additives to meet established lubricant quality standards. Thus, this research can make an important contribution in improving the quality and performance of lubricants available on the market, as well as ensuring the proper distribution of lubricants that meet quality standards..

Keyword: *Zinc Oxide, Viscosity, Castrol, Storage, Quality.*

PENDAHULUAN

Lubricants are chemical substances generally in the form of liquids that are applied between two moving objects with the aim of reducing frictional forces. Meanwhile, lubrication is the act of placing lubricant between surfaces that slide against each other to reduce wear and friction. The need for lubricants in Indonesia currently continues to increase along with the development of motor vehicle technology and industrial machines. One of the main uses of lubricants is engine lubricants used in internal combustion engines. There are many varieties and types of engine lubricating oil or what is better known as engine oil. Depending on the type of use of the engine itself, it requires the right oil to increase or preserve the engine's life time. The optimum state of metal lubrication can be achieved if the metal surfaces in contact are completely coated with lubricating oil, in order to obtain perfect lubricating oil. The characteristics and type of oil used must be taken into account. The increasing number of types of lubricants nowadays means that consumers are faced with various lubricant choices, because in general lubricant manufacturers claim that their lubricants are the best. Consumers really need high quality lubricant products that are available when needed. The quality of this lubricating oil is determined by its physical properties, namely the viscosity index.

In every fluid, gas or liquid, each has a property known as viscosity. Viscosity or viscosity of a liquid is one of the properties of a liquid that determines the amount of resistance to frictional forces. In the world of lubricant logistics, especially storage activities, compliance with lubricant standards is highly prioritized, one of which is the viscosity of the product to be distributed. The viscosity of the product must pass the

quality control stage, that is, it must comply with the standard used as a reference. In Indonesia, lubricants are distributed using three types of packaging, namely drums, boxes and pails. Of course, all three types of packaging must have the same quality and quality. If not, when the quality of the lubricant to be distributed turns out to have decreased in quality, such as a decrease in product viscosity, the quality assurance officer will act to analyze the causes of quality non- conformity due to various factors, and of course this will waste a lot of time and cause the distribution of the lubricant to be hampered. and lubricants do not reach consumers on time. If a problem like this occurs, to increase viscosity, the ability of the lubricant is also greatly influenced by the additive components (for anti- wear type lubricating oil, the recommended amount is 1% - referring to SNI 06-7069.9- 2005). The added additives function to reduce friction and wear, increase viscosity, viscosity index, resistance to corrosion and oxidation, and contamination. Additives can improve the function of lubricants, including as antioxidants, detergents, resistance to high pressure (EP), and anti-wear (AW). Lubricant additives generally use sulfur, chlorine and phosphorus which can form a layer on the surface of the material to reduce friction. The use of chlorine and phosphorus has been restricted because they are not environmentally friendly (Pawar, RV, Hulwan, DB, & Mandale, MB 2022).Alternative materials that have been used include CuO, SiO2 and ZnO (Leitans, A., & Palcevskis, E. 2017).

(Leitans, A., & Palcevskis, E. 2017)reported that the use of ZnO in lubricating oil with a content of 0.5% was quite optimal, but it did not show a good ability to resist friction, because of the presence of polar groups that adhere to the surface during film formation. Then try to analyze the effect of adding ZnO or Zinc Oxide to the lubricant on the changes in viscosity that occur using the Anton Paar svm 3001 Viscometer. To see how this affects the quality of a lubricant product, a characteristic test is carried out in the laboratory using the ASTM test method, namely viscosity at a temperature of 40ºC and 100ºC (ASTM D445) and viscosity index (ASTM D2270). The result to be achieved is to be able to determine the quality of engine lubricants made from various types of base materials when viewed from the viscosity index. Apart from that, it is also to find out which lubricant additives are good and effective to use in the lubricant manufacturing process so that when the lubricant is distributed it meets On Spec standards, especially the viscosity value when quality control is carried out.

