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Characterization of The Waste Oil and Solar Modifiers in Cold Mixed Asphalt Lasbutag (Buton Aggregated Asphalt Layer)

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ABSTRACT

One of the uses of Buton Asphalt is LASBUTAG which is a road surface with a mixture of Asbuton, modifier and aggregate. Currently, waste oil as a modifier is scarce in the market, so it is necessary to consider other alternatives as a modifier, one of which can be used, namely waste oil motor vehicle or other machinery. The aim of this study is to analyze the ideal modifier variation in Lasbutag blends using waste oil and diesel fuel as modifiers. This research is a quantitative research using experimental methods conducted in the laboratory. The use of the modifier with waste oil and diesel fuel for Lasbutag cold mix pavements can meet the Marshall characteristics required in the special Lasbutag specifications. The stability required in the Lasbutag special specifications is met by using a modifier content of 4.2% to 6.8%, Void in the Mix (VIM) can be achieved at different modifier levels between 4.8% and 7.2%, Void in the mineral Aggregate (VMA) can be achieved using modifiers from 4% to 7.0% and Melt Value (Flow) can be achieved using modifiers from 4% to 6 .2%. The cold-mixed Lasbutag characteristics required in the Lasbutag special specifications can be met using a modifier between 4.8% and 6.2%, so the most ideal modifier is achieved at 5.5%.

Keywords: asbuton; diesel fuel; lasbutag; marshall test; modifier; Waste oil.

INTRODUCTION

The portion of Asbuton as a road pavement binder is always smaller than the required Bitumen mixture in the general specifications of Highways, Asbuton point B 50/30 is limited from 7% - 10% of the total weight of the asphalt mixture, while the availability of Asbuton is very much that has not been utilized, this is due to Asbuton which has a low penetration value so that the resulting road surface has low resistance. Another thing that affects is that the asphalt in the asbuton is located in the cavity between the materials which is difficult to remove. This is anticipated by making Asbuton Buton with a smaller size and adding modifiers or rejuvenating agents that are more dilute than the types of rejuvenators commonly used, namely in the form of bunker fuel oil or flux oil. (Gusty & Tandi Paty, 2022)

One of the uses of Buton Asphalt is LASBUTAG (Buton Aggregated Asphalt Layer), this is one of the road pavements with a mixture of Asbuton, modifier and aggregate. Several studies conducted on LASBUTAG mostly use additives in the form of heavy oils such as MFO, Bunker Oil or Link Residue as modifiers. Currently, it is rare to obtain these modifiers on the market, so it is necessary to consider other alternatives as modifier materials (Gusty & Tandi Paty, 2022). In addition to the several types of heavy oil above, there is one other heavy oil material that can be used to make modifiers for buton mixtures, namely waste motor vehicle oil or other machines, which are quite large in quantity and can be obtained more easily and at a lower price. In this research, a mixture of waste oil and diesel fuel will be tried as a modifier, waste oil and diesel will be used as a modifier. The purpose of this study was to analyze the relationship between the use of modifiers originating from a mixture of oil and diesel waste for cold mixed Lasbutag pavements to the Marshall test (Marshall Stability, Flow, Air Void and Marshall Quotient). To analyze the large variation of modifiers given in the mix in order to produce the best quality Lasbutag pavement mix based on the marshall test To analyze the large variation of modifiers given in the mix in order to produce the best quality Lasbutag pavement mix.

RESEARCH METHODS

Material

This research is quantitative research using experimental methods carried out in the laboratory. Research attention was focused on laboratory tests on variations in modifier levels in cold mixed Lasbutag using modifiers in the form of a mixture of waste oil and diesel fuel. Asphalt mixture testing is carried out using a Marshall test equipment. The research flow is seen in the following diagram.

