Utilization Of Cement Kiln Dust As A Mineral Filler On A Bituminous Pavement

G.Arivunithi[1], V.Ashokkumaran[2], P.Rajkumar[3], E.Chandrabose[4]
Department of Civil Engineering
[1, 2, 3, 4] Surya Group Of Institution

Abstract-*By pass cement dust is proposed within this research as an alternative to traditional limestone mineral filler in hot mix asphalt (HMA). The effect of using waste cement dust as a mineral filler on the mechanical properties of hot mix asphalt was investigated. The optimum cement dust content was determined. The studied mechanical properties include Marshall properties, indirect tensile strength, and unconfined compressive strength. Five asphalt concrete mixtures with various cement dust contents, namely; 0%, 25%, 50%, 75% and 100% by weight of the limestone mineral filler were studied. Laboratory testing has revealed an enhancement in Marshall and mechanical properties of asphalt concrete mixtures when cement dust was used. Marshall testing results have indicated an increase in the stability, unit weight and a decrease in the flow, voids ratio and voids in mineral aggregates when the percentage of cement dust content increases. The indirect tensile strength and unconfined compressive strength have also increased as the ratio of cement dust increased. The optimum cement dust ratio was found to be 100% of the used mineral filler. Hence, cement dust can totally replace lime stone mineral filler in asphalt paving mixtures.*

Keywords-character recognition, character segmentation, Number plate detection, Toll collection, Vehicle number recognition.

I. INTRODUCTION

Waste materials can broadly be categorized as industrial wastes such as cement dust, wood lignins, bottom ash and fly ash; and municipal/domestic wastes such as incinerator residue, scrap rubber, waste glass and roofing shingles. Waste cement dust or cement kiln dust is the by-product of the manufacture of portland cement. It is generated during the calcining process in the kiln. Lime (CaO) constitutes more than 60% of CBPD composition. Other compounds include SiO2, Al2O3, Fe2O3, K2O, Na2O, Cl, etc. Most of Cement Company generates huge quantities of CBP problems. Therefore, the design of the plant includes different types of filters and dust collectors which investment up to 12% of the entire cost of the plant. The cement industry usually uses mechanical, electrostatic precipitators bughouse dust collectors, or combinations in order to control the emission of dust particle. These studies try to match society's need for safe and economic disposal of waste materials with the highway industry's need for better and more costeffective construction materials.

The current study is performed to study the effect of using waste cement dust obtained form white cement industry in asphalt concrete mixtures as a part of the fine aggregate. The effect of cement dust content on the mechanical properties of asphalt concrete mixtures was also evaluated. A laboratory study was conducted on five asphalt mixtures with various cement dust every year. Some CBPD is recycled back again with the clinker. However, most of the material is disposed of on-site without any further reuse or reclamation.

II. MATERIAL CHARACTERIZATION:

1-Asphalt Binder:

Asphalt binder 60/70 supplied by Suez Bitumen Supply Company was used within this research. The used asphalt binder was subjected to a series of standard laboratory tests to determine its physical properties. Recently, many environmental and highway agencies are using waste material in highway construction. Some fines have a considerable effect on the asphalt cement making it act as a much stiffer grade of asphalt cement compared to the neat asphalt cement grade[2-5], and thereby affect the HMA pavement performance including its fracture behavior[6-7]. Study made by Taha[8] indicated through Marshall testing that cement dust can be used as a substitution for lime stone mineral filler in asphalt paving mixtures. It was also shown that the components of cement dust can assist in promoting stripping resistance and thus can replace hydrated lime or liquid antistripping agents[9-10 Results of those tests are shown in Table (1).

2-Aggregate:

Coarse aggregate and fine aggregate (Bulk specific gravity of 2.72 and 2.67 respectively) were used in the preparation of the asphalt concrete mixtures. Limestone was used as mineral filler. The selected gradation of aggregate incorporated in all asphalt concrete specimens confirms to the

mid point of the standard 4-c aggregate gradation specified in the Egyptian highway standard specifications. Table (2) presents the selected mix gradation (including Cement dust).

3-Mineral filler:

Cement dust was used as a percent of 0%, 25%, 50%, 75%, and 100% of limestone The properties (Gradation, Specific Gravity, and Absorption) of the cement dust and lime stone are given in Table (3).

Sieve	% Passing	
	Cement Dust	Lime Stone
No. 30	100	100
No. 50	100	95
No. 200	85	78
Plasticity Index	2	3
Specific Gravity	2.7	2.55
Absorption	1%	1.5 %

III. EXPERIMENTAL PROCEDURE:

1-Marshall Testing:

Laboratory investigations on the mechanical performance of asphalt concrete mixtures have been conducted by using varying specimen bitumen content. The Marshall stability test (ASTM Designation: D 1559-82), is used in highway engineering for both mix design and evaluation. Although Marshall method is essentially empirical, it is useful in comparing mixtures under specific conditions.

