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Use of Silica Fume and Plastic Waste in Concrete

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Abstract: ***The modern civil engineer needs to deal with traditional construction materials as well as advanced materials. Use of waste materials to produce new materials is very necessary for prevention and conservation of environment. This paper deals with the use of waste plastics as partial replacement of aggregate and Silica fume as partial replacement of cement in M30 concrete. Waste Plastics are incrementally added in 0%, 10% and 20% to replace the same amount of aggregate. Silica fume is a non-metallic and non-hazardous waste of industries. It is added in 0%, 6%, 9% and 12% to replace the same amount of cement. The main objective of this research paper is to improve the properties of concrete. Almost sixty-four cubes are moulded for compressive strength and cured for 7days, 14days and 28 days. This paper insures that using of waste plastic and silica fume in concrete gives a good approach to reduce cost of construction and some amount of solid waste problems.***
Keywords: Waste plastics, Silica fume, Compressive strength, Aggregate, Cement.

I. INTRODUCTION

As the world's population continues to grow, so does the amount of waste that people produce. As plastic is composed of major toxic pollutants, it has the potential to cause great harm to the environment in the form of air, water and land pollution. Put simply, plastic pollution is when plastic has gathered in an area and has begun to negatively impact the natural environment and create problems for plants, wildlife and even human population. Often this includes killing plant life and posing dangers to local animals. On other hand Plastic is an incredibly useful material because it is meant for durability. So, the concept of using waste plastic in concrete is arisen. To reduce the cost of design, development, prototyping, manufacturing, and product life cycle durability, it is very good to introduce new advanced material.

Silica fume is a byproduct of producing silicon metal or ferrosilicon alloys. One of the most beneficial uses for silica fume is in concrete. Because of its chemical and physical properties, it is a very reactive pozzolona Concrete containing silica fume can have very high strength and can be very durable. Silica fume is available from suppliers of concrete admixtures and, when specified, is simply added during concrete production. Silica fume consists primarily of amorphous (non-crystalline) silicon dioxide (SiO2). The individual particles are extremely small, approximately 1/100th the size of an average cement particle. Because of its fine particles, large surface area, and the high SiO2 content, silica fume is a very reactive pozzolona when used in concrete

II. METHODOLOGY

A. *Material*

1) *Cement:* Pozzolona Portland cement of Ambuja brand of 53 grade confirming IS 12269-1987(9) was used.
2) *Coarse Aggregate:* Crushed aggregates confirming IS 383-1987 were used.
3) *Fine Aggregate:* The Bhandara river sand was used as fine aggregate.
4) *Water:* Water confirming to as IS 456-2000 was used for mixing as well as curing of concrete specimens.
5) *Silica Fume:* Silica fume was procured from the steel wire industries, Nagpur. It contains 85.5 percent silicon dioxide. Bulk density varies from 550 to 650 Kg/m^3.

Figure 1. Silica Fume

6) *Plastic Waste*: Plastic waste is in crushed form having particle size below 10mm. Specific gravity 1.3 gm/cc.

Figure 2. Plastic Waste

7) *Plasticizer:* ADDAGA PLAST AP 251 Plasticizer having specific gravity 1.121 gm/cc, PH value is 7 and Chloride contain is less than 0.05%.

B. Mix Design

According to IS10262:2009, the prepared mix design the quantities and the ratio obtained are as follows;

1) *Cement:* 380.56 kg/m^3
2) *Water:* 167.45 kg/m^3
3) FINE AGGREGATE: 800.87 kg/m^3
4) *Coarse Aggregsate:* 1088.57 kg/m^3
5) ADMIXTURE: 2.1 L/m^3
6) W/C RATIO 0.44
7) MIXING RATIO: **1:0.44:2.1:2.86**

C. Casting and Curing

The mixing of ingredients of concrete was done using electric concrete mixer machine. As per the guidelines of the IS Code 15388:2003, silica fume and plastic waste concrete is prepared on M30 concrete. Plastic waste such as 0%, 10% and 20% was added in percentage, in order to replace the same amount of aggregate. Silica fume is added in 0%, 6%, 9% and 12% to replace the same amount of cement. Standard cube of size (150mm*150mm*150mm) was used as specimens for determination of compressive strength of concrete. These specimens were tested for 14, 28 days strength.

