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Economy And Strength Comparison Of Waste Plastic Concrete With Ordinary Concrete

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Abstract:- In this paper, we are planning to use M20 concrete and recycled waste plastic powder as modifier. Modifier will be added in different amounts (2%, 5%, 10%, 15% & 20%) to replace the same amount of cement. Tests are to be conducted on fine and coarse aggregates and cement to find their physical properties. Based on these tests, we have to analyze whether the addition of plastic waste in concrete is economical or not.

I. INTRODUCTION

Numerous waste materials are generated from manufacturing processes, service industries and municipal solid wastes. The increasing awareness about the environment has tremendously contributed to the concerns related with disposals of the generated wastes. Solid waste management is one of the major environmental concerns in the world. With the scarcity of space for land filling and due to its ever increase in cost, waste utilization has become an attractive alternative to disposal. Research is being carried out on the utilization waste products in concrete. Such waste products include discarded tyres, plastic, glass, steel, burnt foundry sand, and coal combustion by products (CCBs). Each of these waste products has provided a specific effect on the properties of fresh and hardened concrete. The use of waste products in concrete not only makes it economical, but also helps in reducing disposal problems.

II. OBJECTIVES OF STUDY

To compare the variation in properties of concrete with different percentages of plastic in concrete and that of ordinary concrete.

Properties to be tested are Compressive Strength Flexural Strength, Splitting Tensile Strength. Conduct an economic study of usage of waste plastic powder as supplementary material in place of cement in ordinary concrete.

Test On Cement

Type	High Density polyethylene (HDPE)
Specific gravity	1.04
Density (g/cc)	0.9452-0.962
Melting point (ºC)	75-100
Softening point (ºC)	110
Elongation at break (%)	>500
Fineness	<2.36mm

Table: 3.1.1, Standard Consistency

III. EXPERIMENTS ON CEMENT

Percentage of water content for standard consistency = 32%
The initial setting time of the given sample of cement =95min.
The final setting time of the given sample of cement =265min.
Specific gravity of cement = 3.10

Experiments On Coarse Aggregate

The aggregate crushing value of the given sample =27.1%
Specific gravity of coarse aggregate = 2.62
Fineness modulus = 3.1

Plastic Powder %	w/c ratio	Water In (Kg/m³)	Waste plastic Powder (Kg/m³)	Cement (Kg/m³)	28 days compressive Strength (N/mm²)
0	0.5	186	0	372.00	27.30
2	0.5	186	7.44	364.56	25.80
5	0.5	186	18.6	353.40	26.50
10	0.5	186	37.2	334.80	17.70
15	0.5	186	55.8	316.20	16.70
20	0.5	186	74.4	297.60	16.10

Experiments On Fine Aggregate

Specific gravity of fine aggregate= 2.78
Fineness modulus = 3.9

EXPERIMENTS ON PLASTICS

MIX PROPORTIONS

Water: Cement: Fine aggregate: coarse aggregate
186lit:372 kg: 656kg: 1148 kg
0.50:1:1.76:3.08

TESTS ON HARDENED CONCRETE

COMPRESSIVE STRENGTH OF CUBES AND CYLINDERS

The compressive strength were tested in compressive strength testing machine and the loads obtained for plain concrete and concrete of different percentage of waste plastic added , at 7&28 days curing are tabulated.

TABLE 7 DAYS COMPRESSIVE STRENGTH OF UBES

Plastic Powder %	w/c ratio	Water In (Kg/m³)	Waste plastic Powder (Kg/m³)	Cement (Kg/m³)	7 days compressive Strength (N/mm²)
0	0.5	186	0	372.00	21.93
2	0.5	186	7.44	364.56	18.60
5	0.5	186	18.6	353.40	19.45
10	0.5	186	37.2	334.80	11.68
15	0.5	186	55.8	316.20	10.87
20	0.5	186	74.4	297.60	9.42

