A STUDY ON STRENGTH PARAMETERS OF CONCRETE BY PARTIAL REPLACEMENT OF CEMENT WITH QUARRY DUST AND SAND WITH IRON SLAG

[1]Rahul D. Ghode, [2]Dr. P. P. Saklecha, [3]Prof. A. B. Dehane
[1]Student of Mtech Structural Engineering, [2]Professor, [3]Assistant Professor
[1,2,3]Department of Civil Engineering,
[1,2,3]Bapurao Deshmukh College of engineering, Sevagram, India

***Abstract*—Due to growing environmental awareness, as well as stricter regulations on managing industrial waste, the world is increasingly turning to researching properties of industrial waste and finding solutions on using its valuable component parts so that those might be used as secondary raw material in other industrial branches.**
Concrete a composite material made from cement, water, fine aggregate and coarse aggregate. But present researchers are in interest of finding new cement materials by waste materials or waste products produced from industries which are harmful to environment. The present paper deals with partial replacement of cement with quarry dust which are having silica used as admixture for making concrete. First quarry dust is made partial replacement of cement and found that 25% of partial replacement is beneficial to concrete without loss of standard strength of cement. Making 25% partial replacement of cement with quarry dust as usage in partial replacement to cement can be made.

Index Terms — Iron Slag, Quarry Dust (QD), natural sand, slump test, compressive strength, water absorption.

I. INTRODUCTION

In Civil Engineering 'Cement' plays an important role as it is impossible to produce any sustainable infrastructure without use of cement. We can say everything is incomplete without 'Cement', as construction industries rapidly growing with new innovations and ideas. Leaving waste materials in to environment directly results to damage of natural climatic conditions, hence use of waste materials is made at most importance in present study. Quarry dust a waste obtained from quarrying process is used as partial replacement to cement a pozzolonic material also used after identifying the optimum usage of quarry dust in partial replacement of cement. Cement, at the time of production produces equal amounts of Co2. Hence the partial replacement of cement can be made practice to optimize the cement content effects the production of cement and CO2 content production.

Now a day's consumption of natural aggregate and cement as the largest concrete component is constantly and rapidly increasing with the increase in the production and utilization of concrete. The demand for construction material is also increasing, at the same time the cost of the construction material is also increasing, To overcome these type of problems are want to found the new composition with low cost is the ultimate aim of our project.

Waste management has become one of the most complex and challenging problem in the world which is affecting the environment. The rapid growth of industrialization gave birth to numerous kinds of waste byproducts which are environmentally hazard and creates problems of storage. Always, construction industry has been at forefront in consuming these waste products in large quantities. The consumption of Slag in concrete not only helps in reducing green house gases but also helps in making environmentally friendly material. During the production of iron fluxes (limestone and dolomite) are charged into blast furnace along with coke for fuel. The coke is combusted to produce carbon monoxide, which reduces iron ore into molten iron product.

II. LITERATURE REVIEW

S.P.Palanisamy1, et.al, In this paper, Steel slag is an industrial by-product of steel industry. It possesses the problem of disposal as waste and is of environmental concern. The results were compared with conventional concrete property can be maintained with advanced mineral admixtures such as steel slag powder as partial replacement of cement 0 to 40%. Experiments were conducted to determine the compressive strength; split tensile strength of concrete with various percentages of steel slag aggregate. Compressive strength of steel slag concrete with different dosage of slag was studied as a partial replacement of cement. From the experimental investigations, it has been observed that, the optimum percentage of steel slag for high strength concrete. [1]

A.V.S.Sai. Kumar1, Krishna Rao B et.al[2], Concrete a composite material made from cement, water, fine aggregate and coarse aggregate. But present researchers are in interest of finding new cement materials by waste materials or waste products produced from industries which are harmful to environment. The present paper deals with partial replacement of cement with quarry dust which are having silica used as admixture for making concrete. [2]

