INTRODUCTION

Due to the movement of traffic, the road stones used in the surfacing course are subjected to wearing action at the top. Resistance to wear or hardness is hence an essential property for road aggregates, especially when used in wearing course. Thus road stones should be hard enough to resist the abrasion due to traffic. When fast moving traffic fitted with pneumatic types move on the road, the soil particles present between the wheel and road surface causes abrasion on the road stone. Steel tires of animal drawn vehicles, which rub against the stones, can cause considerable abrasion of the stones on the road surface. Hence in order to test the suitability of road stones to resist the abrasion action due to traffic, tests are carried out in the laboratory.

Abrasion test on aggregates are generally carried out by any one of the following methods:

a) Los Angeles abrasion test
b) Deval's abrasion test
c) Dorry's abrasion test

Of these tests, the Los Angeles abrasion test is more commonly adopted as the test values of aggregates have been correlated with performance of studies. The ISI has suggested that wherever possible, Los Angeles abrasion test should be preferred.

In addition to the above abrasion tests, another test, which is carried out to test the extent to which the aggregates in the wearing surface get polished under traffic, is "Polishing stone value" test. Samples of aggregates are subjected to an accelerated polishing test in a machine and a friction test is carried out on the polished specimen. The results of this test are useful only for comparative purpose and specifications are not yet available.

OBJECTIVE

Determination of Los Angeles abrasion value of the aggregate.

THEORY:

The principle of Los Angeles abrasion test is to find the percentage wear due to relative rubbing action between aggregates and steel balls used as abrasive charge. The pounding action of these balls also exits while conducting the test. Some investigators believe this test to be more dependable as rubbing and pounding action simulate the field conditions where both abrasion and impact occur. Los Angeles

abrasion test has been standardized by the ASTM, AASHO and also by the ISI. Standard specification of Los Angeles abrasion values is also available for various types of pavement constructions.

EQUIPMENT & APPARATUS

The apparatus consists of Los Angeles machine, sieves, balance, iron spheres, oven etc.

Los Angeles machine consists of a hollow steel cylinder, closed at both ends having an inside diameter 70cm and an inside length of 50cm, mounted on stub shafts about which it rotates on a horizontal axis. An opening is provided in the cylinder for the introduction of the test sample. A removable cover of the opening is provided in such a way that when closed and fixed by bolts and nut, it is dust-tight, and the interior surface is perfectly cylindrical. A removable steel shelf projecting radially 8.8 cm into the cylinder and extending to the full length of it is mounted on the interior surface of the cylinder rigidly parallel to the axis. The shelf is fixed at a distance of 125 cm from the opening, measured along the circumference in the direction of rotation as shown in Figure 3.1.

Abrasive charge, consisting of cast iron spheres approximately **4.8 cm in diameter** and **390 to 445 g in weight** are used. The weight of the sphere used as the abrasive charge and the number of spheres to be used are specified depending on the gradation of the aggregates tested. The aggregate grading has been standardized as A. B. C, D. E, F, and G for this test and the IS specifications for the grading and abrasive charge to be used are given in Table 3.1. IS sieve with l.70 mm opening is used for separating the fines after the abrasion test.

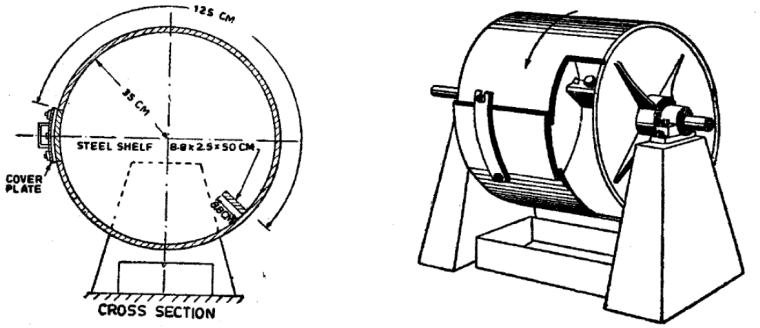

Figure 3.1: Los Angeles Abrasion Machine

Table 3.1 Los Angeles Abrasion grading table

Grading	Weight in grams of each test sample in the size range, mm (Passing and retained on square holes)										Abrasive charge (number of spheres)	Weight of charges, g
	80-63	63-50	50-40	40-25	25-20	20-12.5	12.5-10	10-6.3	6.3-4.75	4.75-2.36		
A	-	-	-	1250	1250	1250	1250	-	-	-	12	5000±25
B	-	-	-	-	-	2500	2500	-	-	-	11	4584±25
C	-	-	-	-	-	-	-	2500	2500	-	8	3330±20
D	-	-	-	-	-	-	-	-	-	5000	6	2500±15
E	2500	2500	5000	-	-	-	-	-	-	-	12	5000±25
F	-	-	5000	5000	-	-	-	-	-	-	12	5000±25
G	-	-	-	5000	5000	-	-	-	-	-	12	5000±25

*Tolerance of ±2 percent is permitted.