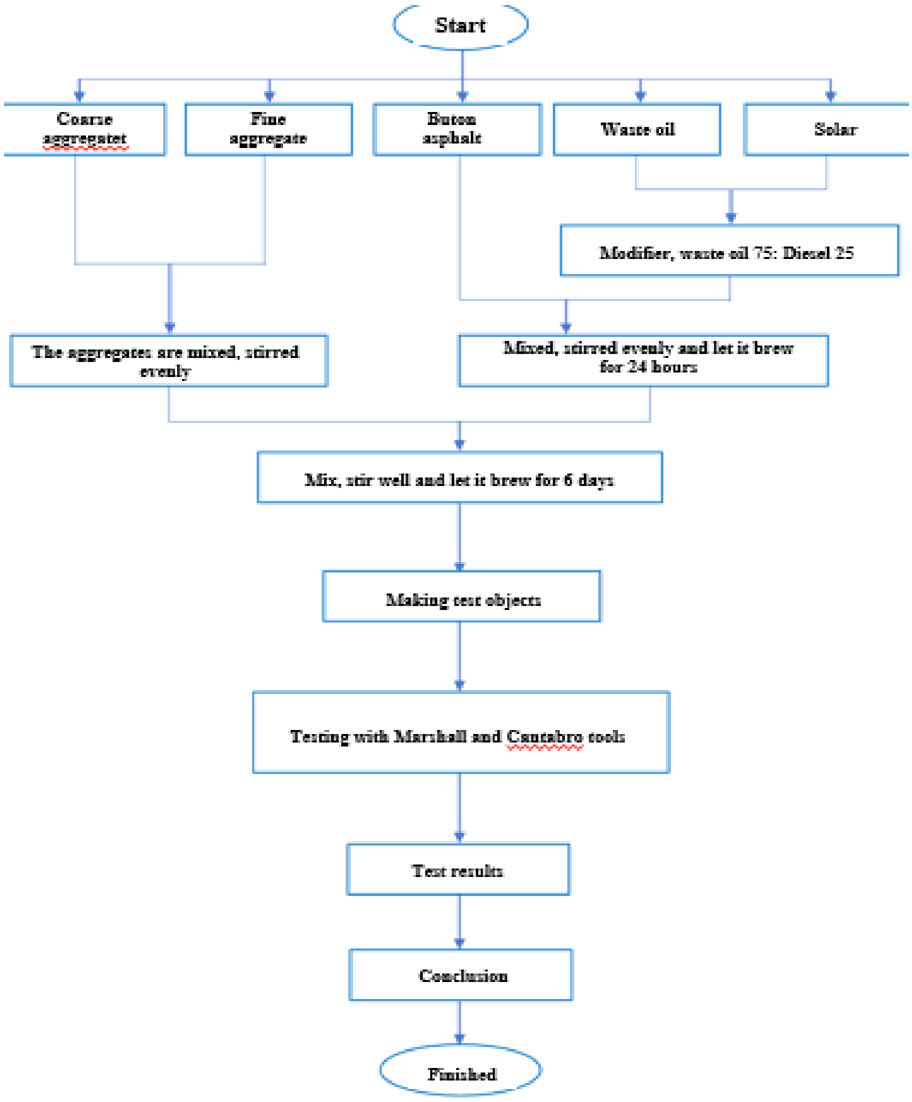

Figure 1. Research flow diagram

The materials used in this research consisted of granular asphalt asphalt, modifiers (waste oil and dieselfuel), coarse aggregate and fine aggregate. Before making test objects, these materials are tested with reference to the Indonesian National Standards (SNI). The asphalt used in this research was Asbuton Lawele Granural Asphalt (LGA) type B 50/30 in packaged form. By testing bitumen content, gradation and water content, the aggregate material to be tested is standard consisting of coarse aggregate and fine aggregate. The aggregates used in this research were taken from stone crushers and AMP from PT. Karya Mandala Putra's work at the Ampalas quary, Kab. Mamuju, West Sulawesi. The modifier used in this research is a mixture of waste motor vehicle oil and diesel. Waste oil was obtained from a vehicle repair shop in the city of Mamuju, while diesel was Pertamina

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diesel obtained from a fuel filling station. For the modifier mixture ratio, refer to previous research with a waste oil: diesel fuel ratio of 75:25.

