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An Experimental Investigation on Utilization of Waste Plastic as a Modifier in Rigid Pavements for Improving Strength

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ABSTRACT
The percent study investigates the effective use of waste plastic as a modifier for cement concrete roads. Civilization produces waste products disposals issue of the waste products is a challenge. Solid waste management is the thrust area. The various waste materials, plastic waste and principle solid waste are of great concern these leads to disposal crisis and environmental pollution. On the other side, road traffic is increasing. The load bearing capacity of the roads are to be increased. Our present work is helping to take care of both these aspects. Plastic waste consists of carry bags cups and disposals. Plastic waste which is cleaned is cut into a size such that it passes through 2.3mm sieve using shredding machine. The aggregates mix is heated and the plastic is coated over aggregates and this coated stones can be used for road constructing. By this process a road of 1km length 3.375m width of single lane can consumes 10,00000 carry bags and road strength is increased and found no pot holes. Commonly soil, aggregates, sand, cement can be used in road construction. Natural materials being exhaustible in nature, its quantity is declining gradually. If our material can be utilized in highway construction, the pollution and disposal problems may be partly reduced. The use of the innovative technology will not only strengthen the road construction but also increase the road life as well as will help to improve the environment. In my research work I have done a thorough study on the methodology of using plastic waste coat over aggregates and presented various tests performed on aggregates.

Keywords: Fine plastic as filler, M35 plain cement concrete, plastic coated aggregates, plastic roads, and plastic waste.

I. INTRODUCTION

To the availability of the waste plastics is enormous, the plastic materials have become part and parcel of daily life.

The environmental problem such as disposal of waste plastic is major concern. To overcome the problems the modifiers (waste plastic) are used. In general there are two types of roads rigid pavement and flexible pavement for rigid roads material used is concrete. This is mix of plastic coated aggregates. The concept of using plastic in flexible pavement and rigid pavement has been done since several years ago in India. Plastic has played a very vital role in increasing the strength of bitumen as well as aggregate. These plastics are considerably non-biodegradable thus can be used as a modifier in concrete and aggregates to increase their strength. This study presents the proper utilization of waste plastic on aggregates and aggregate to enhance pavement performance, to protect environment and to provide low cost roads. The present study investigates about the use of waste plastic as coating over aggregates and as a fine filler material of plastic.

II. LITERATURE REVIEW

1. Sasane Neha .B. (2015): "Application of waste plastic as an effective construction material on flexible pavements".

It shows that with the increase of waste plastic in bitumen increases the properties of aggregate and bitumen.

2. Miss Apurva J Chavan1 (2013) "Use of plastic Waste in flexible pavements"

This has resulted in reducing rutting, ravelling and there is no pothole formation. This helps to have a better binding of bitumen.

III. METHODOLOGY

1. Identification of problem.
2. Literature Review.
3. Material collection.
4. Preparation of plastic coated aggregates.
5. Study on properties of plastic coated aggregates.
6. Procurement of cement.
7. Conduction of tests on cement and plastic coated aggregates.
8. Sample preparation for compression & split tensile tests, flexural strength test.

9. Result analysis.
10. Conclusion

3.1 Investigation

The present study investigates about the use of waste plastic as coating over aggregates and as a fine filler material of plastic.

3.2 The highlights of the study are

1. To evaluate the properties of aggregates by coating plastic over it and by mixing the plastic with aggregate in different ratios (LDPE, HDPE, and PP) and comparing with unmodified materials.
2. To evaluate the performance tests like crushing, impact, abrasion, attrition using plastic coated aggregates.
3. To know the compressive strength of cubes using plastic as coated over aggregate
4. The debate on the use and abuse of plastics vis-à-vis environmental protection can go on, without yielding results until.

3.3 Need of study

1. Disposal of waste plastic is a major problem.
2. It is non –biodegradable.
3. Burning of these waste plastic bags cause environmental pollution.
4. It mainly consists of low density pollyethylema.
5. To find the utility in plastic coated aggregate and filling material in road construction.
6. Laboratory studies were conducted on plastic coated aggregate to improve the properties of aggregates.

3.4 Study on waste plastic

1. Waste plastics –as filler and strength modifier the domestic plastic (softened plastic) have a binding property. The molten plastic can be used as coated over aggregates as strength modifier and fine plastic as a filling material.
2. By our study the waste plastic coated aggregates and filling material process a road of 1 km length and 3.375m width off single lane can consumes 10,00000 carry bags in the road strength increased by 100% and no found of cracks and pot holes.

