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EFFECT OF IRON SLAG POWDER ON MECHANICAL PROPERTIES OF CONCRETE

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ABSTRACT - Environmental pollution is one of the major concerns of all the environment related departments. Industrialization is at peak, releasing billions of tones of wastes & by products every day, thereby producing a great threat to the existing living creatures of the universe. So it is the dire need of the hour to tackle with such problems, in a technical manner so that the hazards of these wastes will be reduced to minimum extent. As far Blast furnace slag & Cast Iron Chips are concerned they were considered to be as waste materials & were thrown unused. In this present research work we are going to bring such said wastes in, this will not only increase the practical utility of these products but also will make the concrete mixes economical & will reduce the threat of environment by being polluted by such wastes. The environment problems are very common in India due to generation of industrial byproducts. Due to industrialization enormous byproducts are produced and to utilize these byproducts is the main challenge faced in India. Iron slag is one of the industrial by-products from the iron and steel making industries. Iron slag is an industrial waste by-product of steel industry. The demand for aggregate in construction industry is increasing rapidly and so is the demand for concrete. In this study the Cement was partially replaced with iron slag at different proportions of 0%, 10%, 20%, 30% 40% and 50%. Compressive strength and Flexural strength on M30 grade of concrete with 0.45 water/cement ratio were investigated. In which to determine and check out the compressive strength with various percentages of iron Slag Aggregate. The result has been found from the various tests which were compared with conventional concrete. Thus the use of iron slag in concrete could enhance the strength in concrete.

Keywords: Concrete, Iron Slag Powder, Compressive Strength, Optimum Replacement, Curing

1. INTRODUCTION

Concrete is prepared by mixing various constituents like cement, aggregates, water, etc. which are economically available. Concrete is a composite material composed of granular materials like coarse aggregates embedded in a matrix and bound together with cement or binder which fills the space between the particles and glues them together. Over time, the cement forms a hard matrix which binds the rest of the ingredients together into a durable stone-like material with many uses. Concrete is used in large quantities almost everywhere mankind has a need for infrastructure. The amount of concrete used worldwide ton for ton is twice that of steel, wood, plastics and aluminum combined. Concrete usage in the modern world is exceeded only by that of naturally occurring water. The cement industry is one of the three primary producers of carbon dioxide, a major greenhouse gas (the other two being the energy production and transportation industries). We can reduce the pollution effect on environment by increasing the usage of industrial by-products in our construction industry. In India, natural river sand (fine aggregate) is traditionally used in mortars and concrete. However, growing environmental restrictions to the exploitation of sand from riverbeds have resulted in a search for alternative sand, particularly near the larger metropolitan areas. This has brought in severe strains on the availability of sand forcing the construction industry to look for an alternative construction material. Now-a-days construction works is increasing day by day everywhere in the world on large scale and due to which our natural resources which we are using for construction purpose are vanishing at a rapid rate. This paper focus on investigating behavior of M30 concrete by partial replacement of cement by iron slag.

2. LITERATURE REVIEW

Radhikesh P (2010): said that a lot of face lift is actually is given to roads, footpaths lengthwise with roadside. Concrete paving blocks are clue materials on the footpath for easy laying recovering look and finish. Cement concrete paving blocks are precast solid products made out of cement concrete. The produce is made in many sizes and shapes

viz. rectangular, square and overweight blocks of unlike breadths with design for linking of adjacent paving blocks. The parboiled materials oblige for assemblies of the product are Portland cement and aggregates which are available nearby in all part of the country. Market potential cement concrete paving hunks find solicitations in pavements, footpaths, gardens, passengers waiting sheds, bus stops, industry and other public places. The product is generally used in urban areas for the above bids. Hence the unit may be set up in urban and semi urban areas near the bazaar for summit the superiority limitations. Quality parameters like authentic share of the individual raw materials ratio of coarse aggregates, water to cement ratio, good finish, truth in size and shape and compression strength after curing are the some of the vital factors that ought to be plaid at times to certify good class of the product.

Hameed and Sekar (2009) studied upshot of crushed stone dust as fine sand and set up the flexural strength upsurges than the concrete with expected sand but the standards drops as calculation of grinder dust increases. It has existed described by Reddy and Reddy, 2007 from their new revision on use of rock flow and insulator ceramic scrap in concrete that the rock flow when hand-me-down as fine aggregate intensifications the modulus of bliss so the flexural strength. From the schoolwork of green concrete take holding quarry concrete dust and marble muck residue it has been testified that the split tensile strength of green concrete was 14.62% higher at 7 days and 8.66% higher at 28 days. But split tensile strength stayed initiate to be lesser by 10.41% at 3 days than measured concrete.

Raman (2010): studied the weight of quarry dust and found that by supplanting the river sand with quarry dust is done lacking the exclusion of fly ash it ensued in the lessening of the compressive strength of concrete specimen. It eats also been sensed that the bargain in the compressive strength due to unused of quarry dust in concrete was recompensed by the enclosure of fly ash as into the concrete mix. According to prior study by Reddy and Reddy, 2007 described that there is a cooperative compressive strength by use of rock flour as fine aggregate in its place of river sand.

