Selecting the Best Materials Compositions of Resin Based Bioasphalt

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Abstract. Damar asphalt is one type of bioaspal which is a mixture with the main ingredient is a resin as a binder and cooking oil as a solvent. One major drawback of this damar asphalt is the low ductility. To improve the ductility values, then use the added material Filler. Filler serves as a divider between the impurities with damar asphalt, increases ductility and increase the ability of cohesion or bonding between the particles of material damar asphalt. The purpose of this study was to determine damar asphalt modifications to the properties in accordance with the properties of damar asphalt test specifications based on the value of penetration. This method uses some variant on material such as powder bricks and fly ash as a binder. Solvent in constituent used oil and used cooking oil. It also added the polymer latex up to 10% at intervals of 2%. The best composition of damar asphalt materials were obtained with gum rosin, Fly Ash, Oil and Latex. Damar asphalt modification damar asphalt optimum mix of resin (100g pure resin or resin chunk + 350g powder), Fly Ash powder (150g), cooking oil (205g), and latex 4%, ductility increased from 63.5 cm to 119.5 cm, the value of the flash point was originally at temperature of 240 °C to 260 °C, damar asphalt penetration of 68.2 dmm to 43 dmm, and the value of density decreases from 1.01 g / cm³ to 0.99 g / cm³. Damar asphalt at these modifications meet the specifications in terms of solubility in trichlore ethylene is equal to 99.5%, and also meet the affinity of damar asphalt at 99%. With the optimum value, damar asphalt could be categorized as bitumen 40/60 penetration.

1. Introduction

Increased environmental regulations and the rising costs of asphalt binder have encouraged researchers to investigate alternative binders that can be used for hot mix asphalt (HMA) [1]. The use of wasted materials has been done by incorporating wet process of Recycled Asphalt Single (RAS) and bioasphalt gave comparable results to conventional asphalt [2]. Damar asphalt have similar characters with bitumen pen 60/70 but do not meet the requirements of ductility and exceed the requirements for melting point [4]. Damar asphalt has a higher value of workability index based on the standards provided by Cabrera and Dixon is 6 [3]. Damar asphalt meet the requirements in terms of stability, density (density), flow and value marshal quotient. Resin is a natural resin produced by plants Dipterocarpaceae (genus Shorea, Hopea, Balanocarpus and Vateria) and Burseraceae (clan canarium) [15]. Asphalt composition comprised of asphaltenes which is material in black or dark brown and maltenes which is a viscous

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liquid consisting of resins and oils. Damar is a major component in damar asphalt as a natural resin, has hardness depending on the temperature of the so-called thermoplastic properties [16]. To follow up on it, then further research on asphalt resin by changing the composition of the mixture with some variants of such material, resin, fly ash, brick powder, used motor oil, cooking oil and latex. The use of varied materials aims to get maximum results.

2. Experimental
The function is as a resin binder of damar asphalt itself. Many say the least influential resin mixture. The resin used is a resin that has been in the packaging in the form of powder [3]. Fly ash that serves as a filler and as absorbent damar asphalt work by removing impurities contained in damar asphalt mixture during cooking so that the results obtained pure mixture [5,6]. Fly is not completely lost during the cooking process, but still contained within the composition damar asphalt evident when the testing solution trichlore ethylene results of the tests showed that damar asphalt 95%, 5% insoluble fly ash is a non hydrocarbon which is insoluble in a solution of ethylene trichlore.

Cooking oil as diluent mixture damar asphalt which also play a role in reducing the elasticity damar asphalt plastic traits possessed by the resin. Latex is very influential in the rate of elastic damar asphalt evident from the results of testing ductility by adding 4% latex ductility damar asphalt meet the requirements of penetration bitumen. From the research damar asphalt the resin composition, fly ash, oil and latex fulfill some requirements as bitumen or asphalt pen 40 pen 60. Two tests that do not meet the requirements of the test is the specific weight and soluble in a solution of ethylene trichlore.

The method used is an experimental method to the test object damar asphalt with a mixture of damar resin, fly ash, and wasted cooking oil, which is used as a binder layer of asphalt concrete compared to asphalt penetration [7]. Testing standards used are:
  1. SNI 06-2456-1991 (Penetration Test) [8].
  2. SNI 06-2434-1991 (Softening Point Test) [9].
  3. SNI 06-2433-1991 (Flash Point Test) [10].
  4. SNI 06-2441-1991 (Specific Gravity Test) [11].
  5. SNI 06-2432-1991 (Ductility Test) [12].
  6. PA-0312-76 (KVBB-V-19) (Affinity Test) [13].
  7. SNI 06-2438-1991 (Solubility Test) [14].

