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USE OF INDUSTRIAL WASTE IN FLEXIBLE PAVEMENT CONSTRUCTION

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ABSTRACT

In present era, safe disposal of Industrial wastes is a great problem. These waste materials create environmental pollution because many of them are non-biodegradable. India has a large network of industries which are located in different parts of the country and many more are to come in the near future. Million metric tons of industrial wastes are produced in these Industries. The pollution and disposal problems may be minimized by utilizing these materials in highway construction. It is essential to test these materials and to find a new methodology and specifications to increase the use of these industrial wastes in road construction in India. A review of various Industrial wastes to be used in the construction of highway has been discussed in this paper. The common waste materials used are construction and demolition waste and tiles waste causing problems in the disposal.

Keywords- C & D (Construction and Demolition) waste, Tiles waste, Ceramic waste, Industrial wastes

1. INTRODUCTION

We know that the India is the developing country which means that industrialization is growing day by day. Because of the industrialization waste are producing on large scale. Disposal issue of the waste products is a challenge now a day. Some of these waste materials are not biodegradable and often leads to waste disposal crisis and environmental pollution. Due to increasing waste volume and a shortage of landfill, waste management is becoming a more significant and important subject. Studies reveal that in recent years, industrial wastes were successfully used in road construction in many developed countries. The use of these materials in road making is based on technical, economic, and ecological criteria. India has a vast network of industries located in different parts of the country**.** Traditionally soil, stone aggregates, sand, bitumen, cement etc. are used for road construction. Natural materials being exhaustible in nature, its quantity is declining gradually. Also, cost of extracting good quality of natural material is increasing.

Concerned about this, it is important to find alternative materials for highway construction, and industrial waste product is one such category. If these materials can be suitably utilized in highway construction, the disposal problem of these waste may be get reduced it will also help to reduce the pollution. Keeping in mind the need for bulk use of these solid wastes in India, it was thought expedient to test these materials and to develop specifications to enhance the use of these industrial wastes in road making, in which higher economic returns may be possible. The possible use of these materials should be developed for construction of low-volume roads in different parts of our country. The necessary specifications should be formulated and attempts are to be made to maximise the use of solid wastes in different layers of the road pavement.

2. MATERIAL EMPLOYED

Since construction and demolition waste are producing on large scale and ceramic (tiles) wastes are also generating on large scale. Management of these waste is a big problem that world is facing now. Here is the best way to manage these is utilizing it in road construction. Hence we are using these two waste materials.

2.1 Sampling

Sampling is the process of collection of materials from their resources. Sampling of C and D waste and Tiles waste can be done as follows:

C and D- Due to urbanization the construction domain is increasing drastically along with that environmental issue like landfill due to illegal dumping etc are also increasing and every man made structure has a certain year of life span. After their life span building has to be demolished. Due to demolition construction waste is produced and due to less land availability disposing is a problem. So C and D waste is collected from the site where the demolition process is going.

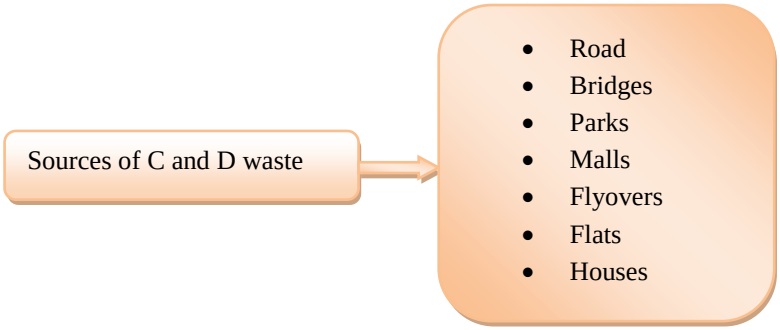

Fig-1: Various sources of Construction and Demolition waste

Tiles Waste- Tiles are produced in ceramic industry by metallurgical process. Tiles is composed of various materials and some of them are chemically hazardous which may cause a problem to environment if are not properly managed.

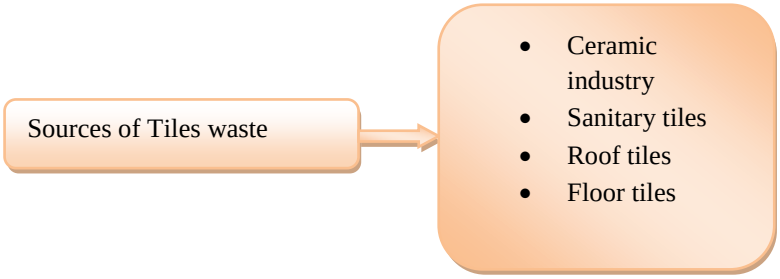

Fig-2: Sources of Tiles waste

2.2 Grading of material

Gradation of material is concerned about its shape and size. The gradation analysis or sieve analysis of the coarse aggregate and the fine aggregates available is carried out by sieving through the standard IS sieves.