METODE PENELITIAN

The research Method used is a quantitative method used to measure and analyze data numerically. In addition to the quantitative method, this research method will start with material preparation, where a representative type of lubricant will be selected along with Zinc Oxide (ZnO) as an additional ingredient. After that, the main variable to be studied, namely the concentration of ZnO addition to the lubricant, will be determined. Viscosity measurements were carried out using an Anton Paar svm 3001 Viscometer at temperatures of 40ºC and 100ºC, using the ASTM test method (ASTM D445 and ASTM D2270) to observe changes in lubricant viscosity with the addition of ZnO. Experiments were carried out by adding ZnO to the lubricant in varying concentrations, then each variation was tested separately to obtain representative data. The obtained viscosity data will be analyzed statistically to evaluate significant differences between different samples and to determine the relationship between ZnO concentration and changes in lubricant viscosity. The results of the analysis will be interpreted to understand the effect of adding ZnO on lubricant viscosity, as well as its implications for lubricant quality and performance. The conclusion of this research will provide recommendations regarding the use of lubricant additives that are effective in improving product quality and meeting established quality standards.

Tools and materials

Tool

Equipment used: Anton Paar SVM 3001 Viscometer, Syringe, Beaker, Tissue, Hot Plate Magnetic Stirree, Magnetic Capsule, Spatula, Cup, and Analytical Balance.

Material

The materials used are: Lubricant, Toluene, and Zinc Oxide (ZnO) 0.01%, 0,02% and 0.05%.

Work procedures

The work procedure for measuring kinematic viscosity in fuel products using the Anton Paar SVM 3001 Viscometer begins with preparing the necessary tools and materials. After that, the Anton Paar SVM 3001 Viscometer is turned on and the cell cleanliness of the tool is checked by selecting the Cleaning Screen menu, which is marked with a Green Quality Factor Indicator. If there is a color other than green, the tool cell is cleaned again using toluene. After ensuring cell cleanliness, the viscosity measurement method is selected by selecting the Method menu and selecting the Viscosity Index method. The desired settings are set in the Quick Settings menu, including sample name, measurement

mode, and temperature. The test sample is poured into a Glass Beaker and inserted into the syringe without any air bubbles. The syringe is placed at the device injection site and approximately 1.5 ml of the test sample is injected into the device. Testing begins by pressing the Start button, and when prompted, add approximately 1 ml more test sample into the device. The measurement results are printed after completing the test. If you want to test a different test sample, the tool cell must be cleaned first with Toluene before testing again.

HASIL DAN PEMBAHASAN

Viscosity analysis in Castrol brand lubricants with SAE 10W-50 using the Anton Paar SVM 3001 Viscometer. Referring to ASTM D 7042. To obtain a solution of lubricant and ZnO 0.01%, 0,02%, and 0.05%, the same treatment is carried out, the stirring time is 8 minutes and the stirring speed is 1250 rpm.

Table 1. Effect of adding ZnO to Castrol 10W lubricant

No	Ingredients (mL)	Viscosity Index 1(3 days)	Viscosity Index 2 (5 days)	Viscosity Index 3 (7 days)
1	Castrol 10W-40	153.30	153.04	153.26
2	Castrol 10W-40 + ZnO 0.01%	155.49	155.20	155.28
3	Castrol 10W-40 + ZnO 0.02%	155.73	155.89	155.67
4	Castrol 10W-40 + ZnO 0.05%	156.46	156.76	156.84

Table 2. The effect of adding ZnO to Castrol 10W lubricant on the results of Kinematic Viscosity 100 C

No	Ingredients (mL)	Kin. Viscosity100° C 1 (3 days)	Kin. Viscosity100° C 2 (5 days)	Kin. Viscosity100° C 3 (7 days)
1	Castrol 10W-40	14,327 mm2/s	14,373 mm2/s	14,366 mm2/s
2	Castrol 10W-40 + ZnO 0.01%	14,383 mm2/s	14,386 mm2/s	14,398 mm2/s
3	Castrol 10W-40 + ZnO 0.02%	14,462 mm2/s	14,436 mm2/s	14,433 mm2/s
4	Castrol 10W-40 + ZnO 0.05%	15,541 mm2/s	15,329 mm2/s	15,334 mm2/s

In the analysis of the addition of ZnO or Zinc Oxide to the viscosity of oil and gas products, namely Castrol 10W – 40 lubricants, using the Anton Paar Viscometer in lubricant distribution activities in Indonesia. The results are in the form of Viscosity Index values and kinematic viscosity expressed in mm2/s.

