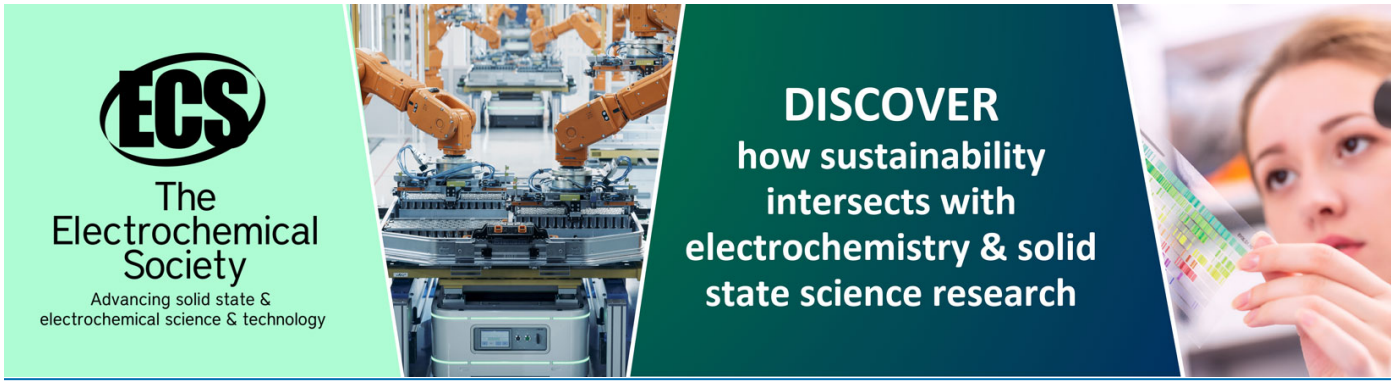
Texture Depth and Cost Analysis of Slurry Seal Cationic Rapid Setting Cold Asphalt Mixture



Texture Depth and Cost Analysis of Slurry Seal Cationic Rapid Setting Cold Asphalt Mixture

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Abstract. Slurry seal is a mixture of asphalt emulsion, fine aggregate, mineral filler, water, and other added ingredients are mixed evenly without heating and is spread over the surface of the pavement with a maximum thickness of 10 mm. This study was conducted to determine the relationship of the depth texture and skid resistance resulting from the modification of the aggregate and filler slurry seal based texture depth test of sand patches. Slurry seal is made using basalt stone aggregate filler Ordinary Protland Cement (OPC), limestone filler aggregate OPC and aggregate rock with filler standard OPC composition: High Calcium Fly Ash 50%: 50%. Increasing the texture depth will add road surface roughness. Slurry seal with basalt stone aggregate having the largest texture depth is 1.837 mm so as to provide the greatest improvement of skid resistance. Texture depth slurry seal with limestone aggregate is 1,767 mm that mean increasing skid resistance. Slurry seal standard aggregate has a depth of 1,673 mm texture which represents an increase skid resistance smallest slurry seal between basalt stone aggregate and limestone. Slurry seal with cheapest price is limestone slurry seal aggregate Rp. 44,817.00 / m2 compared basalt aggregate Rp. 45,085.00 / m2 and a standard stone mixture of cement and fly ash filler Rp. 44,914.00 / m^2.

1. Introduction

Slurry seal is a mixture of cold asphalt as a maintenance material, for road pavement surface treatment, or as an addition to the thickness of the surface layer. The function of the slurry seal is to increase the smoothness of the pavement due to roughness and rutting, coat the surface and increase the rigidity without retexturing. The composition of the slurry seal for road maintenance has been developed. The use of Ordinary Portland Cement as a filler, slurry seal is most commonly used [1]. As a result of the increasing price of cement, there are several alternatives that can be used, for example: a mixture of cement and fly ash as a filler, and the use of basalt stone and limestone as an aggregate for slurry seal. Modification of the composition of the slurry seal will affect the costs incurred by the contractor in its manufacture. The addition of fillers and polymers and addictive substances will increase the production cost of the slurry seal [2]. For this reason, it is necessary to carry out a cost analysis of the modifications made so that they are known to have economic value or not compared to standard slurry seals. With the variety of slurry seals that have been developed, it is necessary to compare them to find out which slurry seal modifications are the most profitable in terms of characteristics and costs. This research will find the most profitable maintenance of road pavements with modified slurry seal. Slurry seal is a mixture of emulsified asphalt without heating, containing

finely graded aggregate, mineral filler, water and other additives mixed evenly and spread over the pavement surface as asphalt slurry or slurry [3]. Based on the type of emulsion asphalt used, it is anionic or cationic. Then based on the aggregate differentiated between type I, type II, and type III. The use of slurry seals includes improving the texture of road surfaces that experience raveling, oxidation, and improving road roughness [4]. Skid resistance or tightness is the force that holds the tire from slipping along the road surface. The texture of the road surface can be measured by the Sand Patch method. This method is suitable for asphalt surface layers and concrete pavement surfaces with a texture depth greater than 0.25 mm. By testing the sand patch on slurry seal modifications, the characteristics of each type of modification will be known.

2. Experimental

The research was conducted by carrying out the spread of slurry seals in the parking area of Building 5 FT UNS. The test conducted is a texture depth test using the sand patch method [6]. Slurry seal modifications made are slurry seal with basalt rock aggregate, limestone aggregate slurry seal, and standard rock seal slurry with a mixture of OPC filler and coal fly ash. Analyze the test result data to get a conclusion on the relationship between the texture depth and roughness value. In the final stage the researcher makes conclusions and suggestions from the test analysis related to the research objectives.