2-Indirect Tensile Strength Test (ITS):

A mechanical displacement control testing frame was used to conduct the indirect tensile tests in accordance with (ASTM D4123) to evaluate the tensile strength of asphalt concrete mixtures. Test specimens 2.5 inches thick and 4 inches diameter were compacted and then tested using curved steel loading strips 0.5 inch wide. The load was applied at a vertical deformation rate of 4 mm/min. The indirect tensile strength is the maximum stress developed at the center of the specimen in the radial direction during loading. The specimen failed by splitting along the vertical diameter as shown in Figure (1). Indirect tensile strength testing was made at a room temperature of around 25 oC.

3-Unconfined Compressive Strength Test:

The unconfined compression tests were performed using a 15-ton capacity universal testing machine in the a room temperature of around 25oC. Test specimens 2.5 inches thick and 4 inches diameter were placed on the lower fixed plate of the testing machine. Load was applied with a uniform rate of 2 mm/min on the circular face of the testing samples until failure occurred. The maximum load to failure was recorded and hence the compressive strength was calculated.

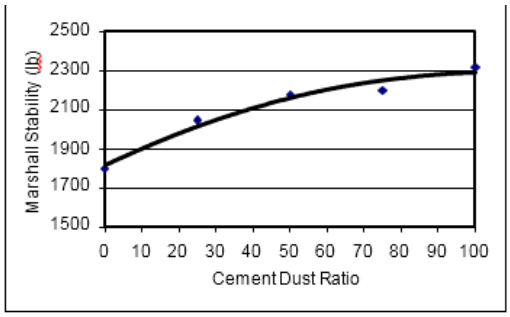


Fig. (3): Marshall Stability for Mixtures with Different Cement Dust Content

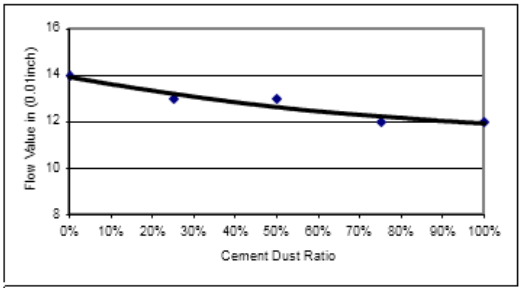
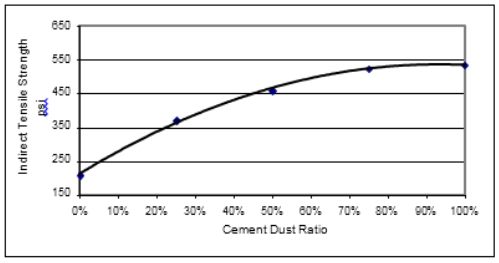


Table (7): Indirect Tensile Strength of Mixtures with Different Cement Dust Content

Limestone %	Cement Dust %	Indirect Tensile Strength (psi)
100%	0%	207
75%	25%	370
50%	50%	458
25%	75%	523
0%	100%	535



IV. CONCLUSION

By pass cement dust is proposed within this research as an alternative to traditional lime stone mineral filler. Evaluation of the mechanical properties of asphalt concrete mixtures has revealed an enhancement in their Marshall and mechanical properties when cement dust was used. It was found that each of Marshall stability, specific gravity, indirect tensile strength, and unconfined compressive strength increase as the cement dust increase. Flow values, void ratio and voids in mineral aggregates decreases as the cement dust content increases. Optimum cement dust content was found to be 100%. Thus cement dust can replace lime stone as a mineral filler in asphalt concrete mixtures. Using cement dust in

asphalt mixing can also have many enviromental advantages. Before widely adapting cement dust in asphalt paving, trial sections and adequate provisions should be provided.

REFERENCES

[1] R.J. Collins and S.K. Ciesielski. Recycling and Use of Waste Materials and Byproducts in Highway Construction, Volumes 1 & 2, 1993.

[2] Kandhal, P.S. Evaluation of Baghouse Fines in Bituminous Paving Mixtures. Journal of the Association of Asphalt Paving Technologists, Vol. 50, 1981.

[3] Anderson, D.A., J.P. Tarris, and D. Brock. Dust Collector Fines and Their Influence on Mixture Design. Journal of the Association of Asphalt Paving Technologists, Vol. 51, 1982.

[4] Eick, J.M., and J.F. Shook. The Effects of Baghouse Fines on Asphalt Mixtures. Asphalt Institute, Research Report 78-3, November 1978.

[5] Dukatz, E.L., and D.A. Anderson. The Effect of Various Fillers on the Mechanical Behavior of Asphalt And Asphaltic Concrete.