Mohammed Nadeem, Arun D. Pofale, et.al[3], This paper presents result of an experimental investigation carried out to evaluate effects of replacing aggregates (coarse & fine) with that of Slag (Crystallized & Granular) which is an industrial waste by-product on concrete strength properties by using Taguchi's approach of optimization. Whole study was done in three phases, in the first phase natural coarse aggregate was replaced by crystallized slag coarse aggregate keeping fine aggregate (natural sand) common in all the mixes, in the second phase fine aggregate (natural sand) was replaced by granular slag keeping natural coarse aggregate common in all the mixes and in the third phase both the aggregates were replaced by crystallized & granular aggregates. The study concluded that compressive strength of concrete improved almost all the % replacements of nor- mal crushed coarse aggregate with crystallized slag by 5% to 7%. In case of replacements of fine aggregate and both type of aggregates, the strength improvements were notably noticed at 30% to 50% replacement level. [3]

Rafat Siddique, et.al[4], The environment problems are very common in India due to generation of industrial by-products. Due to industrialization enormous by-products are produced and to utilize these by-products is the main challenge faced in India. Iron slag is one of the industrial by-product from the iron and steel making industries. In this paper, the compressive strength of the iron slag concrete was studied. The results confirm that the use of iron slag overcome the pollution problems in the environment. The results shows that the iron slag added to the concrete had greater strength than the plain concrete. [4]

Shiva Kumar K, et.al, This dissertation work deals with the potential use of using Pond ash and Iron slag as the partial replacement of sand in plastered mortar. Pond ash is rarely used due its pozzolonic reaction may be used as a fine aggregate in a mortar mix used for plastering purpose. Then iron slag and pond ash is improves the quality of plastered surface inn terms of strength and durability. When the pond ash and iron slag was used 20% replacement of sand to make mortar mix, produced higher percentages compressive strength as well as a higher development rate than those tradition cement-sand mortar mix. As a result of compressive strengths, it was concluded that pond ash could be used as a good replacement material in mortar. It is proposed to perform some field and laboratory experiments in different mix proportions of pond ash and plaster sand and compare with normal mortar. Due to the pond ash replacement, the initial strength gaining process is quite slow but in later stages it gains very good strength as compare to the normal mortar mixes. [5]

III. MATERIAL USE

Under this experimental investigation, following materials are using which are given as below:-

- Cement
- Sand
- Aggregate
- Coal dust
- Iron Slag

A.**Cement:-**

Grade: 43

Type: Ordinary Portland Cement.

Table 1 Properties of Cement

Sr.No	Physical Properties	Value
1	Specific Gravity	3.14
2	Initial Setting Time	155
3	Final Setting Time	270
4	Final Consistency	34%

B. **Aggregate:-**

Aggregates are those chemically inert materials which when bonded by cement paste form concrete. Aggregates constitute the bulk of the total volume of concrete and hence they influence the strength of concrete to great extent.

1) ***Fine Aggregates :*** The material which passed through I.S. Sieve No. 480 (4.75mm) is termed as fine aggregates. The source for fine aggregate used is from natural river bed. The fine aggregate used which have fineness modulus of 3.01, specific gravity of 2.62.

2)***Coarse Aggregates :*** The material whose particles are of such size as are retained on I.S. Sieve No. 480 (4.75mm) is used as coarse aggregates. The aggregate used which have specific gravity of 2.82 and fineness modulus of 7.38.

C. Coal dust:

Table 2 Chemical Properties Coal dust

Constituents of coal	Symbol	Percentage (%)
Silicon Oxide	SiO_2	62.48%
Potassium Oxide	K_2O	3.18%
Magnesium Oxide	MgO	2.56%
Aluminum oxide	Al_2O_3	18.72%
Calcium Oxide	CaO	4.83%
Iron oxide	Fe_2O_3	6.54%

D. Iron Slag :

In this work, the Iron Slag is taken from the Bhugao Iron and Steel industry located at Wardha, Maharastra.