| Table 1. Material composition |
|------------------------------|
| Sample | Composition |
|       | Damar | Filler | Solvent   |
|       | 450 g | 150 g  | 205 g - 230 g |
| S1    | Damar | Red Brick | Wasted Cooked Oil |
| S2    | Damar | Fly Ash  | Wasted Cooked Oil |
| S3    | Damar | Fly Ash  | Recycled Oil   |

3. Results and Discussion
3.1.1 Selecting the materials composition to characterize the basic damar asphalt mixtures
Previous research has been done with various material compositions and the method of mixing [3,4]. The various compositions were then subjected into bitumen tests characterization included penetration test, softening point test, ductility test, flash point test, specific gravity test, solubility and affinity test. The results are summarized in Table 2. Damar asphalt on modification of code S2 selected as the best composition with which the resin powder composition (350 g), gum rosin chunks (100g), fly ash (150 g), and waste cooking oil (205 g).
Table 2. The properties of damar asphalt with various ingredients

| No. | Asphalt properties | Unit | Asphalt Specification | Damar asphalt composition and properties |
|-----|--------------------|------|------------------------|-----------------------------------------|
|     |                    |      | Pen 40 | Pen 60 | Pen 80 | S1 | S2 | S3 |
| 1   | Penetration        | dmm  | 40 - 59 | 60 - 79 | 80 - 99 | 65 | 68 | 68.4 |
| 2   | Softening Point    | °C   | 51 - 63 | 40 - 58 | 46 - 54 | 57 | 56 | 56.25 |
| 3   | Ductility          | Cm   | 100     | 100     | 100     | 40.5 | 63.5 | 19.5 |
| 4   | Flash Point        | °C   | 200     | 200     | 225     | 245 | 240 | 240 |
| 5   | Specific Gravity   | g/mm | 1       | 1       | 1       | 1.003 | 1 | 0.97 |
| 6   | Solubility         | %    | 99      | 99      | 99      | 99.84 | 95 | 78.75 |
| 7   | Affinity           | %    | 99      | 99      | 99      | 99 | 99 | 99 |

3.1.2 Determination of the latex content to improve damar asphalt properties

The polymer of latex is added into the ingredient to achieve the requirement of the ductility test. Table 3 and Figure 1 present the role of latex into the damar asphalt penetration. The effect of latex addition into the ingredient decrease the penetration of damar asphalt.

Table 3. The properties of damar asphalt with various latex content

| No. | Asphalt properties | Unit | Asphalt Specification | Latex content (%) |
|-----|--------------------|------|------------------------|-------------------|
|     |                    |      | Pen 40 | Pen 60 | Pen 80 | 0 | 2 | 3 | 4 | 5 |
| 1   | Penetration        | dmm  | 40 - 59 | 60 - 79 | 80 - 99 | 68 | 68.4 | 59.3 | 43 | 26 |
| 2   | Softening Point    | °C   | 51 - 63 | 40 - 58 | 46 - 54 | 56 | 56.25 | 57.5 | 57.5 | 58.5 |
| 3   | Ductility          | Cm   | 100     | 100     | 100     | 63 | 19.5 | 27 | 119.5 | 114.5 |
| 4   | Flash Point        | °C   | 200     | 200     | 225     | 250 | 240 | 250 | 260 | 270 |
| 5   | Specific Gravity   | g/mm | 1       | 1       | 1       | 0.99 | 0.97 | 0.98 | 0.97 | 0.99 |
| 6   | Solubility         | %    | 99      | 99      | 99      | 95 | 78.75 | 76.25 | 95 | 99.84 |
| 7   | Affinity           | %    | 99      | 99      | 99      | 99 | 99 | 99 | 99 | 99 |

Figure 1. The effect of latex content into the penetration

Figure 2 shows the effect of latex addition into the softening point of damar asphalt. The addition of latex increase the softening point of the ingredient.
Figure 2. The effect of latex addition into the softening point of damar asphalt

The main objective of latex addition is to increase the ductility test, which is the main problem pure of damar asphalt; it could be seen in Figure 3 that by adding a latex content of 4% the ductility of damar asphalt could be more than the requirements of 100cm.

Figure 3. The effect of latex addition into the ductility of damar asphalt

4. Conclusion

Based on the results of testing that was done on damar asphalt, the composition that meets the requirements of penetration bitumen pen 60/70 is a damar asphalt composition with gum rosin (rosin resin powder 350g + mashed 100g), fly ash 0%, cooking oil 205g, but for ductility requirements the composition is not eligible. The most optimal composition obtained in this test is the composition of gum rosin (rosin resin powder 350g + mashed 100g), fly ash 0%, cooking oil 205g with latex content of 4% with a penetration value of 43, the value of the softening point of 57.5°C, value a flash point of 260°C, the value of the burning point 275°C, ductility 119.5 cm and a viscosity of 99%. The composition does not meet the requirements for specific gravity of 0.97 and a solubility of only 95%, but due to the penetration of just 43, the most optimal composition is more similar to asphalt pen 40.
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