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 <https://doi.org/10.30736/cvl.v2i2>



An Easy Way To Determine The Flexural Quality Of Asphalt Is Using ASTM D113 – 07 and SNI 2432:2011

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ARTICLE INFO

Article History :

Article entry : 2022-01-14
Article revised : 2022-02-19
Article received : 2022-03-11

Keywords :

Ductility, Asphalt, ASTM D113 – 07, SNI 2432:2011, 2018 Highways Specification Revision 3

IEEE Style in citing this article :

S. Pratama, A.D. cahyono, C.D. Saputra, L.B. Lestari, P.B. Laso, F. A. Putri and P.R. Febyningtyas, "An Easy Way To Determine The Flexural Quality Of Asphalt Is Using ASTM D113-07 and SNI 2432:2011, " , CIVILA, vol. 7, no. 1, pp. 1–12, 2022.

ABSTRACT

Asphalt is a material that has non-volatile properties and softens gradually when heated and functions as a binder for aggregates and as a surface covering material to make it impermeable to water. However, asphalt also has a weakness. Namely, it is easy to crack and be damaged when vehicles pass through the main road. To overcome cracked and worn roads, it is necessary to test the ductility of asphalt so that the road becomes flexible/plastic. This ductility test is very important because it greatly affects the pavement layer; Therefore, a ductility test is needed to determine the level of plasticity of an asphalt. The asphalt ductility test method refers to the specifications of ASTM D113 – 07 and SNI 2432:2011 with 3 samples of test objects and a test instrument called a ductilometer of type TAS – 250. Based on the ductility test, the asphalt ductility reaches an average elongation of 117.33 cm; This value indicates that the plasticity level of the asphalt has met the specifications and can be used in sustainable pavement construction layers because it has good plasticity.



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1. Introduction

In the pavement structure of the road, there are important construction materials, namely asphalt, and asphalt, which is a "binding agent" which is produced from petroleum [1],[2]. Asphalt is a black or dark brown material with non-volatile properties and softens gradually when heated. It functions as a binder for aggregates and covers the surface layer to make it impermeable to water. Most asphalt is formed from a hydrocarbon element called bitumen. Asphalt is often called bituminous material[3],[2]. Asphalt is water-resistant and viscoelastic. Quantitatively, usually, 80% of the mass of asphalt is carbon, 10% hydrogen, 6% sulfur, and the rest is oxygen and nitrogen, as well as trace amounts of iron, nickel, and vandaliun[4]. The physical properties of asphalt are durability, adhesion, and cohesion, sensitivity to temperature, frictional properties, oxidation resistance, hardening, and aging plasticity, which greatly affect the planning, production, and performance of asphalt mixtures to become more stable and rigid at high temperatures and flexible at low temperatures [4][5][6]. Pavement using asphalt is very ductile because it has inherent viscoelastic properties at normal temperatures and asphalt pavement maintenance costs are low [7][8]. The road pavement mixture consists of coarse aggregate and asphalt [9].

The high frequency of vehicles passing through a road causes the road to become easily cracked and damaged; this is a drawback of asphalt roads[10]. The impact of the large frequency of this vehicle resulted in the possibility of the load received by the road exceeding the design load (overloading) [11][12]. In addition, climate change and humid weather can cause potholes and cracks [13][14]. To overcome cracked and worn roads, it is necessary to test asphalt ductility so that the road becomes flexible/plastic.

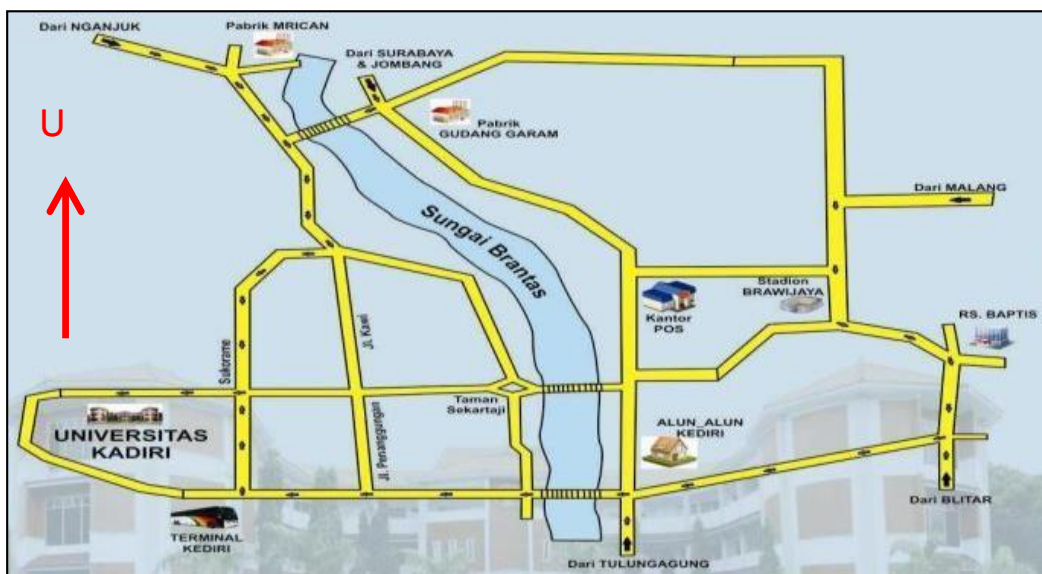
Asphalt ductility test, as currently carried out by ASTM D113 – 07 and SNI 2432:2011 specifications using the TAS – 250 ductilometer test equipment produced from Tatonas, is a measure of the ultimate elongation of the asphalt binder sample at a constant rate and a certain temperature before breaking. Asphalt ductility test is used in several specifications in Indonesia as an indicator of asphalt modification performance, especially at lower service temperatures [15]. The significance of the ductility test results as a measure of asphalt performance has been debated due to the empirical nature of the test results and the unclear relationship between the measurement results and the properties of the base material [16]. Historically in the absence of advanced characterization methods, several researchers have used ductility assays as a qualitative measure to determine the degree of aging of asphalt binders after laboratory aging or extraction from the field[17]. The study conducted by Kandhal et al. proved that the pavement layer with ductility results above 10 cm at 15.6°C had a relatively good performance in terms of thermal cracking[18].

