ADDITION OF COLD ASPHALT MIXTURE STABILITY USING CEMENT FILLER

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ABSTRACT

The objectives of this research are (1) To know the influence of usage of filler cement to optimum water content at the time of mixing and compaction of cold asphalt mixture.(2)To know the influence of usage of filler cement to optimum asphalt content of cold asphalt mixture (3)To know the increasing of cold sphalt mixture stability by using cement filler. Research was done by making 5 various of cement filler in cold asphalt mixture dense graded with emulsion asphalt CSS-1 as binder material. Base on research result it can be concluded as follows (1) Addition of cement filler decreased the optimum water content at mixing and compaction time.(2) Addition of filler cement initially degraded the optimum asphalt content but improved the stability. The optimum of cement filler is 4.5 % by weight of aggregate. At this cement filler content the optimum residual asphalt content is 4,8 % with dry stability 850 kg and 4 days soaking stability is 990 kg (3) Cement filler improved dry stability around 67 % and 4 days soaking stability about 130 %

Key words: cold asphalt mixture - cement filler - stability

INTRODUCTION

Most of roads in Indonesia use cement asphalt as a binder material. In order to mix with aggregate the asphalt requires high temperature, so that in road construction this asphalt mixing is known with term of hot asphalt mixture. Asphalt Mixing Plant (AMP) is required to make the hot asphalt mixture. For maintenance works with lrequiring low materials, usage of AMP become inefficient. Usage of AMP need much oil fuel, whereas oil fuel now is very expensive in Indonesia. In Indonesia existence of AMP is still very rare, so that road maintenance location sometime too far from the location of AMP. It will make temperature of hot asphalt mixture drop when reach the work location so that the quality of the mixture become unfavorable.

Overlay of Open Graded Emulsion Mixture (OGEM) at Cilacap in 2000 showed that after compaction work the mixture of OGEM was unstable (Hutama Prima, 2000). Full stability of OGEM is estimated take place 1-2 months after completion of compaction. Traffic is expected will accelerate the stability and evaporation. Contrary, burden of traffic destroyed the cold asphalt mixture, because unstable of mixture will not capable to support the existing traffic load.

The failures of cold asphalt mixture construction works is predicted as the minor understanding of cold asphalt mixture characteristics by construction company (contractor). Emulsion asphalt only content effective asphalt (residual asphalt) as binder material around 60 % while the other 40 % is water. The water will be expected evaporable as the passing of vehicle wheel or hot air temperature. This matter like that happened at Hasanudin and Rumah sakit Jiwa street project in Surakarta. The effective asphalt content after tested in Transportation Laboratory UMS was only 4 %, while the design is 6 % (Widodo, 2004). The other problem is the residual asphalt in emulsion asphalt have high penetrating value so that the stability of asphalt mixture tend to low. Emulsion asphalt of CMS-2 usually used for the mixture of DGEM and OGEM has penetration value between 100-250. It is too high penetration if compared with cement asphalt used for hot asphalt mixture which its penetration range from 60 to 100.

Base on various problems that happened in construction, hence the research of application of cement filler for acceleration and increasing the stability of cold asphalt mixture is interesting to be conducted. Cement is expected can pull out existing water in emulsion asphalt, so that residual asphalt which implied in emulsion asphalt earn immediately react with aggregate. The reaction of water and cement which forming cement pasta will assist the adhesion between aggregate in the mixture.

The research using of cement as filler in cold asphalt mixture to accelerate and increase the mixture stability has the following purposes :

1) To know the influence of usage cement filler to optimum water content during mixing and compaction of cold asphalt mixture.
2) To know the influence of usage of filler cement to optimum asphalt content of cold asphalt mixture .
3) To know the increasing of cold asphalt mixture stability by using cement filler

According to Asphalt Institute (1985) aggregate to be used for the mixture of cold asphalt mixture have to meet the gradation specification as shown in Table 1. At mixing of aggregate and emulsion asphalt, the aggregate surface area that is coated with asphalt shall excess than 50 percent. Cold asphalt mixture should be have Marshall stability value at least 500 lb (227 kg). After 4 days soaking the lossing of Marshall stability should not more than 50 %.

