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Producing of Warm Asphalt Mix Using Sasobit

Dr. Amr Mohamed Eloufie [1]
1El Shorouk Academy, Al Shorouk, Cairo, Egypt

الملخص:

الخلطه الاسفلتيه الدافئة تنتج وتخلط فى درجة حرارة منخفضة تتراوح من (100 - 140) درجة مئوية وهي درجة حرارة اقل من الخلطة الاسفلتية الساخنة (التقليدية) التى تنتج وتخلط فى درجة حرارة عالية (150 - 170) درجة مئوية .ومن أكثر التقنيات شيوعا لتحسين الخلطة الاسفلتية الدافئة هي استخدام الاضافات العضوية او الاضافات الكيميائية حيث تعتبر الاضافات من اهم الطرق التى تستخدم فى تحسين الخصائص الهندسيه للخلطه الاسفلتيه الدافئة .وفي هذا البحث سيتم استخدام الاضافة الكيميائية (Sasobit) وذلك لتحسين اداء الخلطه الاسفلتية الدافئة عندما تقارن بالخلطة الاسفلتية الساخنة. و الهدف الاساسى لهذه البحث هو تقييم اداء (Sasobit) بأستخدام بودرة غبار الاسمنت و بأستخدام بودرة الحجر الجيري بنسب مختلفة من (Sasobit) مع ثبات نسبة البودرة علي الخلطة الاسفلتية الدافئة "في درجة حرارة منخفضة" ويتم مقارنتهما بالخلطة الاسفلتية الساخنة "في درجة الحرارة العالية" , وذلك لتحديد النسبة المثلي منها و لتحديد ايهما يقدم اداء افضل مع تكلفه اقل وكفاءه اعلي.

Abstract:

Organic additive (Sasobit) is used in order to produce WMA due to its Environmental, economic and paving operations benefits. Adding both Sasobit with cement dust filler (S.C.D.F) and Sasobit with limestone filler (S.L.S.F) to WMA mixture enhanced mix properties. Maximum stability was achieved by adding 20% of (S.C.D.F) which increased stability from 1020 to 2070 Ib and then decreased, while adding 2.5 % of (S.L.S.F) increased stability from 1830 to 2050 Ib and then decreased. The Flow decreased with the increase of (S.C.D.F) and (S.L.S.F) percentages. The total cost of 1 ton of WMA was found 474.55 and 271.94 (L.E/ton) for (20%S.C.D.F) and (2.5%S.L.S.F) respectively, but using (0.5%S.L.S.F) cost 249.68 (L.E/ton) which is almost the same cost of HMA. The percentages in reduction in Carbon dioxide (CO2), Nitrogen Oxides (NOx) and Volatile Organic Compounds (VOCs) were 14.10, 31.71 and 5.48% respectively at the optimum S.C.D.F, while the reduction percentages were 14.94, 32.91 and 9.86% respectively at the optimum S.L.S.F.

Keywords: Sasobit, organic additive, cement dust filler, lime stone filler.

1-Introuduction

Warm mix Asphalt (WMA) is always produced and mixed with a relatively low temperature ranging from (100-140) °C, a temperature which is lower than the hot mix asphalt (HMA) traditional method, that is produced and mixed at high temperature (150-170) °C. Referring to previous researches, it was found that using of WMA reduces the fuel consumption by 20% than the traditional method (HMA). As it needs a little power when heating asphalt mixture; thus needs a little amount of fuel to produce WMA D'Angelo, et al. (2008) [1]. One of the most common techniques to produce WMA is adding organic or chemical additives. Environmentally, the addition of chemical additives to WMA reduces CO2 between (3.20 to 46%), NOx between (6.10 to 62%), SO2 between (17.60 to 81%), volatile organic compounds (VOCs) between (8-25%) and reduces carbon monoxide (CO) between (29-63%). Also, WMA is produced in low temperature which is considered to be an economical benefit. WMA has lower temperature compared to HMA, therefore it consumes a relatively little time to cool to normal temperature. However, the lower mixing and paving temperatures minimize fume and odor emissions and creates cooler working environment for the asphalt workers John Wiley, et al. (2009) [2].

2-Experimental Program

Many test specimens of type (4C) according to ECP, were collected from site for analysis. A sufficient number of samples were taken for laboratory investigations. The specimens were divided using either squaring or mechanical division method which illustrated in AASHTO. The source of the used crushed stones of Dolomitic aggregate with angular particles and rough surface texture is Attaka from Arab – Contractors Company located in Kattamia and the Binder (60/70) obtained from ELNASR COMPANY – located in Suez city with specific gravity 1.02. The results of the evaluation tests are illustrated in table (1). These experiments were carried out at the General Authority for Roads, Bridges, and Land Transport. The Organic additive used is Sasobit which is type of paraffin, previously explained in the introduction and is shown in figure (1).

Table (1): Show names of the material tests, and number of specifications from AASHTO, and ASTM.

Name of the test	AASHTO	ASTM
Sieve Analysis of fine and coarse aggregates	T 27 T 37	C 136 D 546
Los Angeles test	T 96	C 131
Specific gravity and Absorption of coarse aggregates	T 85	C 127

Figure (1): Sample of Sasobit, Hurley, and Prowell (2005) [3].

Testing of emissions and gases was divided into two parts according to inorganic gases and organic solvents. The tests aimed to measure carbon dioxide (CO2), nitrogen oxides (NOx) and volatile organic compounds (VOCs). The tests were carried out at the National Center for Safety Studies, Occupational Health, and Environmental Insurance Work. The nitrogen tube, Carbon dioxide tube (Drager), Accuro Manual Pump and Gas chromatograph are illustrated in figure (2).


Figure (2): Gas chromatograph.

