ASSESSING THE CHEMICAL PROPERTIES OF DAMMAR ASPHALT USING FOURIER TRANSFORM INFRARED SPECTROSCOPY

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ABSTRACT

Dammar Asphalt (Daspal) is expected to be used as a bio-asphalt renewable binder for road construction. It is made with a modification of the "Jabung", which is the dammar gum based material mixed with grounded red brick debris and low quality cooking oil at a certain ratio. Dammar gum is obtained from the Dipterocarpaceae family of trees in India and East Asia, most are produced by tapping trees. The gum varies in color from clear to pale yellow. Dammar gum is a triterpenoid resin, containing a large number of triterpenes and their oxidation products. Many of them are low molecular weight compounds. The objective of this research is to analyze the chemical properties of Daspal uses a Resonance Fourier Transform Infrared Spectroscopy (FTIR) method to compare with conventional asphalt. The investigation using spectral data showed that all types of Daspal have similar functional groups of Saturate, Aromatic, Resins, and Asphalten as the 60/70 penetration conventional bitumen, so that based on its chemical properties Daspal can be considered as bioaspal.

Keywords: Dammar Asphalt, Dipterocarpaceae, FTIR.

PENDAHULUAN

The Bioaspal resin material is made with additional ingredients such as oil, bentonite and soda ash (Moelyo, 2012). Bioaspal can also be obtained from the pyrolysis of various materials such as coconut shell (Prayogo, 2010), various garbage from house waste such as grass, as well as wood oak tree (Jennings *et al*., 2011), bagasse (Kusumawati, 2012), albasia wood sawdust (Nindita, 2012) and palm shells (Sa'diah, 2014). The Bioaspal advantage of this is that the type of asphalt is an environmentally friendly material because it can be renewed and have lower toxicity than conventional asphalt. However, the disadvantage of this type of pavement material is yet to apply on a large scale in heavy traffic so that the level of trust, its use is still low compared to conventional asphalt, the type of asphalt is also still difficult to obtain, and volume production is not as big as conventional asphalt.

The hypothesis are revealed that bioasphalt properties close to the conventional asphalt, so that the expected modification of the original bioasphalt resin materials can have the same characteristics or at least closer to the characteristics of conventional asphalt in general. It is expected that Jabung modification efforts can contribute to the scientific world, especially in highway engineering to produce new insights of the binder in the form of bioaspal-based resin.

METHODS

A bearing Jabung appropriate to the needs of silver carve needed materials such as resin, red brick powder, cooking oil and low quality using consecutive volume ratio of 2 : 1 : 0.25. Jabung are made using such comparison will produce a harder material, plastic, and brittle so that the composition ratio is not suitable for use as a binder for flexible pavement. Therefore, it is necessary to modify the comparison materials were to be adapted as a binder for flexible pavement.

The resin used is a gum resin cello lowest quality obtained in Kotagede market in the form of powder. The use of this type of gum rosin because the price is much cheaper compared to other types of gum rosin. Brick powder obtained from Singosaren, Bantul, Yogyakarta in the form of red brick that has been refined (brick powder) derived from the demolition / renovation of the house. This brick powder can not be directly used for the manufacture of daspal, the material must be dried prior to dry and then crushed again using a mortar / pestle and mortar. Before use brick powder is filtered using a filter ½ ", # 4, # 8, # 30, # 50, no. 100, no. 200, and pan. Brick powder sieve no. 200 and restrained pan used for the manufacture of daspal with the largest brick powder grains 0.075 mm. For materials that do not pass the filter no. 200 smoothed back using mortar / pestle and mortar. Reason retaining brick powder in the composition due to the hypothesis that the brick powder has absorption properties that are able to absorb resin from resin and oil, so the oil resin and gum resin is not easily lost. The other reasons brick powder is expected to contribute to the composition can maintain daspal with mixed form and can act as a silencer heat so that the mixture is not easy to burn.