The first test sample is pure lubricant or Castrol base. There was no special treatment for this sample. This is because Castrol base is the main object in this experiment, so the viscosity index and kinematic viscous values of pure lubricant samples are needed using the Viscosity Index method on the Anton Paar SVM 3001 Viscometer. Pure lubricant in the form of Castrol 10W-40 is claimed to be a multigrade oil. where in the table obtained on the Anton Paar website, the viscosity index for multigrade oils is in the range of 140-200 and based on the minimum viscosity index table for petrol motor lubricating oils and diesel lubricating oils, for SAE 10W-40 lubricants the minimum is 130, so for the first sample we test on spec. Because the results of the three experiments showed that the castrol base sample had a viscosity index above 130, the results can be seen in table 1.

Next, we tested the effect of adding ZnO or Zinc Oxide to Castrol 10W-40 lubricant, where ZnO was mixed in 3 trials, each at 0.01%; 0.02% and 0.05%, then analyze these variables based on several journals, namely that the ability of the lubricant is greatly influenced by the additive component, with the recommended amount being 1% - referring to SNI 06-7069.9- 2005. The added additives function to reduce friction and wear, increase viscosity, viscosity index, resistance to corrosion and oxidation, as well as contamination (Please, SKS 2018). (Opia, AC, Hamid, MKA 2021)reported that additives can improve lubricant functions, including as antioxidants, detergents, resistance to high pressure (EP), and anti-wear (AW). Lubricant additives generally use sulfur, chlorine and phosphorus which can form a layer on the surface of the material to reduce friction. The use of chlorine and phosphorus has been restricted because they are not environmentally friendly (Pawar, RV, Hulwan, DB, & Mandale, MB 2022).Alternative materials that have been used include CuO, SiO2, and ZnO (Leitans, A., & Palcevskis, E. 2017).So we agreed to choose ZnO as an additional ingredient for lubricant samples in the hope of increasing the viscosity value and viscosity index of lubricant samples. By using the Anton Paar VSM 3001 Viscometer with the Viscosity Index method, if you look at it the same as the first lubricant base sample based on the same specifications, of course the value that has been obtained is on spec. This is proven by the results obtained in table 1.

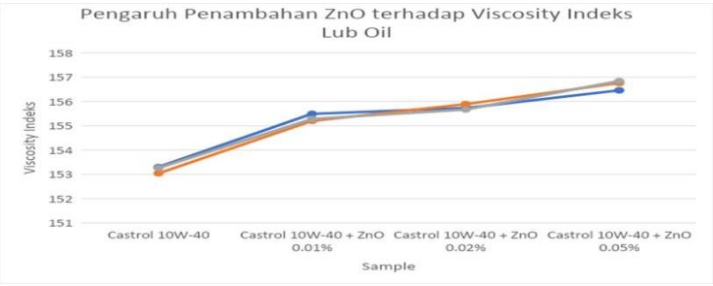

Figure 1. Effect of adding ZnO on the Viscosity Index of Lub Oil

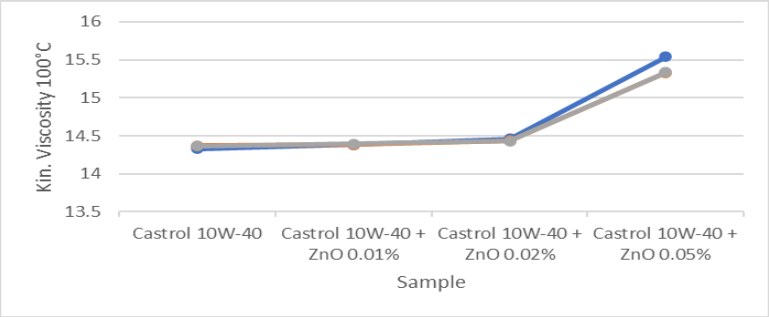

Figure 2. Effect of adding ZnO on Kinematic Viscosity 100°C Lub Oil

From the results of comparing the Viscosity Index and 100°C Kinematic Viscosity data on the base sample and the base + ZnO sample, a graph based on Figure 1 and Figure 2 shows that the relationship is directly proportional, even though the composition is very small, the addition of ZnO is able to increase the viscosity index and viscosity values. kinematics of 100°C on lubricant samples. The addition of ZnO in the form of solid particles to lubricants can increase viscosity because these particles can form physical bridges that inhibit the relative movement between liquid layers in the lubricant, thereby increasing overall viscosity.

