© UNIVERSAL RESEARCH REPORTS | REFEREED | PEER REVIEWED
ISSN : 2348 - 5612 | Volume : 05 , Issue : 03 | January – March 2018

Analysis of suitability of the aggregate for use in pavement construction

Subodh Khatkar
Department of Civil Engineering, MRIEM, Rohtak, Haryana, India
Email – khatkarsubodh@gmail.com

Abstract
This paper deals with the methodology used and the tests conducted on aggregates while performing the tender work for the improvement of pavement by widening from 5.50 meter to 10.00 meter staging and C. C. Block on Rewari Dadri road upto Lula Ahir in Rewari District including shifting of utility of P. H. and Electrical (Road ID: 1339, 4656 and 1682) including HSAMB Portion with an objective to tailor the functionality of this framework so that it is suitable for cultural exploration across national and regional boundaries. Aspects of specimen preparation and of procedures adopted of aggregate tests are analysed and demonstrated that results from these tests can affect, significantly, the results obtained.The paper presents the detailed procedure and equipment required for each testing method.

ISSN : 2348-5612 © URR
9 770234 856124

Key words: Aggregates, Crushing, Abrasion, Specific gravity and Water absorption

1. Introduction

Coarse aggregates establish 40% to 80% of concrete volume. The mechanical properties of aggregates are important to describe concrete strength and recent studies revealed that its physical properties can distress concrete durability parameters [1]. Hence, it is of prime importance to test the aggregates before using them as construction material. Various tests conducted to determine the properties of aggregates are enlisted and described in this paper.

2. Aggregate tests

In order to decide the suitability of the aggregate for use in pavement construction, following tests are carried out:

2.1 Crushing test

Pavement materials can be unsuccessful in one test i.e. crushing under compressive stress. This test is standardized by IS: 2386 part-IV and is carried out to define the crushing strength of aggregates [2]. The aggregate crushing assessment offers a relative measure of resistance to crushing under progressively applied crushing load. In this test, the sample of aggregate is exposed to standard load conditionsin standard mould to a compression test. Dry aggregates which can pass through 12.5 mm sieves and recollected 10 mm sieves are occupied in a cylindrical measure of 11.5 mm diameter and 18 cm height in three depositing layers. Each layer is meddled 25 times with at standard tamping rod used during this test. The test sample is weighed and placed in the test cylinder in three depositing layers where each layer is being tampered again. The sample goes through a compressive load of 40 tonnes gradually applied at the rate of 4 tonnes per minute. After that, the crushed aggregates are sieved through 2.36 mm sieve and weight of passing material (W2) is expressed as percentage of the weight of total sample (W1) which is the aggregate crushing value. Aggregate crushing value = W1 W2 × 100. When the value is less than 10 it signifies a remarkably strong aggregate while when this is above 35, it is regarded as a weak aggregate.

2.2 Abrasion test

Abrasion test [3] is conducted to test the hardness properties of aggregates and to check suitability of these materials for different pavement construction works. Los Angeles abrasion test is a chosenas the ideal one for conducting the hardness property and has been standardized in India (IS:2386 part-IV). The main aim of Los Angeles abrasion test is to test the percentage wear owing to comparative rubbing action amongst the aggregate and steel balls used as abrasive charge. Los Angeles machine contains a circular drum of internal diameter 700 mm and length 520 mm mounted on horizontal axis

© UNIVERSAL RESEARCH REPORTS | REFEREED | PEER REVIEWED
ISSN : 2348 - 5612 | Volume : 05 , Issue : 03 | January – March 2018

allowing it to be rotated as depicted in Figure 1. An abrasive charge containingcast iron spherical balls of 48 mm diameters and weighing 340-445 g arepositioned in the cylinder alongside with the aggregates.

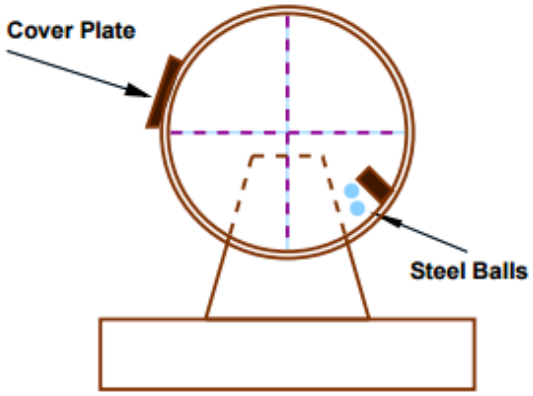

Figure 1 Los Angeles abrasion test setup

The amount of the abrasive spheres differsrendering to the grading of the specimen. The amountof aggregates to be used is dependent on the gradation and generally ranges from 5-10 kg. After that, the cylinder is locked and rotated at speed of 30-33 rpm for a period of 500 -1000 revolutions subject to the gradation of aggregates. After predefined revolutions, the specimen is sieved via a 1.7 mm sieve and the amount that passed is articulated as percentage total weight of the sample. This percentage total weight is called Los Angeles abrasion value. A maximum value of 40 percent is allowed for WBM base course in Indian conditions. For bituminous concrete, a maximum value of 35 is specified [4].

2.3 Impact test

The aggregate impact test [5] is conducted to carry out the resistance to impact of aggregates. Aggregates which pass 12.5 mm sieve [10] and which are retained on 10 mm sieve are filled in a cylindrical steel cup of internal dia 10.2 mm and depth 5 cm which is attached to a metal base of impact testing machineas shown in Figure 2. The sample is filled in 3 layers where each layer is tampered for 25 blows. Metal hammer of weight 13.5 to 14 Kg is arranged to drop with a free fall of 38.0 cm by vertical guides and the sample under test is subjected to 15 blows. The crushed aggregate is allowed to pass through 2.36 mm IS sieve [9-10]. And the impact value is measured as percentage of aggregates passing sieve (W2) to the total weight of the sample (W1) [6].