C and D waste and Tiles waste collected from the resources are of irregular grading. It is obvious thing that they are waste material so they don't have required shape and size. The aggregates which are used in road construction are consisting of a standard grading. This grading of aggregate is specified by various agencies like ASTM, BSI, IS, IRC and MORTH

2.3 Material acceptability and suitability

Flexible pavement is composed of different layers like soil sub-grade, sub-base course, and base-course. Different layer contains different composition of aggregate. For conventional materials, a number of tests are conducted and their acceptability is decided on the basis of test results. These results give the performance of the material in terms of strength, toughness, abrasion, durability etc. The tests and specifications, which are applicable for conventional materials, may be similar for evaluation of industrial wastes. Thus for an appropriate assessment of these materials, new tests are to be devised and new acceptability criteria are to be decided. However, with the result of performance based tests, it is expected that the performances of the conventional as well as new materials can be tested on same set-up and compared.

It is important to consider the health issue while handling the waste materials because these waste materials may be harmful to human. Hence proper inspection should be done on waste materials. Material acceptability is the important step to check whether the materials are suitable for replacement of aggregate or not.

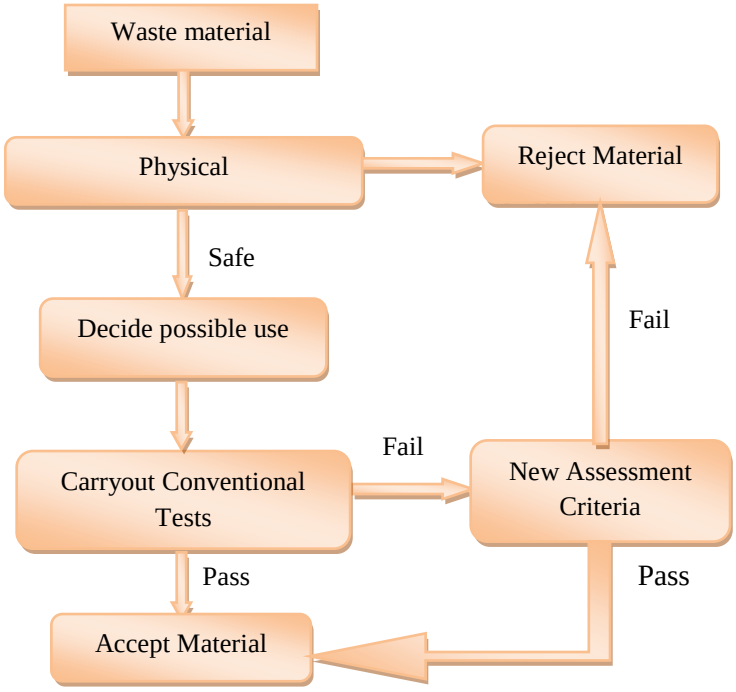

Fig-3: Evaluation of Suitability of Material

The suitability and behavior of waste material in highway is as mentioned in below table:

Material	Advantages	Disadvantages
Construction and Demolition waste	Being strong can be used as aggregates granular base.	May show Inconsistent properties.
Tiles waste	Can be used in base-course, sub-base course	May show Inconsistent properties.

Table-1 Suitability of waste materials in highway construction

3. TESTING METHODOLOGY

For conventional aggregate number of tests are carried out to determine its strength and other characteristics. According to IS 2386:1960, the tests which are carried out on aggregate are a).Elongation Index Test, b).Flakiness Index Test, c).Crushing Value Test, d).Impact Value Test, and e).Abrasion Value Test.

Firstly all the above mentioned tests are carried out on 100% aggregate and secondly after replacing 50% of aggregate with waste materials. The final proportion of aggregate, C and D and Tiles waste taken is 50%, 25% and 25%.

Sr. No.	Tests	Test Methods	Aggregate Test Results	Aggregate (50%) + Waste (50%) Test Result	MORTH Specifications
1	Flakiness Index	IS 2386:1960 P-(I)	18.81 %	19.10 %	Max. 30 %
2	Elongation Index	IS 2386:1960 P-(I)	23.87 %	20.56 %	Max. 30 %
3	Abrasion Test By Los Angeles Machine	IS 2386:1960 P-(IV)	14%	18 %	Max. 30 %
4	Abrasion Test By Deval Machine	IS 2386:1960 P-(IV)	18 %	20 %	Max. 30 %
5	Crushing Value Test	IS 2386:1960 P-(IV)	24.60 %	18.45%	Max.10-25 %
6	Impact Value Test	IS 2386:1960 P-(IV)	21.80 %	17.57 %	Max. 24 %