3. Results and Discussions

3.1 Material Properties

The basic materials tested in this study are coarse aggregate of basalt, limestone, and standard rock. The results of the abrassion materials can be shown in Table 3.1.

Tabel 1. Aggregate Abrassion Results using Los Angeles Machine Test

Type of Aggregates	Abrassion (%)	Standar
Basalt	26.71	Less than 35 %
Limestone	56.46	Less than 35 %
Standar	23.98	Less than 35 %

The aggregate gradation used is a type III slurry seal gradation. The fillers used were OPC cement and coal fly ash mix as presented in Table 2.

Tabel 2. Slurry Seal Gradation type III

Sieve Sizes	Passing (%)	Specification	
		Min	Max
3/8 (9,5 mm)	100	100	100
No. 4 (4,75 mm)	82,5	70	90
No. 8 (2,36 mm)	51,5	45	70
No. 16 (1,18 mm)	35,0	28	50
No. 30 (600 µ)	26,0	18	33
N0. 50 (330 µ)	17,5	12	25
No. 100 (150 µ)	10,0	7	17
No. 200 (75 µ)	7,5	5	10

The optimum emulsion asphalt content for basalt rock aggregate is 12%, the optimum emulsion asphalt content for aggregate limestone is 10.92%, and the optimum emulsion asphalt content for standard rock aggregate is 11.66%. Table 3 shows the results of three type slurry seal.

Tabel 3. The Optimum Cationic Rapid Setting-2 Emulsion Content

Slurry Seal Type	Residual Emulsion Content (%)	Optimum Emulsion Content (%)
Basalt Aggregate	7.80	12.00
Limestone Aggregate	7.10	10.92
Standard Aggregate	7.58	11.66

3.2. The Slurry Seal Field Test

Testing The implementation of mixing and spreading the slurry seal is done manually as shown in Figure 1. Time stirring the emulsion asphalt according to the Emulsion Asphalt Slurry Planning Guidelines is not less than 1 minute and it shouldn't be more than 3 minutes. After overlaying it takes time to consolidate and time drying so that the slurry seal slurry is dry and can be opened for traffic. According to Planning Guidelines Emulsion Asphalt Slurry (Slurry Seal) for type III slurry seal requires a stabilization time of 15-720 minutes and The drying time is 720 minutes starting from the emulsion asphalt mixed with aggregate [5].

Figure 1. The Implementation of Slurry Seal

3.3. The Sand Patch Test

The texture depth value is obtained from the average value of the sand patch diameter which is then converted into texture depth and recapitulated in Table 3.4. Figure 3.2 shows the teksture depth measurement using sand patch method [7].

Tabel 4. Recapitulation of Slurry Seal Modified Texture Depth Value

Slurry Seal Type	Diameter (mm)	Depet Texture (mm)
Initial Condition	247.5	1.039
Basalt	186.15	1.837
Limestone	189.78	1.767
Standar Rock	195.05	1.673

Figure 2. Sand Patch test for texture depth measurement

The depth of surface texture increased after slurry seal was applied. The salt stone aggregate slurry seal has the largest texture depth of 1.837 mm. Meanwhile, the limestone slurry seal is 1.767 mm and the standard rock seal slurry is 1.673 mm

3.4 Slurry Seal Unit Price

Slurry seal work unit price analysis uses the excel program Slurry Seal Work Unit Price Analysis Guide (PAHS) 2010 General Specifications prepared by the Directorate General of Highways, Ministry of Public Works. The difference in the unit price of work between one modified slurry seal and another lies in the price of the material, namely the aggregate and the filler used in each slurry seal modification [8]. The recapitulation of the unit price of the slurry seal modification work is presented in Table 5.

Table 5. The Unit Price of Slurry Seal

No	Slurry Seal Type	Unit Price (Rp / m^2)
1.	Basalt Stone	Rp. 45,085.00
2.	Lime Stone	Rp. 44,817.00
3.	Standard aggregate with fly ash filler	Rp. 44,914.00

The Unit Price of slurry seal using basalt stone aggregate is the most expensive compared to Unit Price of slurry seal stone aggregate standard fly ash filler. The Unit Price of slurry seal uses limestone which is the cheapest compared to the Unit Price of slurry seal for standard aggregate with fly ash filler.

4. Conclusion

From the results of the research and data analysis and discussion that has been carried out, the following conclusions can be drawn that slurry seal increases the texture depth and flatness value of the road surface. Increasing the texture depth will increase the road surface roughness. Road surface roughness is related to skid resistance so that roughness due to increased texture depth will increase the skid resistance of the road surface. Basalt stone aggregate slurry seal has the largest texture depth of 1,837 mm so it provides the greatest increase in skid resistance. The texture depth of the limestone aggregate slurry seal is 1.767 mm, which means that the skid resistance increases. The standard rock aggregate slurry seal has a texture depth of 1.673 mm which represents the smallest increase in skid resistance between the basalt and limestone aggregate slurry seals. Slurry seal with the cheapest Unit Price is the limestone aggregate slurry seal Rp. 44,817.00 / m^2 compared to basalt aggregate of Rp. 45,085.00 / m^2 and standard stone mixture of cement & fly ash filler Rp. 44,914.00 / m^2. Although the basalt stone slurry seal has the most expensive unit price, in terms of the increased skid resistance, Unit Price of slurry seal with basalt stone modification can be considered reasonable. The difference between the modification of the aggregate slurry seal for basalt stone, limestone, and standard stone for cement and fly ash filler is very small so that there is no significant savings.

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