Aggregate impact value = (W1/ W2) × 100

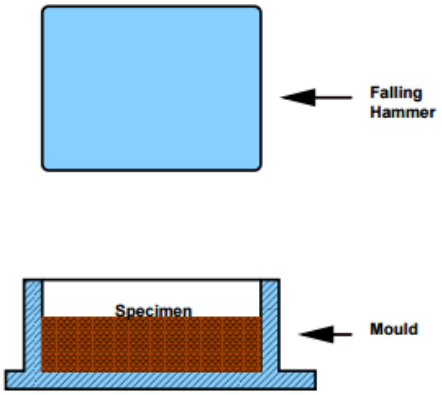

Figure 2 Impact test setup

2.4 Soundness test

Soundness test is envisioned to carry out the resistance of aggregates to weathering action, by using accelerated weathering test cycles. The Porous aggregates imperilled to freezing and thawing are expected to disintegrate prematurely. To establish the durability of such aggregates, they are exposed to an accelerated soundness test as specified in IS:2386 part-V[7,8]. Aggregates of specified size are subjected to cycles of alternate wetting in a saturated solution of either sodium sulphate or magnesium sulphate for 16 - 18 hours and then dried in oven at 105 − 110oC to a constant weight. After five cycles, the loss in weight of aggregates is determined by sieving out all undersized particles and weighing [9,10]. And the loss in weight should not exceed 12 percent when tested with sodium sulphate and 18 percent with magnesium sulphate solution.

2.5 Shape tests

The particle shape of the aggregate mass is determined by the percentage of flaky and elongated particles in it. Aggregates which are flaky or elongated are unfavourable to higher workability and stability of mixes. The flakiness index is well-defined as the percentage by weight of aggregate particles whose least dimension is less than 0.6 times their mean size. Test procedure of conducting this test had been standardized in India (IS:2386 part-I). The elongation index of an aggregate is defined as the percentage by weight of particles whose greatest dimension (length) is 1.8 times their mean dimension. This test is applicable to aggregates larger than 6.3 mm. This test is also specified in (IS:2386 Part-I). However there are no recognized limits for the elongation index.

2.6 Specific Gravity and water absorption

The specific gravity and water absorption of aggregates are significant parameters which are essential for the design of concrete and bituminous mixes. The specific gravity of a solid is defined as the ratio of its mass to that of an equal volume of distilled water at a definite temperature.

Property of aggregate	Type of Test	Test Method
Crushing strength	Crushing test	IS : 2386 (part 4)-1963
Hardness	Los Angles abrasion test	IS : 2386 (part 5)-1963
Toughness	Aggregate impact test	IS : 2386 (part 4)-1963
Durability	Soundness test- accelerated durability test	IS : 2386 (part 5)-1963
Shape factors	Shape test	IS : 2386 (part 1)-1963
Specific gravity and porosity	Specific gravity test and water absorption test	IS : 2386 (part 3)-1963
Adhesion to bitumen	Stripping value of aggregate	IS : 6241-1971

Table 1 Tests for Aggregates with IS codes [2]

Conclusion

It is evident that some properties of aggregates such as crushing value, bulk density etc can have positive impacts for road construction when they are used as construction material. But on the other hand, analysing other properties of aggregates like impact value, water absorption, specific gravity etc. it can be concluded that these materials can be employed in low cost buildings as construction materials. If selection of aggregates is done properly by conducting suitable test they can be used with increased feasibility of concrete and hence enhance and help us to keep environment noise free (noise from query site) and balancing ecological system.

References

1. Pacheco Torgal, F., Castro Gomes, J.P. and Lopes, S.M.R., Experimental Study of Concrete Durability Parameters produced with Different Types of Aggregates, in XXX IAHS, September 9-12, 2002, Coimbra, Portugal.
2. IS: 2386 (Part IV)-1963 Methods of test for aggregate for concrete Part IV Mechanical Properties.
3. ASTM C418 (2005), Standard test method for abrasion resistance of concrete by sandblasting, ASTM International, West Conshohocken, 4pp.
4. ASTM C1138 (1997), Standard test method for abrasion resistance of concrete (Underwater Method), ASTM International, West Conshohocken, 4pp.
5. IS 2430-1996 (first revision): Methods for Sampling of Aggregates for Concrete.
6. IS 5640-1970:" Methods of Test for Determinig Aggregate Impact value of Soft Coarse Agrregate
7. Bjarnason, G. , Petursson, P. and Erlingsson, S. "QUALITY ASSESSMENT OF AGGREGATES FOR ROAD CONSTRUCTION - Fragmentation, weathering and abrasion".Fredonia; World Construction Aggregates to 2011 – Demand and Sales Forecasts; Market Share, Market Size, Market leaders, Industry Report, 2007, pp 321
8. S. Kou, B. Zhan, and C. Poon, "Feasibility study of using recycled fresh concrete waste as coarse aggregates in concrete," Construction and Building Materials, vol. 28, no. 1, pp. 549–556, 2012.
9. IS 383-1970 (re approved in 1999): Specifications for coarse and fine aggregates from Natural source for concrete.
10. IS 460 (part 1 & 2) – 1985: Specification for test sieve.