Method

This research was conducted in Mamuju, West Sulawesi, in January – February 2023. Samples in the form of briquettes were formed with varying modifier composition content and mixed cold at Laboratory PT. Karya Mandala Putera was then subjected to marshall and residual value testing referring to SNI 06-2489-1991.

Data analysis

The analysis was carried out by means of laboratory experiments by comparing Marshall results in the form of density, voids in the mixture (VIM), voids in the aggregate (VMA), voids filled with Bitumen (PFB), stability and flow using varying modifier levels compared with the value specified in the 2006 Lasbutag special specifications for wearing coarse Lasbutag mixtures.

DISCUSSION AND RESULTS

From the results of this aggregate test, it was found that the physical properties or characteristics of the coarse aggregate and fine aggregate used in the mixture met the requirements of the 2006 Lasbutag special specifications and 2018 General Specifications. This can be seen from the results of the examination of the overall specific gravity of the aggregate, which ranges from 2.56 T/m3 to 2.73 T/m3, these results are above the requirements set out in the specifications, namely a minimum of 2.5 T/m3. Absorption also still falls within the requirements set out in the specifications, namely a maximum of 3%, while the test results for Coarse Aggregate (1-2) were 0.98%, Coarse Aggregate (0.5-1) was 1.17% and Fine Aggregate (Stone Dust) of 2.38%. Specifically for coarse aggregates, aggregate abrasion or wear testing was carried out, the aggregate abrasion value resulting from the research was 25.11%, still below the value specified in the specifications, namely 40%.

Based on testing the properties of the original form of asbuton granules, it can be seen that the bitumen content of the asbuton samples used was 20.72%, still meeting the minimum requirements set out in the specifications, namely 20%. For B50/30 type asbuton grain size, it must pass a 3/8" sieve. This has been fulfilled since the packaging process. Meanwhile, the specifications for water content require a maximum content of 4%, from the test results the sample used had a water content of 1.67%. So by looking at the parameters above, the Asbuton grain samples taken can meet the specifications and can be used for this research. In this research, a modifier derived from a mixture of waste oil and diesel fuel was used in a ratio of 75:25.

There are 5 (five) variations in levels of modifiers (rejuvenating ingredients) that will be used in this research, including a mixture using the addition of modifiers (rejuvenating ingredients) of 4%, 5%, 6%, 7% and 8%. The test that will be carried out on five variations of modifier levels is the Marshall test, in order to obtain the levels of added rejuvenating ingredients in the mixture,

The combined aggregate gradation formulation is obtained using the trial and error method, carried out by multiplying the estimated composition by the percent passing each sieve until an ideal combined gradation result is obtained, which is between the minimum and maximum limits based on the specifications.

Table 1. Composition of Combined Graded Aggregates

Filter number		Coarse aggregate (1-2)	Fine aggregate (0,5 – 1)	Stone dust	Asbutone mineral	Combined gradation	Special lasbutag specifications
		20 %	43 %	13.22 %	23,78 %		
¾ "	19,0	100,00	100,00	100,00	100,00	***100,00***	**100**
½ "	12,5	60,00	100,00	100,00	100,00	***92,00***	**90 – 100**
# 4	4,75	2,00	26,89	100,00	100,00	***48,89***	**45 – 70**

Filter number		Coarse aggregate (1-2) 20 %	Fine aggregate (0,5 – 1) 43 %	Stone dust 13.22 %	Asbutone mineral 23,78 %	Combined gradation	Special lasbutag specifications
# 8	2,36	1,50	6,40	86,88	91,70	***36,35***	**25 – 55**
# 50	0,30	1,32	3,75	19,60	45,89	***15,38***	**5 – 20**
# 200	0,075	1,06	2,88	14,93	14,44	***6,86***	**2 – 9**