3.5 Objectives of study

1. To characterize the plastic coated aggregates to use it in the base and sub base courses of flexible pavement construction.
2. To study properties of plastic coated aggregates used in concrete.
3. To study influence of plastic coated aggregates in concrete to conventional concrete.
4. Various percentages of plastic is considered to add With aggregates.
5. To study the characteristics of plastic coated aggregates in concrete.

3.6 Scope of research

1. To study the strength of the concrete by conducting slump cone test and compressive test respectively.
2. To study the properties of plastic coated aggregates which the plastic coated over weak aggregates or normal aggregates.
3. The split tensile test is also carried to calculate the strength properties.
4. 27 cubes of 150x150x150mm size with 7, 14, 28 days of curing.

3.7 Expected outcomes

1. The plastic coat is increases the properties of the aggregates.
2. The weak aggregates used as strength aggregates by making plastic coat.
3. Compressive and split tensile strengths of concrete can be improved.
4. It is economically good.
5. The research can control the environmental pollution.

3.8 Types of waste plastic

1. Low density polyethylene (LDPE):- origin bags, sacks, squeezable detergent bottles.etc…
2. High density polyethylene (HDPE):- milk, fruit juices covers, bottle caps, etc…
3. Polypropylene (PP):- closures, film wrapping for biscuits, microwave trays, etc...
4. Polystyrene (PS):- egg packs, disposal cups, protective packaging, etc...
5. Polyvinyl chloride (PVC):-credit cards, folders, pen, etc…

IV. MATERIAL USED AND TESTS

1. PLASTIC COATTED AGGREGATE 20mm, 10mm.
2. FINE AGGREGATE 2mm size with 2mm plastic as a filling material.
3. PLASTIC FILLING MATERIAL 2mm size plastic filling material.
4. WASTE PLASTIC waste plastic in shredded form.
5. CEMENT 53grade OPC cement.

4.1 Preparation of plastic coated aggregates

1. Coarse aggregates are heated at a temperature of 100 to 150 °C.
2. The waste plastic obtained in the shredded form are added throughout the heated aggregates and mixed thoroughly.
3. It is then cooled for two to three hours.

4.2 Specific gravity test results for mix design

1. Specific gravity of cement =specific gravity of cement with respect to kerosene*specific gravity of kerosene with respect to water.
   =>CSK*KSW=2.8

S.G with respect to water=2.8/1=2.8
S.G with respect to kerosene=2.8/0.79=3.54
S.G with respect to see water =2.8/1.02=2.7

2. Specific gravity of sand = (w2-w1)/(w4-w1)-(w3-w2) =2.7
3. Specific gravity of coarse aggregate=2.7

4.3 Mix proportions for m35 grade concrete

1. For 53 grade OPC cement.
2. 2.20mm, 10mm grade plastic coated aggregate.
3. Degree of workability 80 compaction factor, 30mm slump adopted.
4. 2mm size fine aggregate and waste plastic.
5. Mix proportion in kg

Cement: fine aggregate: coarse aggregate.
i.e. 1:1.08:2.25

6. Water used for M35 grade is 0.37% for mix design.

4.4 Test conduct on plastic coated aggregates

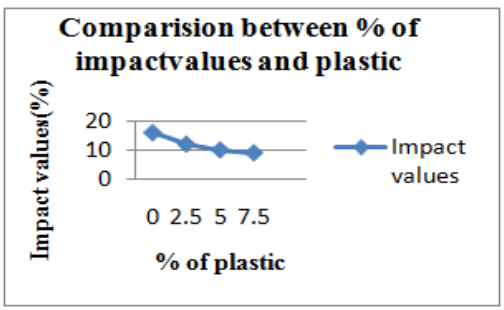
1. Aggregate impact value test.
2. Aggregate crushing value test.
3. Lossangeles abrasion value test.
4. Aggregate alteration test.
5. Elongation test.
6. Flakiness test.
7. Sieve analysis test.