PROCEDURE:

Clean aggregates dried in an oven at 105-110°C to constant weight. Conforming to anyone of the grading A, to G, as per Table 3.l. is used for the test. The grading or gradations used in the test should be nearest to the grading to be used in the construction. Aggregates weighing 5 kg for grading A. B, C or D and 10 kg for grading E, F or G may be taken as test specimen and placed in the cylinder. The abrasive charge is also chosen in accordance with Table 3.1 depending on the grading of the aggregate and is placed in the cylinder of the machine. The cover is then fixed dust-tight. The machine is rotated at a speed of **30 to 33 revolutions** per minute. The machine is rotated for **500 revolutions** for gradations A. B, C and D, for gradations E, F and G, it shall be rotated for 1,000 revolutions. The machine should be balanced and driven in such a way as to maintain uniform peripheral speed.

After the desired number of revolutions, the machine is stopped and the material is discharged from the machine taking care to take out entire stone dust. Using a sieve of size larger than 1.70 mm IS sieve, the material is first separated into two parts and the finer position is taken out and sieved further on a 1.7 mm IS sieve. The portion of material coarser than 1.7mm size is washed and dried in an oven at 105 to ll0°C to constant weight and weighed correct to one gram.

CALCULATIONS:

The difference between the original and final weights of the sample is expressed as a percentage of the original weight of the sample is reported as the percentage wear.

Let the original weight of aggregate =W_1 gm

Weight of aggregate retained on 1.70mm IS sieve after the =W_2 gm

Loss in weight due to wear test = (W_1-W_2) gm

Los Angeles abrasive value, % = Percentage wear = (W_1-W_2) / W_1 *100

OBSERVATION TABLE FOR AGGREGATE ABRASION VALUE TEST:

Name of the Student: _____ Student No. _____

Type of Material : Brick Chips/Stone chips/Gravels/Boulder/Rock
Grade of the material :
Number of spheres used:
Weight of charge :
Size of the aggregate :
Number of revolutions :
Speed of rotation :

Details	Test 1	Test 2
Weight of surface-dry sample, W_1 (gm)		
Wt. of materials retained on 1.70 mm sieve, W_2 (gm)		
Loss in weight due to wear test = (W_1-W_2) (gm)		
Los Angeles abrasive value (%) = (W_1-W_2) / W_1 × 100% (to the first decimal place)		
Average Los Angeles abrasive value (%) = (to the nearest whole number)		

RESULT:

The result of the Los Angeles abrasion test is expressed as a percentage wear and the average value of two tests may be adopted as the Los Angeles abrasion value.

DISCUSSION:

It may seldom happen that the aggregates desired for a certain construction project has the same grading as anyone of the specified gradations. In all the cases, standard grading or gradations nearest to the gradation of the selected aggregates may be chosen.

Different specification limits may be required for gradations E, F and G, when compared with A, B, C and D. Further investigations are necessary before any such specifications could be made.

Los Angeles abrasion test is very commonly used to evaluate the quality of aggregates for use in pavement construction, especially to decide the hardness of stones. The allowable limits of Los Angeles abrasion values have been specified by different agencies based on extensive performance studies in the field. The ISI has also suggested that this test should be preferred wherever possible. However, this test may be considered as one in which resistance to both abrasion and impact of aggregate may be obtained simultaneously, due to the presence of abrasive charge. Also the test condition is considered more representative of field conditions. The result obtained on stone aggregates is highly reproducible.

Applications of Los Angeles Abrasion Test:

Los Angeles Abrasion test is very widely accepted as a suitable test to assess the hardness of aggregates used in pavement construction. Many agencies have specified the desirable limits of the test, for different methods of pavement construction. The maximum allowable Los Angeles abrasion values of aggregates as specified by Indian Roads Congress for different methods of construction are given in Table 3.2.

Experiment No. 04: AGGREGATE ABRASION VALUE TEST

TABLE 3.2: Maximum Allowable Los Angeles Abrasion Values of Aggregates in Different Types of Pavement Layers

Serial no.	Type of pavement layer	Los Angeles abrasion value, maximum %
1.	Water Bound Macadam (WBM), sub-base course	60
2.	(i) WBM base course with bituminous surfacing (ii) Bituminous Macadam base course (iii) Built-up spray grout base course	50 50 50
3.	(i) WBM surfacing course (ii) Bituminous Macadam binder course (iii) Bituminous penetration Macadam (iv) Built-up spray grout binder course	40 40 40 40
4.	(i) Bituminous carpet surface course (ii) Bituminous surface dressing, single or two coats (iii) Bituminous surface dressing using precoated aggregates (iv) Cement concrete surface course (as per IRC)	35 35 35 35
5.	(i) Bituminous/ Asphaltic concrete surface course (ii) Cement concrete pavement surface course (as per IRC)	30 30