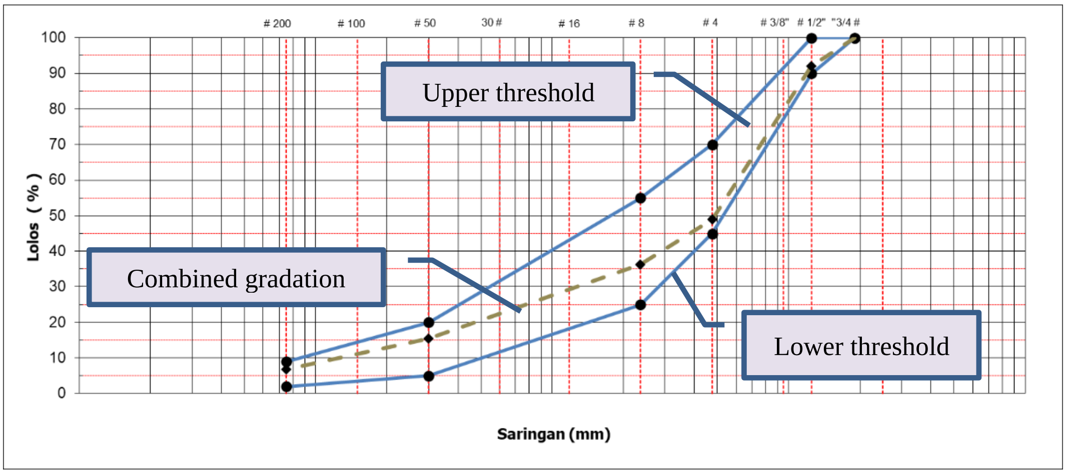

Figure 2. Combined Gradation Graph

From the combined aggregate formulation, a combined gradation graph is obtained as shown in table 1 and figure 2. To get the combined gradation combination in the graph above, the aggregate composition used is 20% Coarse Aggregate (1-2); 43 % Coarse Aggregate (0.5 -1); 13.22% Stone Dust and 23.78% Asbuton mineral. Specifically, the quantity of asbuton minerals cannot be determined using the trial and error method. This value is obtained from the plan to use asphalt in the mixture of 6.2% of the mixture, with a bitumen content of 20.72%, granular asbuton must be used at 30% of the weight of the mixture so that the granular asbuton will be a fine aggregate of 23.78% in the lasbutag mixture. the.

The total mixture of aggregate and asphalt for one test object weighs 1200 grams, consisting of coarse aggregate, fine aggregate and Asbuton. Three test specimens were made each, with variations in modifier content of 4%, 5%, 6%, 7% and 8% with an asphalt content of 6.2%.

Table 2. Mixture composition per sample

Fraction			Percentage to aggregate (%)	Percentage to mixture (%)	Weight per fraction (gr)
Coarse Aggregate (1-2)			20,00	18,37	**220,41**
Coarse Aggregate (0.5 – 1)			43,00	39,49	**473,89**
Fine Agregate (Stone Dust)			13,22	12,14	**145,69**
Asbuton	30 %	Mineral	23,78	30,00	**360,00**
		Bitumen	6,22		
Total				100	**1200,00**

The characteristics of the Lasbutag mixture are shown by fulfilling the requirements stated in the specifications related to Marshall parameter values and residual stability as follows:

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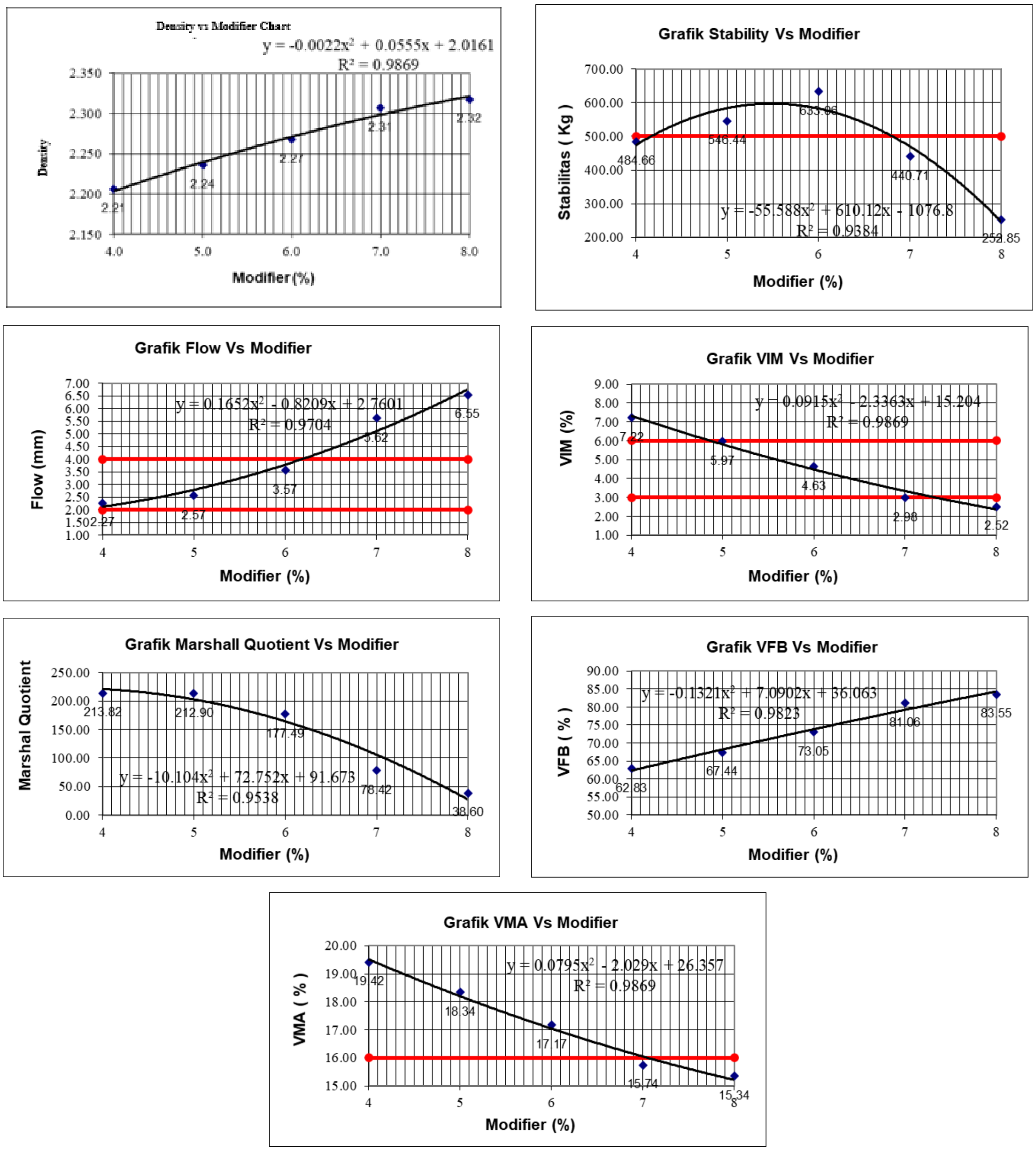

Figure 3. Marshall Characteristic Testing Graph

The graph of the relationship between modifier and density shows that the higher the modifier content, the higher the density of the mixture after compaction. The density value is influenced by several factors such as the gradation of the mixture, the type and quality of the constituent materials, the good compaction factor, the amount of compaction, the use of asphalt content in the mixture. From the graph, the relationship between stability and modifier shows that the stability value of the mixture with a modifier content of 4.2% to 6.8% still meets the limits required in the Lasbutag special specifications, namely min 500 kg. From the graph of the relationship between flow/melting of the fan modifier, it shows that the melting value (flow) for using a modifier of 4% to 6.2% still meets the limits required in the Lasbutag special specifications, namely 2 - 4 mm. The graph of the relationship between VIM and modifier shows that the VIM value for using modifiers of 4.8% to 7.3% still meets the limits required in the Lasbutag special specifications, namely 3 - 6%. From the graph of the relationship between Marshal Quotient (MQ) and modifier, the relationship is obtained that the greater the modifier level, the smaller the MQ value, the smaller the MQ value indicates a stiffer mixture. From the graph of the relationship between VFB and modifier, it can be seen that the higher the level of modifier in the mixture, the higher the VFB value in the sample. The VFB value can determine the stability, flexibility and durability of a mixture. The higher the VFB value means that there are more voids in the mixture, the higher the exposure to water and air, but a VFB value that is too high will result in bleeding. Meanwhile, the relationship between VMA and modifier shows that the higher the level of modifier used, the lower the VMA value obtained. Based on specifications that require the Lasbutag mixture to have a minimum VMA value of 16%. Thus, mixtures that meet these specifications use modifier levels ranging from 4% to 7%.