Used cooking oil is cooking oil and unbranded low quality purchased in the market Gedhe, Surakarta. The use of this oil is also intended that the viscosity of cooking oil is more uniform, compared with the used cooking oil pan has a viscosity that varies

depending on the temperature frying, deep-fried type of material, the number of repeated use, and others.

The method used was pure experimental testing with a first step towards daspal form of penetration (SNI 06-2456-1991) in various composition ratio daspal. Daspal penetration test results are entered specifications 60/70 pen asphalt is used to test the flash point and fuel (SNI 06-2433-1991), ductility (SNI 06-2432-1991), density (SNI 06-2488-1991), and Softening Point (SNI 06-2434-1991). Daspal types are eligible as conventional asphalt then test FTIR. This test was conducted to determine the functional groups of daspal made compared with asbuton and asphalt pertamina 60/70. Before placing the test object spectroscopic tool beforehand mixed with KBr in the ratio between the test specimen and KBr 1/200 daspal and clear pellets formed by means pressed with strength of 60 KN on the mold which has a hydraulic system. The output of this test is shown in graphical form absorption of infrared waves in the direction x and the percentage of wave transmission in the y direction. From the graph further interpretation is done by matching the wavelength of the wavelength of the test results FTIR with a wavelength of various compounds that exist in the literature, so that the functional groups are known compounds contained in daspal, asbuton, and asphalt pertamina.

DISCUSSION

Testing is done with the intention of comparing between the functional groups with 60/70 penetration asphalt and asbuton to determine whether there is equality between the three functional groups of the materials. Figure 1 presented the test results of FTIR spectra for daspal A1, B3, C6, and D4, 60/70 penetration bitumen and asbuton. Daspal A1 (300 g resin, 300 g red brick powder and 145 g waste cooking oil), B3 (400 g resin, 300 g red brick powder and 155 g waste cooking oil), C6(450 g resin, 150 g red brick powder and 170 g waste cooking oil), and D4 (600 g resin, 0 g red brick powder and 225 g waste cooking oil) are depend on the composition of dammar resin, red brick powder and waste cooking oil.

Asphalt Research Institute and Eurobitume (2011) states that the asphalt and asbuton comprised of asphaltenes compound, saturates, Cyclics and resin. In the asphaltenes compounds have functional groups OH, CH aliphatic and aromatic, CO, C = C aromatic, CN, CS, and C = S. At saturates having functional groups C = C aromatic, aliphatic and aromatic CH. On Cyclics resin having functional groups and aromatic CH and C = C aromatic difference is at Cyclics having aliphatic compounds such as aliphatic

CH while the resin has a functional group COC. Then to compare the functional group contained in each specimen, spectra are merging into one. Figure 2 is the combined result of the image at Figure 1.