3- Results and Discussion

Sieve analysis of fine and coarse aggregates, Los Angeles, specific gravity and absorption for coarse aggregates have been carried out and the properties of asphalt binder with and without Sasobit are presented in tables (4) and (3) respectively according to AASHTO.

Table (3): The Properties of asphalt binder without Sasobit.

Property	AASHTO	Result	AASHTO Limits	Approval
Softening Point	T 53	50	45-55	ok
Penetration at 25° C, (0.1mm)	T 49	64	60-70	ok
Flash point	T 48	270	≥ 250	ok
Kinematic viscosity	T 201	419	≥ 320	ok

A comparison between Marshall properties for (C.C.D.F), (C.L.S.F) at 155° C, and (20%S.C.D.F), (2.5%S.L.S.F) at 120° C was illustrated in figure (7), while figure (6) shows a comparison between Marshall stability for (S.C.D.F), and (S.L.S.F) at 120° C.

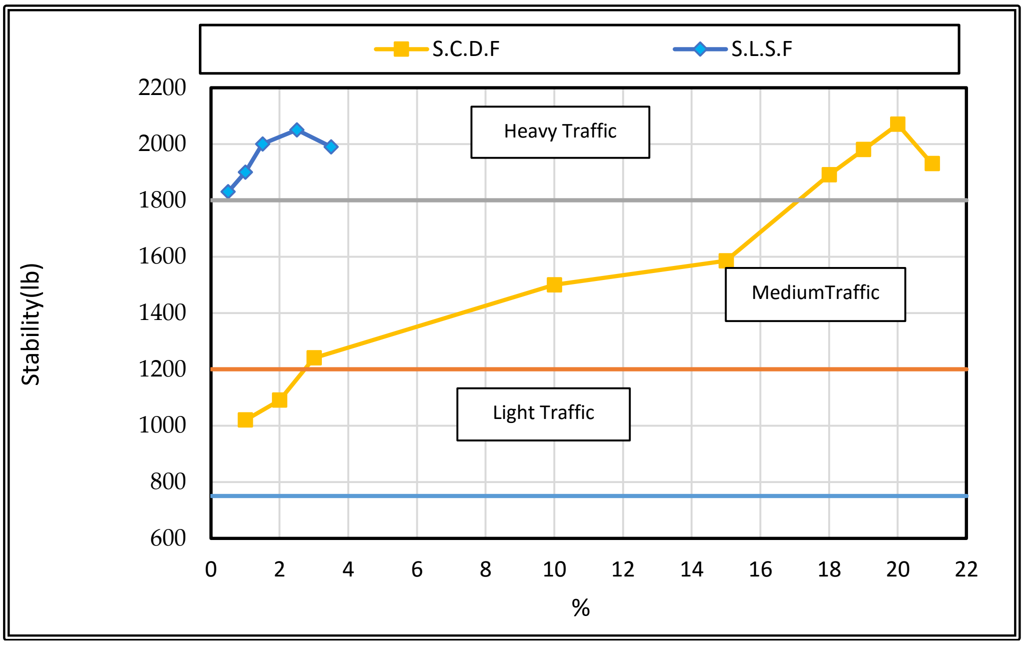

Figure (6): Comparison between Marshall Stability values for (S.C.D.F), and (S.L.S.F).

It can be concluded that the percentage of reduction in time using the furnace with fan is 24.5% using (0.5%S.L.S.F) as minimum requirements in (L.S.F). The advantages of using (0.5%S.L.S.F) are; either decrease in the energy of production by 24.5% or decrease in the time of shift by 24.5%. Also, the reduction in production time by 24.5% leads to increase in the life time of the mixers and accessories by 24.5%, decreasing the maintenance cost and spare parts of the working tools and mixers by 24.5% and reducing the used electric energy by 24.5%. The missions as a function of temperature are presented in table (4). Generally, it was found that the emissions increased by an increase in temperature. A Comparison between emissions when using (20%S.C.D.F), and (2.5%S.L.S.F) at temperature 155 °, and 120° C was illustrated in table (11), while table (12) shows the emissions reduction measured for (20%S.C.D.F), and (2.5%S.L.S.F).

Table (4): Comparison between emissions for (20%S.C.D.F), and (2.5%S.L.S.F) at temperature 155 ºC, and 120 ºC.

	20%S.C.D.F		2.5%S.L.S.F		Limit through 8 work (PPm)
	155	120	155	120	
CO2	15.6	13.4	15.4	13.1	< 25
NOx	0.82	0.56	0.79	0.53	< 3
VOCs	7.3	6.9	7.1	6.4	---

4- CONCLUSIONS

This research compare the effect of adding (S.C.D.F), and (S.L.S.F) at 120º C to asphalt binder with HMA at 155º C. The program consists of two stages, the first stage was adding (S.C.D.F), while the second stage was adding (S.L.S.F) to the specimens after obtaining (O.S.C) for (C.D.F) and (L.S.F) at 120º. The test results were compared with control specimens (C.C.D.F) and (C.L.S.F). The main conclusions can be summarized as;

1. Maximum stability was achieved by adding 20% of (S.C.D.F) which increased stability from 1020 to 2070 Ib and then decreased at 21%.
2. The Flow decreased with the increase of (S.C.D.F) and (S.L.S.F) percentages.
3. The Air Void percentage for WMA increased with the increase of (S.C.D.F) %, while it decreases with the increase of (S.L.S.F)%.
4. The percentages of reduction in Carbon dioxide (CO2), Nitrogen Oxides (NOx) and Volatile Organic Compounds (VOCs) were 14.10, 31.71 and 5.48% respectively at the optimum percentage of (S.C.D.F), while percentages of reduction were 14.94, 32.91 and 9.86% respectively at the optimum percentage of (S.L.S.F).

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