The calculation results are then plotted in a bar chart to determine the ideal percentage.

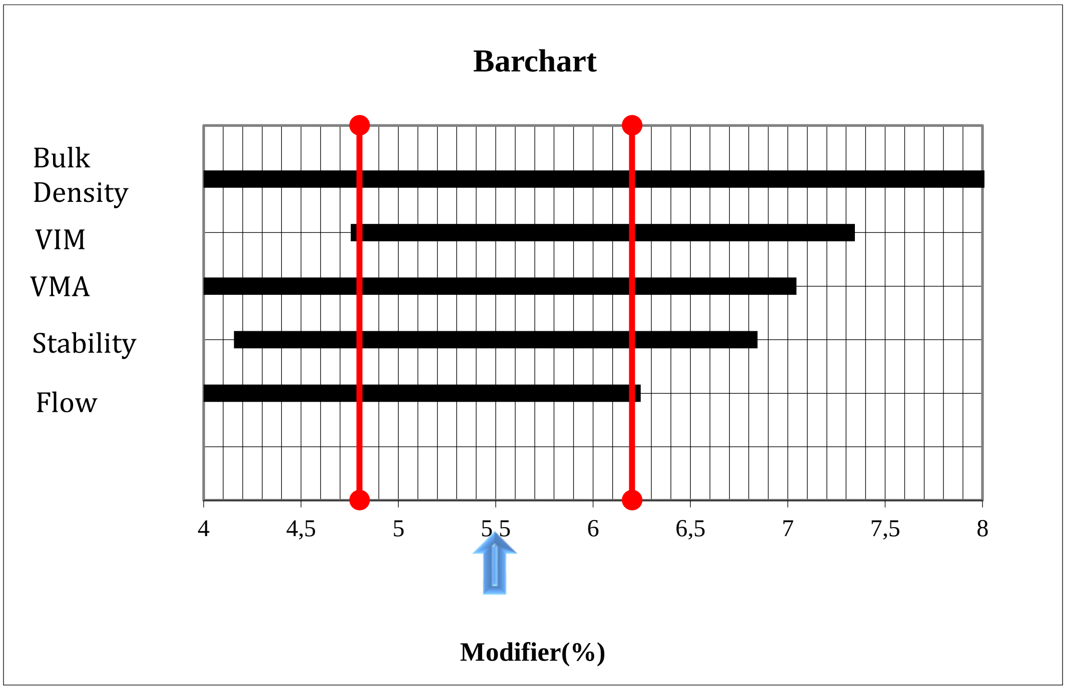

Figure 4. Barchart of the relationship between modifiers and Marshall characteristics

The ideal modifier is determined using interpolation techniques. The modifier content is at a value of 4.8% - 6.2% so that the ideal modifier content is obtained at 5.50% with the formulation Coarse aggregate 1-2 = 20.00%, coarse aggregate 0.5-1 = 43.00%, fine aggregate/Stone Dust = 13.22% and Asbuton usage is 30%.