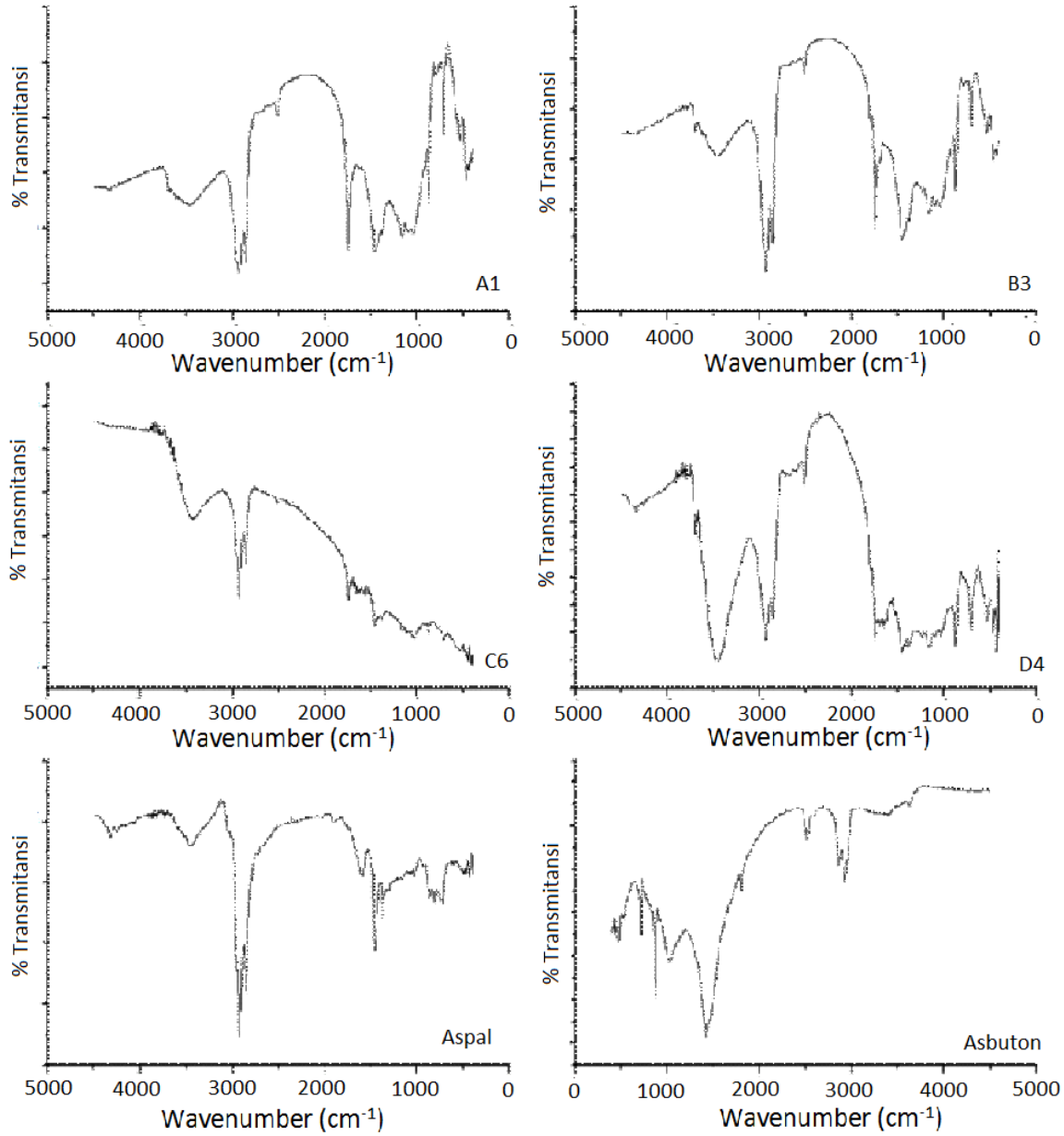

Figure 1. FTIR Spectra for various Bioasphalts (A1, B3, C6 and D4), 60/70 penetration grade bitumen and Rock asphalt.

FTIR results in Figure 2 shows that the asphalt contains fourth such compounds, but the compounds of asbuton asphaltenes little or nothing. It can be proved that in asbuton there and COH OH group, which is a group identifier of asphaltenes. In addition there is also a fourth compound uptake of other compounds such as the uptake of carbonyl C = O on possible asbuton derived from carboxylic acid, OH bending absorption on asphalt

possible derived from phenol or the rest of the water and also contained absorption at 525 - 427 possible presence of metal clusters (MO) derived from nickel and vanadium. This has been mentioned in Nasution (2008) which states that in addition to asphaltenes aromatic compounds also are carboxylic acid compounds, phenols, sulfur, nickel and vanadium. Table 1 to Table 4 show the various functional groups uptake ratio found in 60/70 penetration bitumen, asbuton and daspal for detailed analysis.