RESEARCH METHOD

The research was started by testing the properties of materials compiler of cold asphalt mixture. Samples of cold asphalt mixture hereinafter were prepared at 5 varying of cement filler (Figure 1)

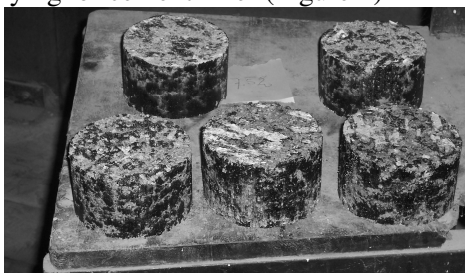

Figure 1. Samples of Cold Asphalt Mixture

The optimum water content for mixing and compaction, optimum asphalt content and optimum cement filler content were determined for each variation of cement filler. The outline of all research procedure is shown at Figure 2.

Table 1. Specification of aggregate for Dense Graded Emultion Mixture

Sieve size	*Semi-Processed Crusher, Pit or Bank run*	*Processed Dense-Graded Asphalt Mixtures*				
50 mm	-	100	-	-	-	-
37,5 mm	100	90-100	100	-	-	-
25,0 mm	80-100	-	90-100	100	-	-
19,0 mm	-	60-80	-	90-100	100	-
12,5 mm	-	-	60-80	-	90-100	100
9,5 mm	-	-	-	60-80	-	90-100
4,75 mm	25-85	20-55	25-60	35-65	45-70	60-80
2,36 mm	-	10-40	15-45	20-50	25-55	35-65
1,18 mm	-	-	-	-	-	-
0,60 mm	-	-	-	-	-	-
0,30 mm	-	2-16	3-18	3-20	5-20	6-25
0,15 mm	-	-	-	-	-	-
0,075 mm	3-15	0-5	1-7	2-8	2-9	2-10
Sand equivalent, %	Min 30	Min 35	Min 35	Min 35	Min 35	Min 35
Abrasion at 500 revolutions, %	-	Maks.40	Maks.40	Maks.40	Maks.40	Maks.40
% Crushed faces	-	Min. 65	Min. 65	Min. 65	Min. 65	Min. 65
Emulsified asphalt	HMS-1, HMS-2. HMS-2h, HMS-2s, SS-1, SS-1h, CRS-1, CRS-2, CMS-2,CMS-2h, CSS-1, CSS-1h					

Source : Asphalt Institute, 1985

RESEARCH RESULT AND DISCUSSION

Aggregate coating test

Testing of aggregate coating was conducted to 5 variation of combination aggregate and cement filler. Combination aggregate and cement filler was made according to specification of Dense Graded Emulsion Mixture (DGEM) with 25 mm maximum aggregate size as written in Tables 1. Base on gradation test result of crushed aggregate and sand also specification of DGEM, it is obtained 5 variations of aggregate and cement combination as described in Table 2.

Table 2. Variation Of Aggregate And Cement Combination

Variation	Coarse agregate	Medium aggregate	Sand	Cement
1	40 %	40 %	20 %	0 %
2	40 %	40 %	18,5 %	1,5 %
3	40 %	40 %	17,0 %	3,0 %
4	40 %	40 %	15,5 %	4,5 %
5	40 %	40 %	14,2 %	5,8 %

The aim of aggregate coating test is to find out the optimum water content of mixture causing to maximum aggregate coating and meet the minimum specification of Asphalt Institute that is 50 %. Mixture to aggregate coating test is referred as Cold mix 1 and the result is shown in Table 3.