4.5 Aggregate tests results, graphs

4.5.1 Aggregate impact value

Percentage of plastic	Impact value
0	16%
2.5	12%
5	10%
7.5	9%

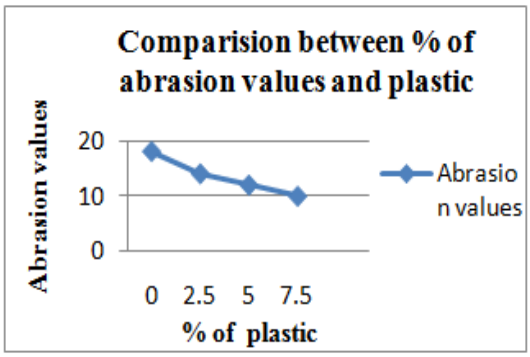
Impact values with plastic percentage



4.5.2 Aggregate abrasion value

Percentages of plastic	Abrasion value
0	18%
2.5	14%
5	12%
7.5	10%

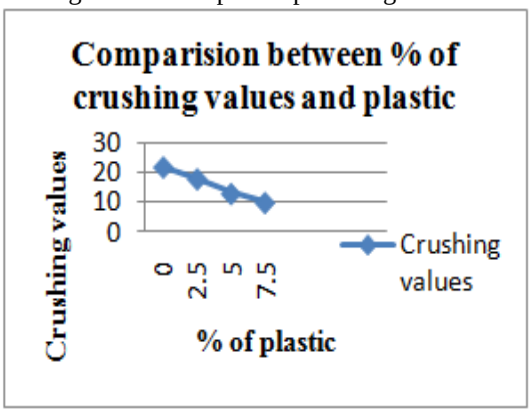
Abrasion values with plastic percentage



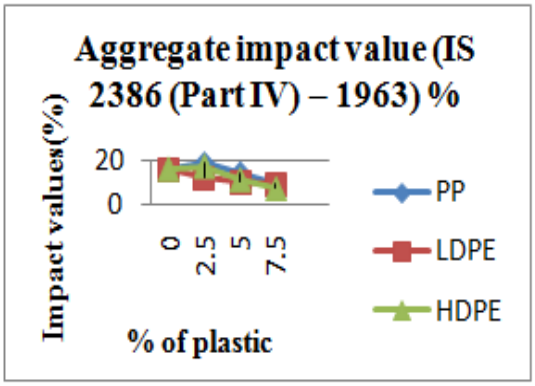
4.5.3 Aggregate crushing value

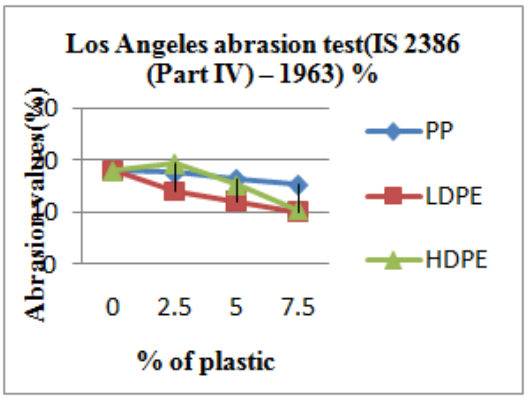
Percentage of plastic	Crushing value
0	22%
2.5	18%
5	13%
7.5	10%

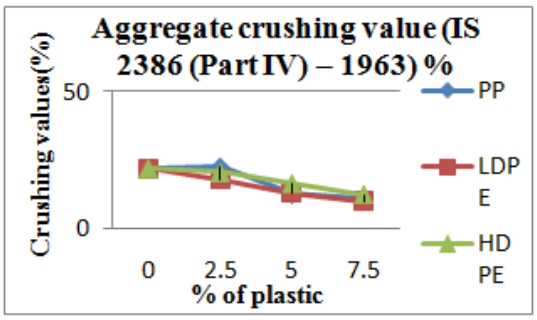
Crushing values with plastic percentage



4.5.4 Comparison of aggregate properties to different types of plastic





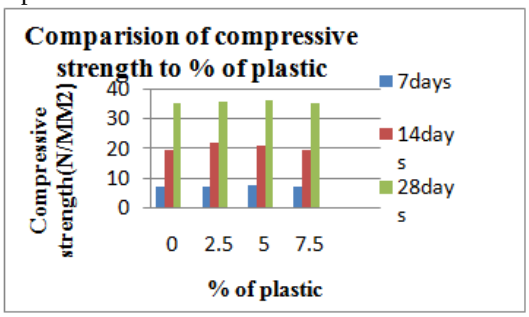


V. FINAL RESULTS OF STRENGTHS AND GRAPH&FINAL COMPARISION

5.1 Compressive strengths

S.NO	% of plastic	7days strength	14days strength	28 days strength
1	0	7	19.2	35
2	2.5	7	21.5	35.5
3	5	7.2	20.5	36
4	7.5	7	19.5	35

