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Fly Ash Tiles and its Resistance to Wear

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Abstract

As fly ash consist of more fine particles and amorphous in nature, it shows pozzolanic behavior and sometimes also self-cementitious character. Depending on the proportion of its porosity and its chemical constitutes, its density ranges between 1.3g/cm3 and 4.8g/cm3. To-date cement and concrete industry uses around half of fly ash. Concrete tiles can be another substitution to the costly traditional tiles. Traditional tiles also have low operating life. Here full size tiles for different compositions of fly ash are picked for the abrasion resistance test. The test samples were of size 70.6mm×70.6mm i.e. their surface area is 5000mm2.
Keywords- Abrasion Test, Concrete Tiles, Fly Ash, Pozollana, Thermal Power Plant

I. INTRODUCTION

Fly ash is an artificial pozzolana. It is a waste material collected from the flue gases extracted through the burning of coal in thermal power generating sectors. About 112 million tonnes of fly ash per annum are produced by about 120 thermal power generating plants in India. The demand of power is increasing with growing population and as coal is the main resource of energy, new thermal power plants expecting to enhance their electricity production capacity in the future. Fly ash is regarded as a “Pollution Industrial Waste” by the “Pollution Control Board”.

Table 1: Fly Ash Production and Their Uses in Different Countries (J.Alam and M.N Akhter in 2011)

SL. NO.	Country	Annual Fly Ash Generation, MT	Uses of Fly Ash in %
1	India	120	40
2	China	105	46
3	USA	80	68
4	Germany	45	90
5	UK	16	55
6	Australia	12	88
7	Canada	7	76
8	France	4	90
9	Denmark	3	100
10	Italy	3	100

A. Measuring Instrument

To measure the thickness of the test specimen before and after the abrasion test, the measuring instrument i.e. dial gauge is used which is capable of measuring the thickness to an accuracy of 0.01mm.

The arrangement of the dial gauge for the thickness measurement is shown in figure below. The shoulder A and B are at perpendiculars and the base C is laid at the top to the precision of 0.01mm. The tile sample is positioned on the base in a manner that the sides of the specimen touches with the shoulders A & B. with its wearing surface facing towards up. The dial gauge is set up so firmly that the reading of dial gauge is taken when the contactor somewhat presses on surface of the tile sample. The sitting of the contactor and the dial gauge should be positioned at the same level throughout the successive measurement of thickness later than abrasion test.

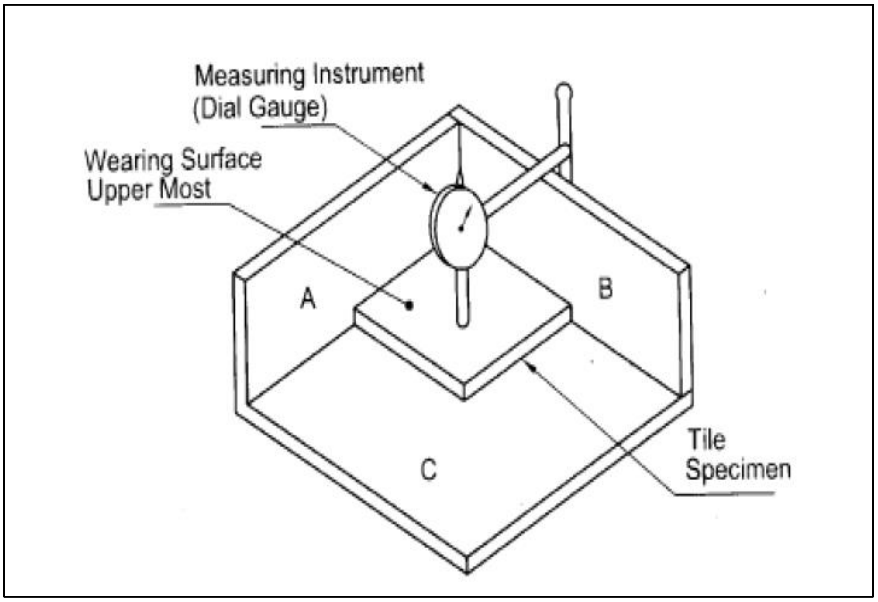

Fig. 1: Arrangement for measurement of tiles

II. MIX DESIGN

The mix used for the design was M25 water cement ratio of 0.5.
Thus volume of cement = 0.001848 m3
Volume of fine aggregate (sand) = 0.001848 m3
Volume of coarse aggregate = 0.003696 m3

III. TWO TYPES OF MIX PROPORTIONS

In the first case, three types of mix arises with the replacement of fine aggregate by 0% , 50% and 60% with their designated name as A0, A1 and A2 respectively.
In the second case, two types of mix were taken in which both the case the fine aggregate was replaced with 70% of fly ash. The cement was replaced with 10% fly ash and designated as B1 and the mix replaced with 20% fly ash was designated as B2.