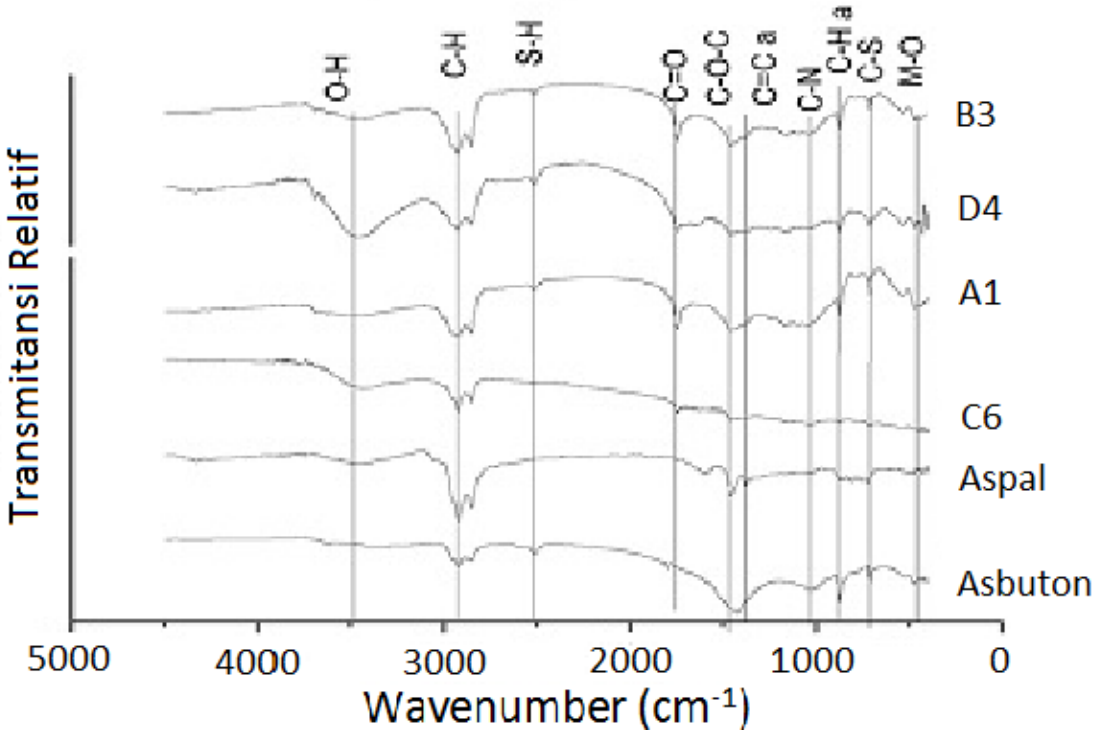

Figure 2. The combined imgae of FTIR spectra for all specimens

Table 1. Comparison of absorbtion of asphaltine.

Function	Wave number (cm^{-1})					
	Asphalt	**Asbuton**	**Daspal A1**	**Daspal B3**	**Daspal C6**	**Daspal D6**
-O-H	3433.44	-	3494.2	3437.3	3427.65	3435.37
-C-O-H	1167.95	-	1162.16	1163.13	1163.13	1165.05
-C=C- a	1606.77 1460.18	1421.6	1459.21	1463.07	1463.07	1461.14
-C-N	1031	1029.07	1035.82	1034.85	1031	1033.89
-C-O-C-	1167.95 1031	1029.07	1162.16 1035.82	1163.13 1034.85	1163.13 1031	1165.96 1033.89
-C-S	747,45	710,8	712,73	712,73	711,76	712,73
-S-H	2682,13	2511,43	2512,39	2514,32	-	2513,36
-C-H a	2922,28 810,14	2923,25 873,79	2926,14 874,76	2956,04 2926,14 874,76	2924,21	2955,07 2926,14 873,79
-C-H	2851,88	2823,25	2853,81	2853,81	2853,81	2853,81