This road pavement research was carried out at the Civil Engineering Laboratory, Kadiri University using the test method, namely ASTM D 113-07 and SNI 2432:2011 with a Ductilometer type TAS – 250 produced from Tatonas. The purpose of ductility testing is to identify and explain the fundamental limitations of stress and strain development in the model during elongation through modeling and compare the ductility results with other more basic parameters for characterizing the damage resistance of binders by the provisions of DGH 2018 revision 3.

2. Research Method

This research was conducted at the Kadiri University laboratory, located on the Kadiri University campus, Mojoroto District, Kediri City, East Java. This study uses quantitative methods and descriptive-analytical methods. The research was conducted on samples of 60/70 penetration type asphalt, which is often used for road pavement materials in general. The test object was produced by PT. TRIPLE Kediri and the test equipment used was a TAS-250 type

ductilometer machine produced from Tatonas with a test method according to ASTM D 113-07 and SNI 2432:2011. Asphalt ductility test is a test to determine the plasticity of asphalt, which is expressed by the length of asphalt lubrication that can be achieved by asphalt before breaking. In obtaining processed data to determine the level of plasticity of asphalt, it is necessary to have a research flow. The flow of this research requires several stages, starting from understanding the material. After that, prepare materials and tools for testing to obtain data in the Civil Engineering laboratory of Kadiri University. Then follow the working steps in the ductility test manual. The first step is heating the asphalt and paraffin in different containers applying the melted paraffin to the brass mold. Pour the asphalt into a brass mold smeared with paraffin until full. Cool and immerse the specimen at 25°C for 30 minutes. Then the test object is mounted on the testing machine by pulling until it breaks. After that, read the distance until the test object breaks. The test results determined the feasibility of the asphalt plasticity level by the 2018 Bina Marga Specifications revision 3, where the ductility value limit must be more than 100 cm. The time of research was carried out on September 28, 2021.



Source : Personal documents,2022

Figure 1. Research Laboratory Location Plan

3. Description and Technical

1. Population and Samples.

Asphalt has a function as a binder which is often used for road pavement materials; the use of asphalt is intended to make the road stronger when receiving a load so that there is no deformation/change in pavement shape because basically asphalt has elastic properties. properties [19]. Asphalt is the main ingredient in flexible pavement construction, highways, which functions as a mixture of aggregate binding materials because it has strong adhesion, adhesive properties, water resistance, and is easy to work with. In this study, 3 test samples were used as required by ASTM D113 – 07 and SNI 2432:2011. From the three samples placed on the ductility test equipment, then pulled to the maximum length / disconnected, then the results were obtained from each sample. After getting the results from each sample then look for the average. This average value is the final result of this research.



Source: Personal Documentation, 2022

Figure 2. Asphalt

2. Sampling Techniques.

Asphalt is the main test object in this research; the asphalt used in this ductility test has a penetration rate of 60/70 and is produced by PT. TRIPLE Kediri. The sampling technique takes a test sample from the drum container at PT. TRIPLE Kediri to taste (in this case, 1 small can is taken full). After completion, the ductility test is ready to be carried out in the Civil Engineering Laboratory of Kadiri University.



Source: Personal Documentation, 2022

Figure 3. Liquid Asphalt Test Sample

3. Definition of Variable Operations.

Can find out the plasticity of asphalt, which is expressed by the length of asphalt lubrication that the asphalt can achieve before breaking by using a testing machine called a ductilometer which has category provisions according to the length of lubrication that can be achieved by the asphalt sample being tested.

4. Instrument Analysis Tool.

a. Testing Machine

The ductility testing machine used in this study was TAS – 250 types produced from tatonas with specifications of length 250 cm, width 50 cm, and height 40 cm. This ductility test machine is composed of a power and temperature control knob, a test tube made of boards, and the inside is covered with an iron plate made of a material that does not absorb asphalt.