TABLE: 28 DAYS COMPRESSIVE STRENGTH OF CUBES

Plastic Powder%	w/c ratio	Water In (Kg/m³)	Waste plastic Powder(Kg/m³)	Cement (Kg/m³)	28 days compressive Strength (N/mm²)
0	0.5	186	0	372.00	22.00
2	0.5	186	7.44	364.56	17.20
5	0.5	186	18.6	353.40	19.20
10	0.5	186	37.2	334.80	10.86
15	0.5	186	55.8	316.20	9.05
20	0.5	186	74.4	297.60	7.36

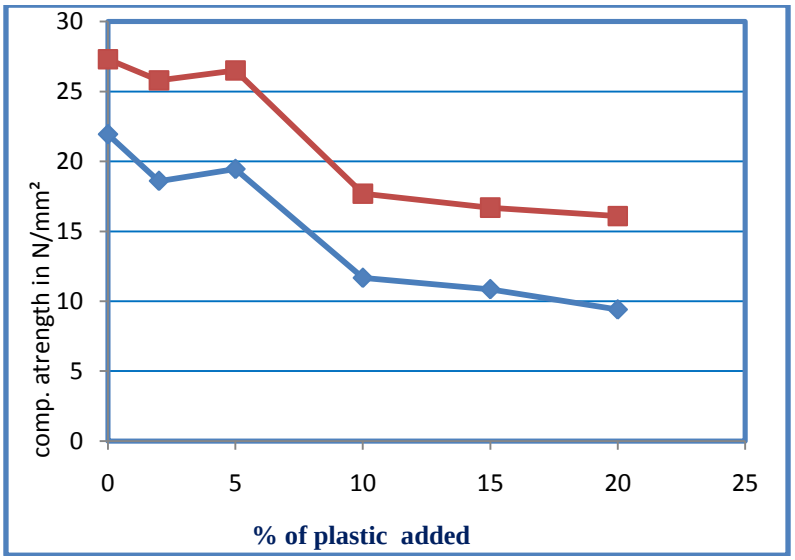
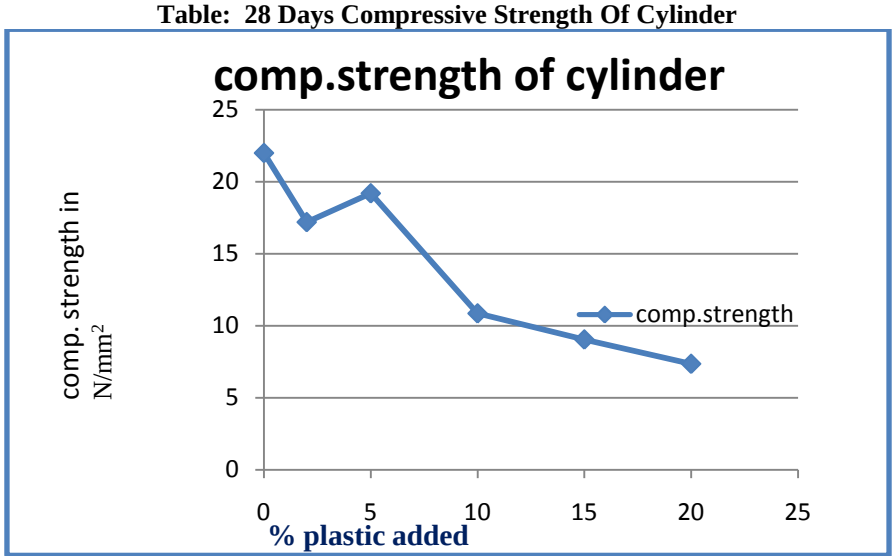


Fig. Compressive strength for 7 days& 28 days curing

When 5% plastic is used instead of cement there is an increase compressive strength, but later on increase to greater % replacement there is reduction in strength.