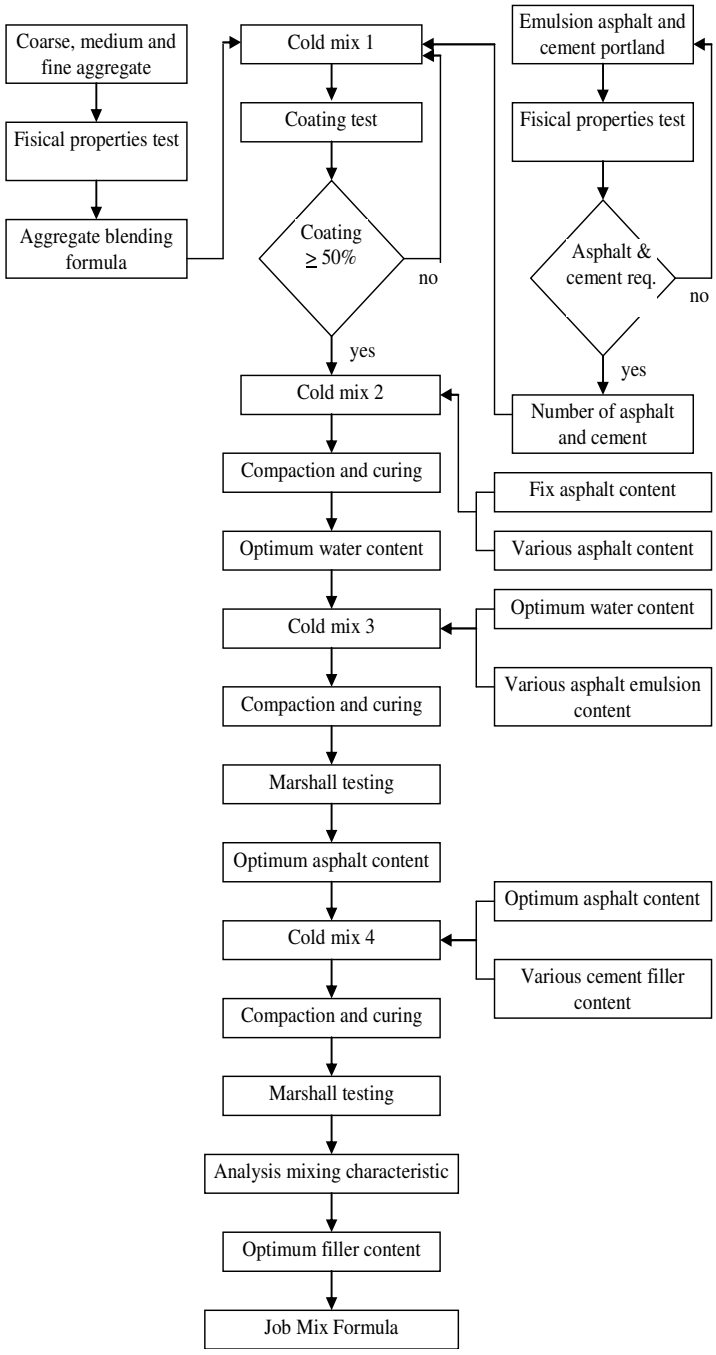

Figure 2 : Flow Chart of Researh Procedure

Table 3. Result of Aggregate Coating Test

Variation	Emulsified asphalt content by weight of dry aggregate	Water content by weight of dry aggregate	Aggregate coating
1	7,15 %	11,1 %	80 %
2	7,74 %	7,8 %	60 %
3	8,33 %	8,0 %	65 %
4	8,92 %	8,2 %	60 %
5	9,43 %	8,4 %	60 %

For the mixture variation 2 until 5 that are using cement filler, coating of asphalt to aggregate seem decrease although use more emulsion asphalt. This matters because cement particle cover the emulsion asphalt that coating the aggregate.

Testing of mixture compaction.

The purpose of mixture compaction testing is to find out the optimum water content during compaction process that yield maximum dry bulk specific gravity. The value of optimum water content of compaction is under the optimum water content of mixing, so that compaction was done after water content during mixing process decrease because evaporation. Testing was conducted to all mixture variation. Every mixture variation was made 5 kinds of water content during compaction which all the water content are under optimum water content of mixing. Optimum water content of compaction to every mixture variation are expressed in Table 4.

From research result seen that optimum water content of compaction at variation 1 which without using cement filler reside about 75 % from optimum water content of mixing. Usage of cement filler tend to deduct optimum water content of compaction in average around 50 % from optimum water content of mixing. This matter indicate that period time between compaction and mixing for mixture with cement filler is longer if it is compared to which without cement filler. This waiting time is used by cement to react with water and form cement pasta that it is causing easier the mixture easier compacted. However if the waiting time is too long or water content of compaction become smallly, cement pasta will become stiff and it will more difficult to compacted.

Table 4. Result of mixture compaction testing

Variation	Emulsified asphalt content by weight of dry aggregate	optimum water content for mixing	Optimum water content for compaction	Dry bulk specific gravity
1	7,15 %	11,1 %	8,6 %	2,05 gr/cm^3
2	7,74 %	7,8 %	3,8 %	2,20 gr/cm^3
3	8,33 %	8,0 %	3,5 %	2,00 gr/cm^3
4	8,92 %	8,2 %	5,2 %	2,08 gr/cm^3
5	9,43 %	8,4 %	4,0 %	2,05 gr/cm^3

Influence of Cement filler to optimum asphalt content

After optimum water content for mixing and compaction obtained, futher

step is to look the optimum asphalt content. Optimum Asphalt content was searched by making the mixture of aggregate and emulsion asphalt that it is mixed and compacted by using optimum water content of compaction and mixing. Mixing of emulsion asphalt and aggregate was made by using 5 asphalt content variation. For each asphalt content variation was made 6 specimens. Three of specimens were tested by Marshall equipment to find out the stability in dry condition, and the other 3 specimens were tested the stability after 4 days soaking.