Table-2: Physical properties of materials

The comparison is made between the results obtained from 100% aggregate and after replacing 50% it with waste materials. Following graph shows the comparison between them:

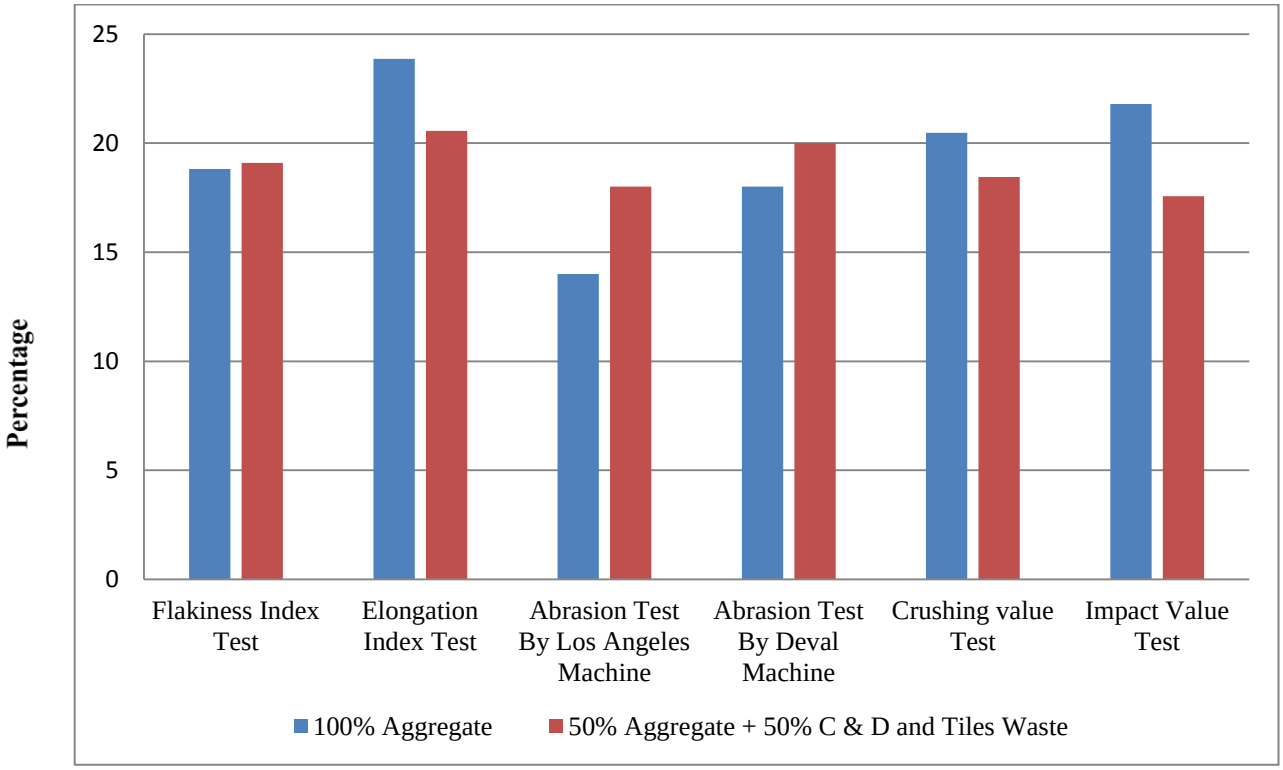

Fig-4: Comparison of conventional aggregate and mixed aggregate

4. DISCUSSION ON TEST RESULTS

After performing all above tests on 100% aggregate and after replacing 50% aggregate with waste material the results obtained are nearly same and under acceptable criteria specified by MORTH (Ministry of Road Transport and Highway).

Hence it is possible to replace 50% of aggregate with 50% of waste (C & D-25% and Tiles waste-25%) and can be effectively used in road construction in sub-base course and base-course.

5. CONCLUSION

The industrial waste materials construction and demolition waste and tiles waste for use in highway construction has been reviewed in this paper. From all analysis and above study following conclusions are made:

1) After doing all tests, the results of conventional aggregate and aggregate with 50% of waste are almost same and hence we can use C & D waste and Tiles waste in road construction in 50% replacement of aggregate.
2) Due to scarcity of natural aggregate it is essential to find its alternative. By using C & D waste and Tiles waste in road construction in place of aggregate we can save its amount by 50 %.
3) Due to less availability of aggregate its cost is high so by using these industrial wastes we can achieve economy on large scale.
4) Since due to industrialization the wastes are producing of huge amount and land is used for their dumping. Hence by using these wastes we can save a land from landfill and we can avoid land pollution.
5) By using these waste materials we can help to maintain the ecological balance in the environment.

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