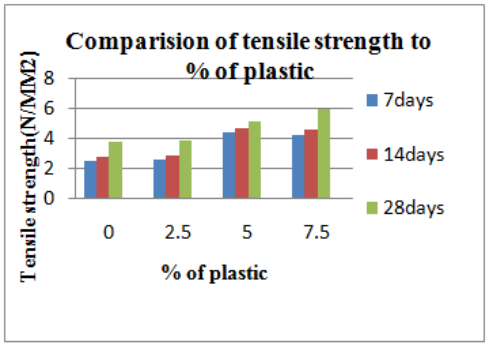
Graph



5.2 Result of split tensile test graph and final compression

S.NO	% of plastic	7days strength	14days strength	28 days strength
1	0	2.5	2.7	3.7
2	2.5	2.58	2.8	3.79
3	5	4.4	4.6	5.11
4	7.5	4.2	4.5	5.9

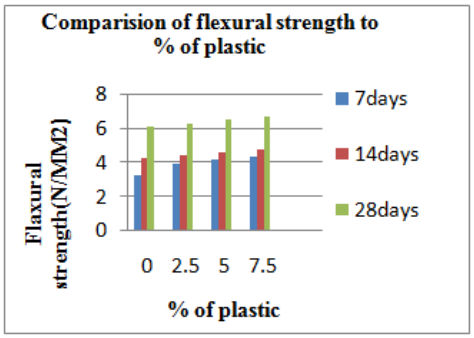
Graph



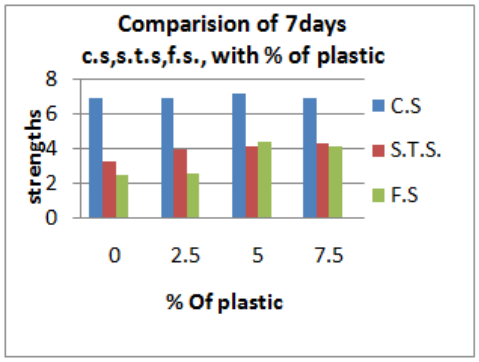
5.3 Result of flexural strength test graph and final compression

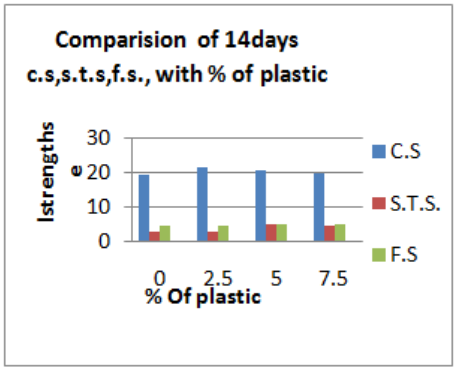
S.NO	% of plastic	7days strength	14days strength	28 days strength
1	0	3.271	4.27	6.17
2	2.5	3.98	4.45	6.34
3	5	4.17	4.67	6.58
4	7.5	4.34	4.82	6.75

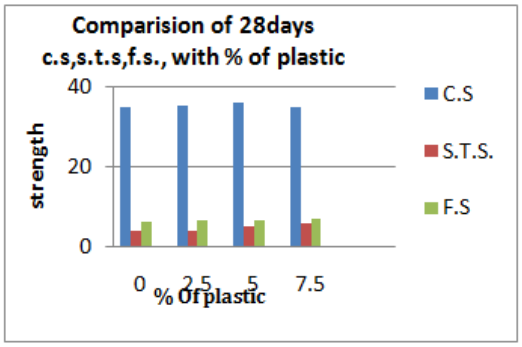
Graph



5.4 Comparison between C.S, S.T.S, F.S







VI. CONCLUSION

1. By using plastic as a coating over aggregates, the properties of aggregates are improved. This shows that weak aggregates can be used in construction by using plastic as a binder material.
2. By adding plastic coat to the weak aggregates, the rheological properties have been improved. The bandings between the aggregates are reducing the road failure i.e. pot holes.
3. The percentage of plastic 2.5%, 5%, 7.5% is added to aggregate samples respectively PP type of plastic, for LDPE type of plastic for both, plastic coated aggregates are increased the binding properties.
4. Based on engineering properties the plastic coated aggregate samples are more stable, strengthen than normal aggregates and can be used in plastic roads.
5. The low density polythene type of plastic shows better performance values than polypropylene.
6. The weak aggregates with plastic coated are used in base and base of the pavement layers.
7. The engineering properties are increased to plastic coated aggregates while comparing with normal aggregates.

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