Source: Kadiri University Civil Engineering Laboratory, 2022

Figure 4. Ductility Testing Machine

b. Base Plate

The base plate shall be made of a non-absorbent material of sufficient thickness to prevent deformation and sufficient size to accommodate one to three molds.



Source: Kadiri University Civil Engineering Laboratory, 2022

Figure 5. Base Plate

c. Soaking Tub

The soaking tub must be adjustable at 25°C or a temperature. The volume of water must not be less than 10 liters and can immerse the test object at a depth of not less than 10 cm, and has a support that can support the test object with a height of not less than 5 cm above the bottom of the soaking tub.



Source: Kadiri University Civil Engineering Laboratory, 2022

Figure 6. Soaking Tub

d. Brass Mold

The mold must be made of brass. The size of the mold must be by the predetermined size, which is 120 mm long, 32.5 mm wide, 10 mm thick.



Source: Kadiri University Civil Engineering Laboratory, 2022

Figure 7. Brass Molding Tool

5. Data Analysis Techniques.

5.1. Research data

The research data used by the author refers to the ASTM D113 – 07 and SNI 2432:2011 method, namely experimental analysis, where the data obtained based on the results of the study include:

a. Asphalt heating process

Asphalt is heated to a temperature of 148.9 – 176 degrees Celsius in accordance with the provisions of ASTM D 113-07 and SNI 2432:2011[19],[20]. The function of heating the asphalt is so that the asphalt melts perfectly and facilitates the printing process of the test object samples which will later be tested for plasticity using a ductility tester.



Source: Kadiri University Civil Engineering Laboratory, 2022

Figure 8. Asphalt Heating

b. Ductility test sample printing process

The first method of making ductility test specimens is to coat the mold using paraffin and glycerin then pour the heated asphalt sample into the mold and wait for it to cool after the cold specimen removes the test object from the mold and the test object is ready for ductility testing using testing machine.



Source: Kadiri University Civil Engineering Laboratory, 2022

Figure 9. Asphalt Molding Process In Brass Mold

c. Ductility Testing Process

The ductility testing process is in accordance with the ASTM D 113-07 and SNI 2432:2011 methods using a tool called Ductilometer type TAS – 250 produced from Tatonas. Testing the sample with a ductilometer machine is used to determine the plastic distance of the test object. The provisions for the level of plasticity that will be concluded from the results of the ductility test are as follows:

- Distance 0 – 100 cm = Brittle

- Distance 100 – 200 cm = Plastic
- Distance of more than 200 cm = Too Plastic



Source: Kadiri University Civil Engineering Laboratory, 2022

Figure 10. The Process Of Ductility Testing

5.2. Data analysis technique

The data analysis technique used is in accordance with the ASTM D113 – 07 and SNI 2432:2011 method, namely by finding the longest point of asphalt stretching distance in the three samples, then recording and finding the average value.

4. Results and Discussions

From the data analysis method above, the results of the ductility test with the steps in accordance with ASTM D 113-07 and SNI 2432:2011 are as follows.



Object 1

Object 2

Object 3

Source: Kadiri University Civil Engineering Laboratory, 2022

Figure 11. The Results Of The Ductility Test Of The Test Object 1,2,3

Figure 11 above shows the results of the asphalt plasticity test using a TAS-250 type ductilometer. It can be seen in the first sample that the elongation of the test object reached 123 cm, the second specimen reached 122.5 cm, and the third specimen reached 106.5 cm. From

the picture above, the detailed results are presented in the table of the results of the ductility test analysis in Table 1 below.

Table 1. Results Of The Ductility Test Analysis

Ductility Test	Distance (Cm)	Average	Description
First	123		
Second	122,5	117,33	Plastic
Third	106,5		

Source: Ductility Test Calculation Analysis, 2022

The results of the ductility test value were obtained from the measurement of the furthest distance of asphalt drawn between the two molds with a pulling speed of 50 mm/minute at a temperature of 25-30°C on the TAS – 250 Ductilometer type produced from tatonas. With the method according to ASTM D 113-07 and SNI 2432:2011 where a minimum of 3 samples are required. It is known that the results for the first test object, the asphalt elongation level reaches 123 cm, the second test object reaches 122.5 cm and the third test object reaches 106.5 cm. Based on the results of Table 1, it is known that the average value of the ductility test is 117.33 cm, which from these results when associated with ASTM D 113-07 and SNI 2432:2011 indicates that the asphalt used in this study is in the plastic category.

5. Conclusion and Suggestion

5.1 Conclusion

Based on the results of ductility tests that have been carried out using the ASTM D 113-07 and SNI 2432:2011 methods, the following results are obtained:

1. Initial heat of test asphalt 152 °C.
2. The asphalt plasticity value in the first test object reached 123 cm, the second 122.5 cm, the third 106.5 cm.
3. the average plasticity value of the three test samples reached 117.33 cm.

From these results indicate that the plasticity level of asphalt has met the specifications and can be used in the construction of sustainable road pavements because it has good plasticity.

5.1 Suggestion

From the results obtained, it is necessary to conduct more detailed research related to the physical properties of asphalt in the form of durability, adhesion, cohesion and sensitivity to temperature so that the results are maximized.

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