IV. TEST PROCEDURE

The test specimen of size (70.6mm×70.6mm) is oven-dried at 100^0C for 24 hours and then they are weighed to the nearest 0.1gm. After initial drying and weighing the test specimen is placed in the thickness measuring apparatus (dial gauge) with its wearing surface facing towards up and the evaluation of the dial gauge is taken. The grinding path of the disc of the abrasion testing machine is evenly sprinkled with 20gm of aluminum oxide powder. The test sample is then attached in the holding tool with the wearing surface to be ground facing the disc and a load of 300N is loaded at the center. The grinding disc of the abrasion testing machine is then set on motion at a rate of 30 rev/min. and the aluminum oxide powder is fed back continuously on to the grinding path in order that it is homogeneously circulated in a track corresponds to the width of the test member. The grinding disc is stopped after every 22 revolutions and the abraded aluminum oxide powder and the residue of the abrasive powder is taken away from the disc and new aluminum oxide powder of 20gm applied in each time. The test specimen is rotated about the vertical axis through a right angle in clockwise direction after every 22 revolutions. This procedure is repeated 15 times there by giving a total number of 352 revolutions. Later than the abrasion test is done, the tile sample is again weighed to the nearest 0.1gm. It is then positioned in the thickness measuring instrument afresh in a way such that with same location and setting of the dial gauge like for the thickness measurement previous to abrasion test. And the reading after abrasion test is noted.

A. Determination of Wear

The wear of the specimen is evaluated from the diversity in the readings taken by the measuring instruments earlier than and later than the abrasion test of the sample. The wear of the specimen is the average loss in thickness of the sample taken by the following method.
t = ((W1 – W2)* V1)/ (W1*A)
Where t = average loss in thickness in mm
W1 = initial weight of the sample, in gm
W2 = Final weight of the specimen after abrasion test in gm

V1 = initial volume of the sample, in mm3
And A = Surface area of the sample, in mm2
The wear on individual specimens and the average of these individual wears are reported.

Abrasion Resistance of Concrete Tiles Concrete Type	*Abrasion Resistance in mm*
A0	*0.131*
A1	*0.097*
A2	*0.083*
B1	*0.059*
B2	*0.066*

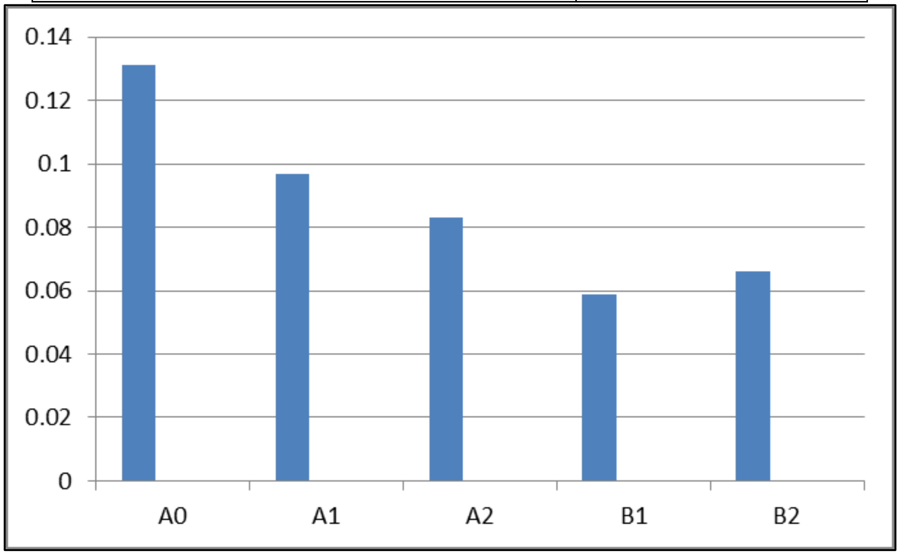

Fig. 2: Abrasion resistance of tiles

V. CONCLUSION

1) All the concrete tiles for all compositions when subjected in abrasion resistance machine showed less loss in thickness as compared to the market tiles that is all the composition of tiles prepared are better wear resistance than the market tile.
2) The concrete tiles with 50% of sand substituted with fly ash showed 25.95% & 61.2% better wear resistance as compared to the control mix concrete tiles and market tiles respectively.
3) The concrete tiles with 60% of sand substituted with fly ash showed 36.64% & 66.8% better wear resistance as compared to the control mix concrete tiles and market tiles respectively.
4) The concrete tiles in which 70% sand substituted with fly ash and 10% cement substituted with fly ash displayed 54.96% & 76.4% better wear resistance than that of the reference concrete tile and market tiles respectively.
5) The concrete tiles with 70% sand and 20% cement replaced with fly ash presented 49.2% & 73.6% better in wear resistance the reference concrete tiles and market tiles respectively.

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