It is no secret that lubricants are vital components in various industries that are used to lubricate machines and equipment so that optimal performance can be ensured. One of the key factors in maintaining the quality of lubricants is proper storage and of course this is related to the logistics activities of the lubricant product itself. Especially when stored in different packages such as boxes, drums and pails, maintaining lubricant viscosity becomes a major challenge that must be overcome. Lubricants have a designed viscosity to ensure proper flow and effective protection of machine surfaces. In this test, the variable storage time had no influence on changes in viscosity in the Castrol 10W-40 product. This viscosity is maintained within a certain range to meet specific application requirements. Changes in viscosity can result in reduced performance and even damage to equipment. In addition, it is important to ensure that packaging such as boxes, drums and lubricant pellets are always tightly closed after use. Contamination by dust, dirt, or other particles can change the viscosity of the lubricant. In addition, outside air entering the package can cause oxidation and other chemical changes that affect the quality of the lubricant.

Storing lubricants in a vertical position, especially for drums and pails, is important to prevent separation of components in the lubricant which can affect its viscosity. This

separation can occur when the lubricant is stored in a horizontal position, resulting in inconsistent viscosity when used. In managing lubricant quality, proper storage is key to maintaining its viscosity. By paying attention to the storage environment, tightly closed packaging, proper storage position, temperature monitoring, use within shelf life limits, and regular checking of the condition of the lubricant, we can ensure that the lubricant maintains the desired viscosity for optimal performance in machines and equipment.

Apart from that, the product viscosity must pass the quality control stage, that is, it must comply with standards that are used as a reference both in terms of viscosity index and kinematic viscosity. Of course, various types of packaging must have the same quality and quality even though the packaging is different. If not, when the lubricant that is to be distributed turns out to have a decrease in quality, such as a decrease in product viscosity which can be caused by temperature, contamination, staff error or something else, the quality assurance officer will act to carry out an analysis of the causes of quality non-conformity due to various factors. various kinds, and of course this wastes a lot of time and causes the distribution of lubricants in Indonesia to be hampered and the lubricants not reaching consumers on time.

For the analysis of the validity and reliability of the data provided regarding the effect of adding ZnO to Castrol 10W-40 lubricant is crucial to ensure the reliability and relevance of the findings obtained. The validity of the measurement instrument is the main consideration, because it determines the extent to which the measurements taken reflect the construct you want to measure. In this case, the viscosity index and kinematic viscosity are used as indicators of the effect of the addition of ZnO on the properties of the lubricant. The question arises whether this viscosity is an adequate representation of the desired change, or whether there are other parameters that are more suitable for measuring the effect of ZnO. This evaluation requires a deep understanding of the properties of the lubricant and how ZnO can affect them. If previous research has shown that viscosity is a good indicator of changes in lubricant properties, then the validity of the measurement instrument can be considered quite high.

Next, measurement reliability becomes the focus of analysis to ensure the consistency and reliability of the results obtained. Reliability refers to the ability of an instrument to produce consistent results if measurements are carried out repeatedly. In this context, we want to ensure that the viscosity index and kinematic viscosity measurements at various time points show a high degree of consistency. One way to evaluate reliability is to use the correlation coefficient between measurements at different

times. For example, the correlation coefficient between the index viscosity on day 3 and the index viscosity on day 5 can provide an idea of how consistent the measurements are over time. The same applies to kinematic viscosity at 100°C. By conducting a careful reliability analysis, we can ensure that the results obtained are reliable and provide an accurate picture of the effect of ZnO addition to Castrol 10W-40 lubricant over the observed time period.