Table: 28 Days Compressive Strength Of Cylinder



Splitting Tensile Strength Of Cylinders

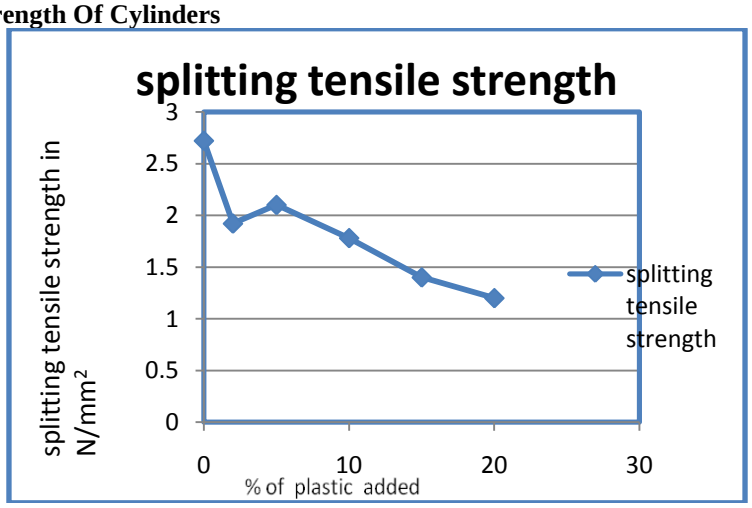
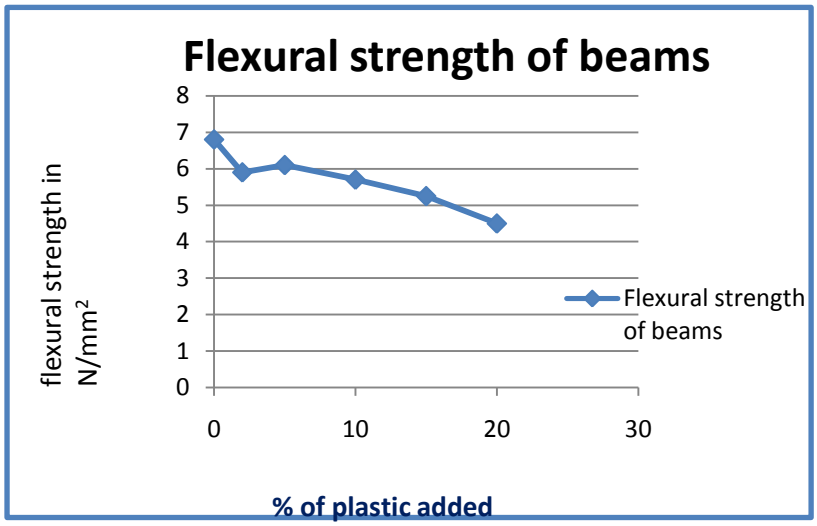


Fig. flexural strength of beams

Table: Flexural Strength Of Beam



Flexural Strength Of Beams

Plastic Powder %	w/c ratio	Water In (Kg/m³)	Waste plastic Powder (Kg/m³)	Cement (Kg/m³)	Flexural Strength (N/mm²)
0	0.5	186	0	372.00	6.80
2	0.5	186	7.44	364.56	5.90
5	0.5	186	18.6	353.40	6.10
10	0.5	186	37.2	334.80	5.70
15	0.5	186	55.8	316.20	5.25
20	0.5	186	74.4	297.60	4.50

Plastic Powder %	w/c ratio	Water In (Kg/m³)	Waste plastic Powder (Kg/m³)	Cement (Kg/m³)	Splitting tensile Strength (N/mm²)
0	0.5	186	0	372.00	2.72
2	0.5	186	7.44	364.56	1.92
5	0.5	186	18.6	353.40	2.10
10	0.5	186	37.2	334.80	1.78
15	0.5	186	55.8	316.20	1.40
20	0.5	186	74.4	297.60	1.20