Iangovan et.al (2008) stated strength of quarry rock dust concrete was comparably 10-13% more than that of a like mix of common concrete. Spare of fine aggregate with the crusher dust up to 50% by weight has a tiny effect on the discount of any corporal and mechanical properties like compressive strength, flexural strength, split tensile strength etc. water absorption is well below the broad limit as per Indian standard codes. There is no variant for robustness tests of different proxies of crusher dust. There is a convertible of 57% of money if sand is traded by crusher dust that is economically nicer. For from production of paving blocks the proportion of good was less but highly advantageous. The saving would be more in coming, if the send handiness is at greater reserve like hilly area. Due to this there is fall in the burden of dumping crusher dust on earth and hence environmental contamination.

3. MATERIALS USED

3.1 ORDINARY PORTLAND CEMENT

Ordinary Portland cement is generally second hand as binder material in concrete mix which forms a solid matrix. Main aim of the OPC is to increase the cohesive property inside the concrete constituents in order to make a good strength. Before use of this OPC all physical and chemical properties are examined for making the design mix like specific gravity, fineness of cement, consistency of cement is checked. Also the hydration process after curing is judged for its strength.

3.2 COARSE AGGREGATES

The bulk of a concrete mixture is attained by aggregates of different sizes and shapes. Also order of firmness is given to concrete by these aggregates particles. As we know that the stone has the extreme compressive strength. So for the growth of the bulk of resulting mix the aggregates are recurrently used in two or more dimensions. The best momentous use of the fine aggregate is to preservation in creating workability and evenness. The aggregates start near about 73% of the bulk of the concrete and hence forward it has tremendous major effect. The aggregates must be right shape, clean, hard, and strong and fit graded.

3.3 FINE AGGREGATES

The aggregates which passes from the 4.75mm IS sieve are known as fine aggregates. According to IS: 383-1970 these fine aggregate has separated into four grading zones i.e. zone 1 to zone 4. During the trail program fine aggregates (stone dust) were collected from Jalandhar and fall in the zone 2 and also brown in color. The sand has sieved through 4.75mm sieve and the greater particles are removed. Specific gravity of fine aggregates is 2.49.

3.4 WATER

The clean water is usually measured good and reasonable for mingling and concrete curing. So this water used for casting work available in university Material Testing Laboratory. This doesn't contain any microorganisms and also of good quality.

4. RESEARCH METHODOLOGY

Cement concrete mix: The cement concrete mix was prepared as per the procedure given in the relevant IS 10262:2009 .For optimal dosage selection of iron slag powder in the concrete mix, modified cubes (% ranging from 10 % to 50 %) are prepared and compared with plain cement concrete cubes. (1:1.67:3.2) .Fig (1) Depicts the compressive strengths of modified blast furnace slag powder cement concrete cubes and plain concrete cube cured under saturated conditions for 28 days. From fig (1) it can be noticed that, at 28 days the blast furnace modified pastes show compressive strength very close to that of the plain paste, even at 30 % replacement levels. Cement used: OPC 43 grade. W/ c Ratio: 0.5% Cement: Fine Aggregate: coarse aggregate proportion used: 1: 1.67:3.2

Table 1: mix specification for 1 m3 concrete

Particulars	Plain Concrete Mix	10 % slag	20 % slag	30 % slag	40 % slag	50 % slag
Cement in kg/ m3	386.14	347.526	308.912	270.298	231.684	193.07
Sand in kg/ m3	645.24	645.24	645.24	645.24	645.24	645.24
Coarse Aggregates in kg/ m3	1235	1235	1235	1235	1235	1235
Iron Slag in kg/ m3	0	38.614	77.228	115.842	154.456	193.07
Water in kg/ m3	190	190	190	190	190	190

5. RESULT & DISCUSSIONS

COMPRESSIVE STRENGTH TEST

Cube specimens of size 150mm*150mm*150* were taken out form the remedial tank at the ages of 7 days and 28 days and dyed-in-the-wool nearly on deletion from the water (while they were still in the wet condition). External water was wiped off the specimens were customary. The spot of cube when tried was at right angle to that as cast. The load was applied gradually without shock box the failure of the specimens happens and thus the compressive strength was start.

Figure 1: Compression testing Machine

Table 2: Compressive strength of various mixes

Mix	7 Days	28 Days
Plain concrete Mix	15.47	33.91
10 % slag	16.42	33.47
20 % Slag	17.54	34.02
30 % Slag	19.54	34.85
40 % Slag	17.58	33.58
50 % Slag	16.84	32.41

CONCLUSIONS

Behaviour of concrete by partial replacement of cement iron slag was studied. From the results obtained the following conclusions can be made,

1. The Compressive strength tends to increase with increase percentages up to 30% of iron slag in the mix.
2. these wastes materials can be efficiently and beneficially used in future for the construction purpose in concrete mix as alternative materials without affecting the desired properties of normal concrete
3. On adding of these materials to the normal concrete mix, they behave as a composite material in the hardening state. So after studying performing the test replacing the above percentages with alternative materials. It is concluded that these composite materials can be used in construction works in order to supports the various kind of loads without any failure till long life.
4. With the increase of percentages of iron slag in the concrete mix, the compressive strength also increases.

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