The validation test results in all experiments (1, 2, and 3) have very high values, namely 0.997, 0.998, and 0.997 respectively. Based on these values, it is concluded that the validation of the data is considered "valid". The validation test results are high and almost the same in all experiments indicating good consistency in the performance of the model or method used. This consistency is an indication that the model produces similar results on different data, ruling out the possibility of random or unstable results. By obtaining high and almost perfect scores (0.997 and 0.998) on the validation scale, the model or method reaches or even exceeds the expected validation standards. This shows that the model is reliable in producing accurate predictions or estimates.

The conclusion that the validation of the data is considered "valid" indicates that the data used in the validation test has met the required criteria. This provides confidence that the model or method can be applied to similar or similar data with the expected results.

SIMPULAN

Viscosity is a measure of a fluid's internal resistance to flow. In other words, viscosity measures how thick or thick a liquid is and how difficult it is for the liquid to flow. The viscosity index is an empirical number that shows the nature of changes in the viscosity of lubricating oil with changes in temperature. Lubricating oils with a lower viscosity index are lubricating oils with a wider range of viscosity changes for the same temperature difference. Lubricating oil with a high viscosity index will lubricate better over a wider range of temperature differences. Therefore, the viscosity index of lubricating oil is limited to a minimum value, both for monograde and multigrade. In managing lubricant quality, proper storage is key to maintaining its viscosity. By paying attention to the storage environment, tightly closed packaging, proper storage position, temperature monitoring, use within shelf life limits, and routine checking of the condition of the lubricant, we can ensure that the lubricant maintains the desired viscosity for optimal performance in machines and equipment.

Viscosity The product must pass the quality control stage, that is, it must comply with

the standards used as a reference both in terms of viscosity index and kinematic viscosity. Lubricants must have good quality and quality even though the packaging is different. If not, when the lubricant that is to be distributed turns out to have a decrease in quality, such as a decrease in product viscosity which can be caused by temperature, contamination, staff error or something else, the quality assurance officer will act to carry out an analysis of the causes of quality non-conformity due to various factors, and of course this wastes a lot of time and causes the distribution of lubricants in Indonesia to be hampered and the lubricants not reaching consumers on time. When a validation test was carried out on the data, the results for all experiments 1,2,3 were 0.997, 0.998, and 0.997. It can be concluded that validation of the data is considered "valid".

DAFTAR PUSTAKA

Arni, Baharsyam dan Juni. 2020. "Hasil Penelitian dan Pembahasan Hadis." Journal of Chemical Information and Modeling 53(9): 33.

Harahap, S. K. S. (2018). PENGARUH PENGGUNAAN CYCLIC NATURAL RUBBER (CNR) SEBAGAI BAHAN ADITIF PADA SISTEM DISPERSI

MINYAK PELUMAS (Doctoral dissertation, UNIMED).

Leitans, A., & Palcevskis, E. (2017). Tribological Properties of Zirconium Oxide, Spinel and Mullite Nanopowders as Lubricating Oil Additives. Key Engineering Materials, 721, 451-455.

Opia, A. C., Hamid, M. K. A., Syahrullail, S., Johnson, C. A., Rahim, A. B., & Abdulrahman, M. B. (2021). Nano- particles additives as a promising trend in tribology: a review on their fundamentals and mechanisms on friction and wear reduction.

Pawar, R. V., Hulwan, D. B., & Mandale, M. B. (2022). Recent advancements in synthesis, rheological characterization, and tribological performance of vegetable oil-based lubricants enhanced with nanoparticles for sustainable lubrication. Journal of Cleaner Production, 378, 134454.

Rizalina, H., Cahyono, E., Mursiti, S., Nurcahyo, B. and Supartono, S., 2018. Optimasi Penentuan Kadar Metanol dalam Darah Menggunakan Gas Chromatography. Indonesian Journal of Chemical Science, 7(3), pp.254- 261.

Slb-c, D A N, dan Y P A Bintoro Jember. 2020. "Digital Digital Repository Repository Universitas Universitas Jember."

Viscometers, Capillary Kinematic. 2017. "Standard Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and Calculation of Dynamic Viscosity) 1." : 1–16.

Yasin, M.H.M., Mamat, R., Yusop, A.F.,
Rahim, R., Aziz, A., Shah, L.A. 2013. Fuel Physical Characteristics Of Biodiesel Blend Fuels With Alcohol As Additives, Procedia Engineering 53: 701-706