After mixture preparation complete, compaction was done by using Hammer of Marshall equipment at 2x75 blows. Determining of optimum asphalt content according to Asphalt Institute are based on maximum soaking stability value, but the stability loss after soaked 4 day no more than 50 % and the aggregate coating shall more than 50 %. Testing result of cold asphalt mixture characteristic by usage of Marshall equipment to find out optimum asphalt content to the each of variation are shown in Table 5.

From Table 5. seen that the stability of of cold asphalt mixture with cement filler after 4 days soaking does not decrease but even increase about 17 %. However the content of residual asphalt tend to decrease in comparison with cold asphalt mixture without cement filler. Addition of cement filler tend to decreasing of optimum residual asphalt content. But for variation 5 with cement filler 5,8 %, the the optimum residual asphalt content increase as e addition of cement also require more water to react become cement pasta.

Influence of cement filler to addition of stability

Addition of cement filler will add the stability of cold asphalt mixture, both for dry and 4 days soaking condition.. At 5 % cement filler content there is dramatically increasing the stability. Dry stability increase around 67 % but 130 % addition of stability take place for 4 days soaking condition.(see Figure 2).For other addition of cement filler 1.5 %, addition of stability are between 100 to 200 kg. Contrary, at variation 5 with cement filler 5,8 %, the stability trend to drop although asphalt and cement content are increased.

Table 5. Testing result of cold asphalt mixtures by Marshall equipment

Variation	Optimum residual asphalt content	Dry stability	4 days soaking stability	Percent loss of stability	*Dry Bulk Density*
1	5,6 %	323 kg	291 kg	+10 %	1,94 gr/cm^3
2	5,3 %	540 kg	670 kg	- 25 %	1,94 gr/cm^3
3	5,0 %	640 kg	700 kg	-12 %	1,98 gr/cm^3
4	4,8 %	850 kg	990 kg	-17 %	1,98 gr/cm^3
5	6,1 %	780 kg	910 kg	-17 %	1,91 gr/cm^3

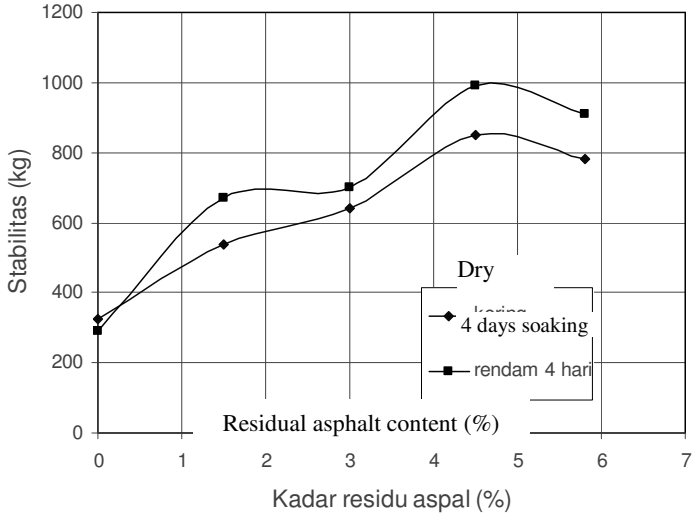

Figure 2. Relation between cement filler content and stability of DGEM

It is concluded that variation 4 with 4.5 % cement filler content is optimum filler content, because this filler content resulting the maximum stability both for dry and 4 days soaking. Even at variation 4 yielding of stability more than 750 kg, which this value is minimum stability requirement of hot asphalt mixture. Base on stability requirement, cold asphalt mixture with cement filler 4.5 % can substitute application of hot asphalt mixture in road work construction.

CONCLUSION

Base on research result of Dense graded emulsion mixture with usage emulsion asphalt CSS-1 and cement filler, it is concluded :

1) Addition of cement filler was decrease the optimum water content at mixing and compaction time.
2) Addition of filler cement initially degrade the optimum asphalt content but improve the stability. The optimum of cement filler is 4.5 % by weight of aggregate. At this cement filler content the optimum residual asphalt content is 4,8 % with dry stability 850 kg and 4 days soaking stability is 990 kg

Using of cement filler improve dry stability around 67 % and 4 days soaking stability about 130 %.

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