Figure 3. Cube Casting

D. Testing for Compressive Strength

Testing of casted specimens is tested for 7, 14- and 28-days compressive strength by using hydraulic compressive testing machine strength. After conducting Compressive strength testing the test Results are tabulated.

Table 1. Physical Properties of Aggregate

Type of aggregate	Test results on Coarse aggregate	Test results on Fine aggregate
Specific Gravity	2.71%	2.63%
Water Absorption	0.81%	1.21%
Aggregate Impact Value	12.25%	-----
Aggregate Crushing Value	11.56%	-----

Table 2. Physical properties of cement

Specific Gravity	3.12
Initial Setting Time	31minutes
Final Setting Time	10hours
Soundness	0.61

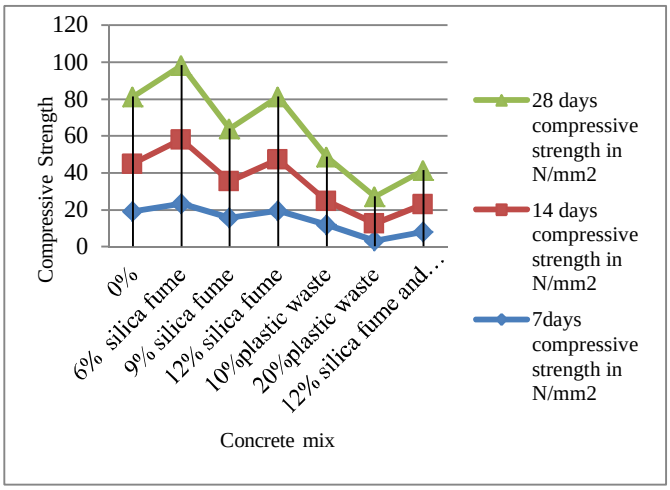

Figure 4. Test of Concrete Blocks

Table 3. Compressive Strength Test Report

Sr. no.	Concrete mix	7days compressive strength in N/mm^2	14 days compressive strength in N/mm^2	28 days compressive strength in N/mm^2
1.	0%	18.98	25.72	36.44
2.	6% silica fume	23.33	34.62	40.44
3.	9% silica fume	15.58	19.82	28.36
4.	12% silica fume	19.47	27.87	33.87
5.	10% plastic waste	11.78	12.8	24.09
6.	20% plastic waste	3.07	9.51	14.62
7.	12% silica fume and 20% plastic waste	8.21	14.62	18.58

III. RESULT AND DISCUSSION

In the present investigation it is found that optimum up to 6% by replacing of silica fume there is increment of compressive strength. It is also observed that up to 20% by replacing of plastic waste there is a deviation of compressive strength. From the test results it was observed that the compressive strength value of the concrete mix decreased with the addition of waste plastics more than 20% of waste plastics. So, we can add waste plastics and silica fume in concrete blocks.

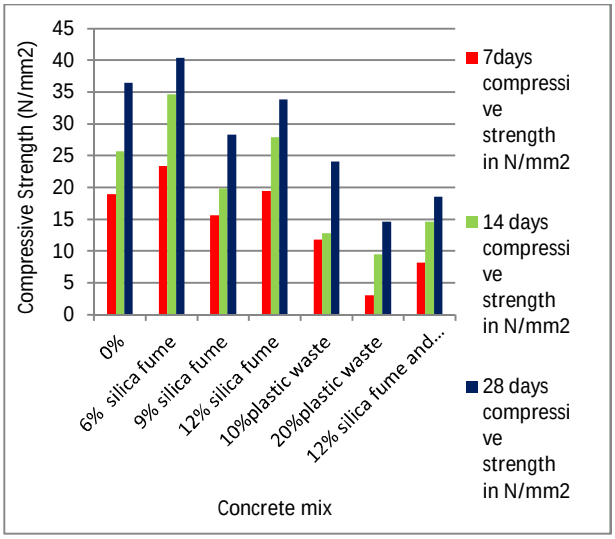

Figure 5. Experiment inferences of Concrete Blocks

IV. CONCLUSION

After observing the above aspects, the analysis concluded that the waste plastics and silica fume can be used in the cement concrete mix. This modified cement concrete mix is applicable in the construction of rigid pavements. The compressive strengths of modified cement concrete are as equal as plain cement concrete. The cost of construction will reduce and also helps to avoid the general disposal technique of waste plastics namely land filling and incineration which have certain burden on ecology.