CONCLUSION

Utilization of Modifiers with waste oil and diesel fuel for Lasbutag pavement. A cold mixture with a waste oil and diesel fuel ratio of 75:25 can meet the Marshall characteristics as required in the Lasbutag Special Specifications. Stability at a room temperature of 25°C required in the special Lasbutag specifications of a minimum of 500 kg is met by using a modifier content of 4.2% to 6.8% of the total weight of the mixture. The required voids in the mixture (VIM) of between 3% to 6% can be achieved at variation in modifier levels between 4.8% to 7.2% in this research mixture; The void in the mineral aggregates (VMA) required in the minimum specification of 16% can be achieved by using a modifier of up to 7.0% and the required melting value (Flow) of between 2 mm to 4 mm can be achieved by using a modifier of up to 6.2%. The amount of modifier use that can be included in these specifications is in the range of 4.8% to 6.2%, so that the most ideal modifier use based on this research is 5.5%.

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REFERENCES

Ansyori Alamsyah, A. (2011). Penggunaan pertamax sebagai modifier pada lasbutag campuran dingin untuk perkerasan jalan.

Ansyori Alamsyah, A., Eko Meiyanto, H., Person, K., & Eko Meiyanto Jl Raya Tlogomas No, H. (2016). Pemanfaatan olie bekas sebagai modifier pada lapisan aspal buton beragregat (lasbutag) campuran panas untuk perkerasan jalan.

Budiamin, Tjaronge, M., Aly, S. H., & Djamaluddin, R. (2015). Marshall Characteristics of Hotmix Cold Laid Containing Buton Granular Asphalt (BGA) with Modifier Oil Base and Modifier Water Base. 2, 2015.

Darsana, I. K. (n.d.). Teknologi Pemanfaatan ASBUTON Sebagai Bahan Perkerasan Jalan.

Denni Widhiyatna, R. Hutamadi, Sutrisno, Tinjauan Konservasi Sumber Daya Aspal Buton

Gusty, S., Erniati, & Yosis. (2021). The effect of using asbuton with used waste diesel oil on the stability of the porus asphalt mix with hot mix cold laid method. IOP Conference Series: Materials Science and Engineering, 1088(1), 012095. https://doi.org/10.1088/1757-899x/1088/1/012095

Gusty, S., & Tandi Paty, Y. (2022). Analysis of The Use of Waste Diesel Oil As an Asbuton Modifier in Hot Mix Cold Laid of Porous Asphalt of Pavement Cantabro Value Article Info. Jurnal Warta LPM, 25, 41–46. http://journals.ums.ac.id/index.php/warta

Gusty, S., Tjaronge, M. W., Ali, N., & Djamaluddin, R. (2017). Pengaruh penambahan buton granural asphalt pada campuran aspal berongga campur panas hampar dingin terhadap stabilitas marshall.

Haryo, A., Raditya, B., Djakfar, L., & Bowoputro, H. (n.d.). Pengaruh oli bekas dengan solar, minyak tanah dan waktu pemeraman pada perkerasan daur ulang.

Hermadi, M. (2015). Pemanfaatan Oily-Sludge Sebagai Bahan Peremajaan Buton Rock Asphalt untuk Pemanfaatan Campuran Dingin Oil-Sludge sebagai Peremajaan Buton Rock Asphalt untuk Dingin.pdf. 44–53.

Pekerjaan Umum, Kementrian. (2006). Spek Khusus Lasbutag-Des 2006.

Pekerjaan Umum, Kementrian. (2020). Spesifikasi Umum Jalan dan Jembatan 2018 Revisi 2

Pustrans Balitbang PU, Metode Pengujian Campuran Aspal Dengan Alat Marshall

Sita, T. (2020). Penggunaan Material Cold Mix Asphalt untuk Penanganan Penambalan Lubang. https://e-journal.poltekbangplg.ac.id/index.php/jaet

Sukirman, S. (2016). Beton Aspal Campuran Panas.

Sumantri, B., Santiko, H., Djakfar, L., & Bowoputro, H. (n.d.). Pengaruh peremaja oli bekas dan solar terhadap karakteristik marshall perkerasan daur ulang dengan asbuton.

Suroso, TW (2008). Faktor-Faktor Penyebab Kerusakan Dini pada Perkerasan Jalan. Puslitbang Jalan Dan Jembatan, 1, 2–3.