Fig.3.7 Plastic waste powder modifier

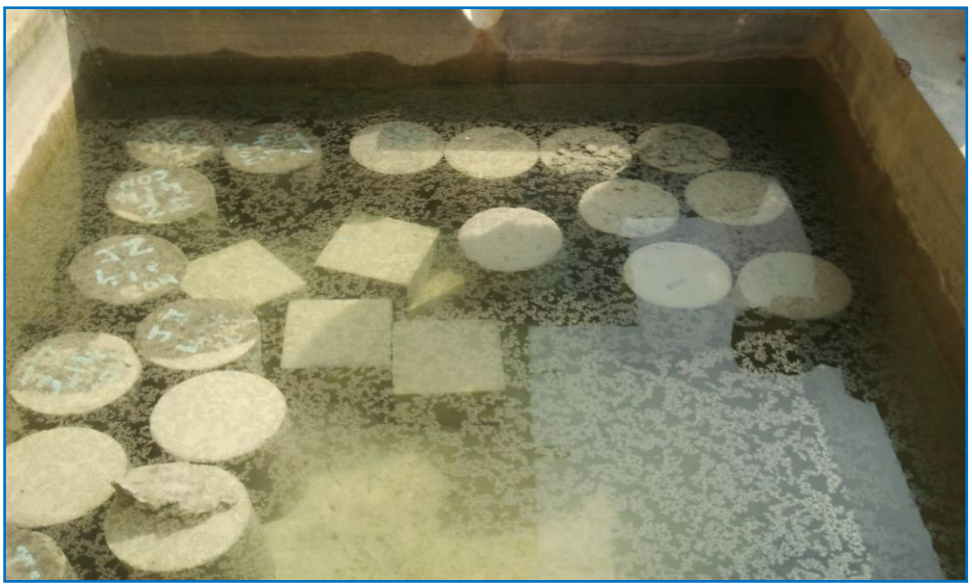


Fig.3.8 curing of concrete cubes and cylinders

IV. ANALYSIS AND DISCUSSIONS

In the present investigation it is found that optimum plastic modifier content was 5% by weight of cement. From the test results it was observed that the compressive strength value concrete mix increase with the addition of modifiers. Comparison of the compressive strength values of the plain cement concrete and modified cement concrete are shown in following figures.

Special aspects:

- Whole process is very simple
- It needs no new machinery
- The waste plastics available in the surrounding area can be used effectively

V. COST ANALYSIS

Cost of 1 bag 43 grade cement=Rs 325/-
Cost reduction in adding 2% modifier:
Amount of modifier in 1m³ concrete=7.44kg
Cost reduction in cement=Rs 48.36/-per m³
Cost reduction in adding 5% modifier:
Amount of modifier in 1m³ concrete=18.6kg
Cost reduction in cement= Rs 120.9/-per m³
Cost reduction in adding 10% modifier:
Amount of modifier in 1m³ concrete=37.2kg
Cost reduction in cement=Rs 241.8/-per m³
Cost reduction in adding 15% modifier:
Amount of modifier in 1m³ concrete=55.8kg
Cost reduction in cement=362.7/-per m³
Cost reduction in adding 20% modifier:
Amount of modifier in 1m³ concrete=74.4kg
Cost reduction in cement=483.6/-per m³

VI. CONCLUSIONS

Looking into the above aspects we came to the conclusions that the waste plastics can be used as a modifier in the cement concrete mix. This modified cement concrete mix is applicable in the construction of rigid pavements in order to reduce the thickness of the pavement and increase the durability of the pavement.

- Compressive strength of concrete is affected by addition of plastic powder by partial replacement of cement and goes on decreasing as the percentage of plastic increases. Addition of 2% of plastic causes about 6% reduction in strength after 28 day curing. But in the case of 5% addition causes only 3%

reduction, indicates that that there increase in strength rather than 2%. Addition of greater percentage of plastic causes drastic reduction in strength.

- Similarly in the case tensile strength of concrete upon 2% addition of causes 30% reduction in strength but on adding 5% plastic increases strength 10% more than 2% addition.
- Similar trend observed in the case of flexural strength also.
- The optimum modifier content is found to be 5%.
- It helps to avoid the general disposal technique of waste plastics namely land filling and incineration which have certain burden on ecology.
- The modified cement concrete mix can be used in construction of rigid pavements reducing the thickness of pavement as it can carry more load than plain cement concrete. It can also be used in the construction of small drainage works and concrete tiles of footpath walkers.

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