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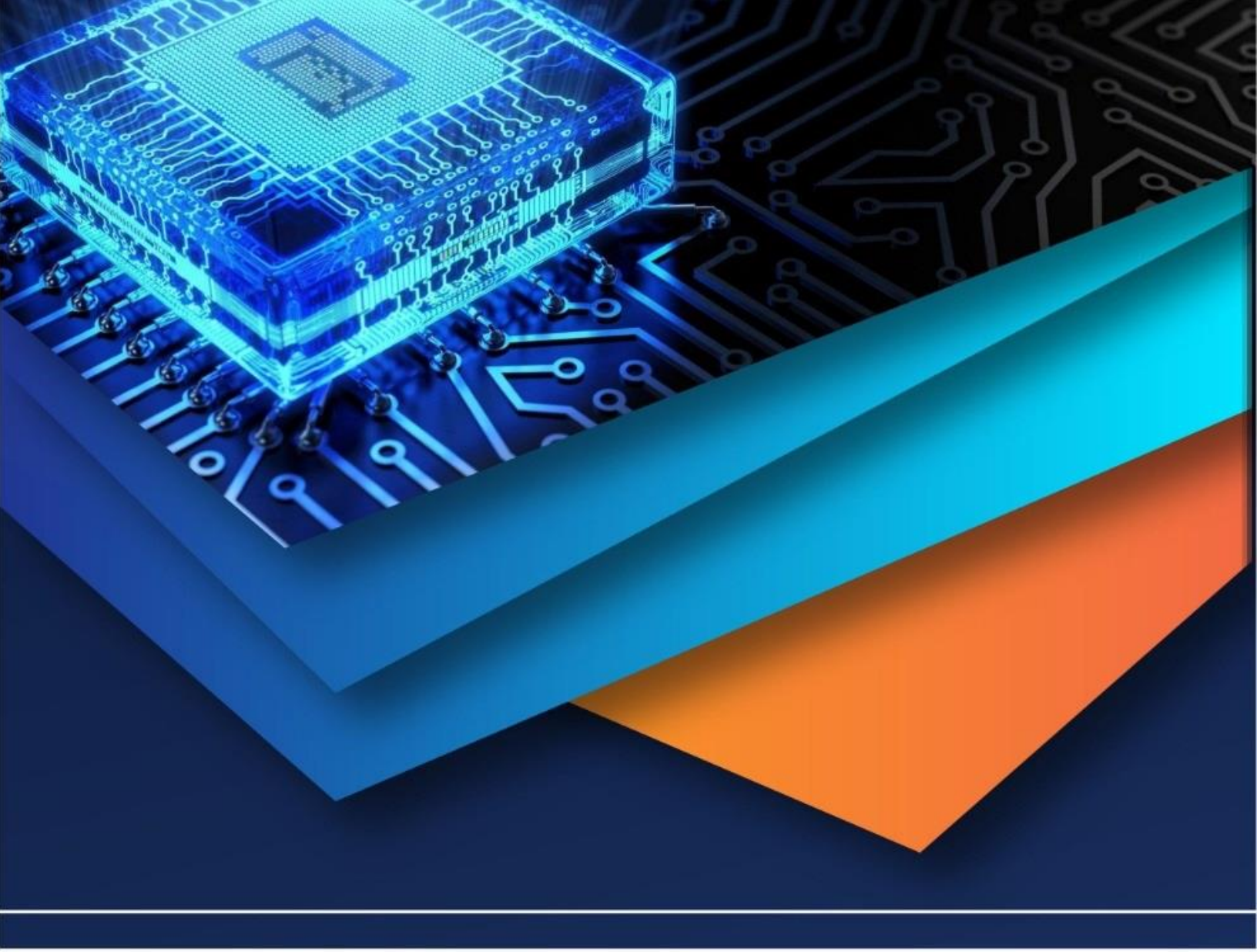

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