Table 2. Comparison of absorbtion of saturates

Function	Wave number (cm^{-1})					
	Asphalt	**Asbuton**	**Daspal A1**	**Daspal B3**	**Daspal C6**	**Daspal D6**
-C-H	2851.88	2823.25	2853.81	2853.81	2853.81	2853.81

Table 3. Comparison of absorbtion of cyclic

Function	Wave number (cm^{-1})					
	Asphalt	**Asbuton**	**Daspal A1**	**Daspal B3**	**Daspal C6**	**Daspal D6**
-C=C- a	1606.77 1460.18	1421.6	1459.21	1463.07	1463.07	1461.14
-C-H a	2922.28 810.14	2923.25 873.79	2926.14 874.76	2956.04 2926.14 874.76	2924.21	2955.07 2926.14 873.79
-C-H	2851.88	2823.25	2853.81	2853.81	2853.81	2853.81

Table 4. Comparison of absorbtion of resin

Function	Wave number (cm^{-1})					
	Asphalt	**Asbuton**	**Daspal A1**	**Daspal B3**	**Daspal C6**	**Daspal D6**
-C=C- a	1606.77 1460.18	1421.6	1459.21	1463.07	1463.07	1461.14
-C-H a	2922.28 810.14	2923.25 873.79	2926.14 874.76	2956.04 2926.14 874.76	2924.21	2955.07 2926.14 873.79
-C-H	2851.88	2823.25	2853.81	2853.81	2853.81	2853.81
-C-O-C-	1167.95 1031	1029.07	1162.16 1035.82	1163.13 1034.85	1163.13 1031	1165.96 1033.89

Table 5. Comparison of absorbtion of other substances.

Function Group	Wave number (cm^{-1})					
	Asphalt	**Asbuton**	**Daspal A1**	**Daspal B3**	**Daspal C6**	**Daspal D6**
C=O		1797.73	1794.84 1746.62	1796.77 1746.62	1741.8	1793.88 1743.72
C=C alkena					1659.82	1655.96
O-H bending pada fenol/air	1375.3		1379.16	1382.06	1381.09	1381.09
C-O			1236.42	1239.32		1240.28
M-O	515.98 471.62 428.22	525.62 471.62 427.25	539.13 467.76	528.16 466.79 429.18	413.75	535.27 465.83 430.14

FTIR spectra showed similarities daspal absorption when compared to asphalt and asbuton, so it can be concluded that there is also a compound daspal of asphaltenes, saturates, cyclics and resin. This can be evidenced by the emergence of clusters absorption at the FTIR spectra that can be seen in the Table 1 to Table 4. At daspal also appear uptake

in addition to compounds asphaltenes, saturates, cyclics and resins such as MO, this is possible can be derived from a compound constituent materials are brick powder. FTIR spectra with MO strong absorption area shown in daspal A1 when compared to B3, C6, and D4 are likely to decline. This is because the portion of brick powder in the mixture is greater than B3, C6, and D4. Masthura shows that the chemical elements contained in the brick powder mostly contain metal elements, resulting in a mixture of A1 daspal more metal elements are bonded to oxygen (MO).

Significant differences in FTIR spectra are of the OH group, which is the higher content of resin, the content of OH is also getting stronger. At daspal D4 contains OH functional groups that are stronger than the others because the brick powder compositions in D4 were eliminated, which means the D4 daspal only resin and oil are added. According Moelyo (2012) states that most of the content of the resin is an organic compound, so it looks clear if the daspal D4 contains OH groups are more than others types of daspal.

CONCLUSION

The FTIR spectra analysis results showed that all tested daspal have similar functional groups such as the 60/70 pen bitumen. Daspal A1, B3, C6, and D4 has the group of saturate, aromatic, resin, and asphalten. Daspal proportion of functional groups that have the most similar to the 60/70 pen bitumen is daspal B3 with a small OH functional groups such as the 60/70 pen bitumen.

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