Color - Black

Fineness modulus – 2.10

IV. RESULT AND DISCUSSION

M25 Grade Compressive Strength:

Table 3 Compressive strength for M25 grade

Sr. No	Coal Dust	Iron Slag	Avg. Strength (N/mm^2) 7 Days	Avg. Strength (N/mm^2) 14 Days	Avg. Strength (N/mm^2) 28 Days
1	Control Mix	Control Mix	20.78	27.11	31.56
2	10%	40%	20.67	27	31.89
3	20%	50%	22	32.22	33.85
4	30%	60%	19.67	25.77	30.55

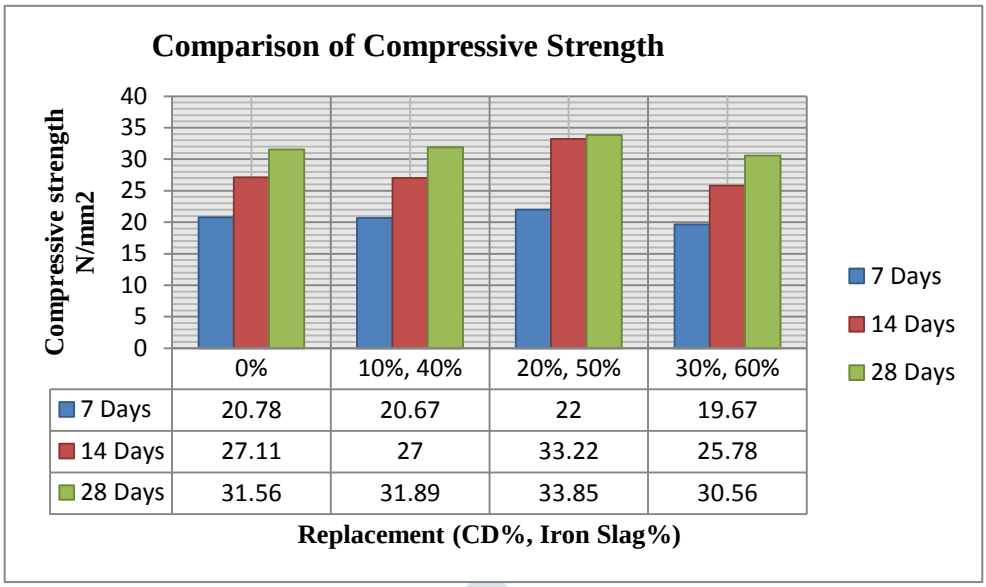

Fig. 1 Comparison of compressive strength for M25 grade

Observation:

In M25 grade of concrete, 7 days compressive strength of control mix is maximum. After addition of 10% Coal Dust & 40% Iron Slag the strength is occur minimum.

The strength is again increased in 20% Coal Dust & 50% Iron Slag but less than control mix. In last mix proportion i.e30% Coal Dust & 60% Iron Slag the strength is again reduced.

The 14 days comp. strength of M 25 grade is increased in of 10% Coal Dust & 40% Iron Slag proportion. In addition of 20% Coal Dust & 50% Iron Slag the strength is occur maximum strength is more than control mix. In last mix proportion i.e. 30% Coal Dust & 60% Iron Slag the strength is again reduced.

The maximum strength is achieved at the mix proportion of 20% Coal Dust & 50% Iron slag. In addition of 10% Coal Dust & 40% Iron Slag the strength is occur minimum.

The strength is again increased in 20% Coal Dust & 50% Iron slag the strength is more than control mix by 1.96 %. In last mix proportion i.e. 30% Coal Dust & 60% Iron Slag the strength is again reduced.

M30 Grade Compressive Strength:

Table 4 Compressive strength for M30 grade

Sr. No	Coal Dust	Iron Slag	Avg. Strength (N/mm^2) 7 Days	Avg. Strength (N/mm^2) 14 Days	Avg. Strength (N/mm^2) 28 Days
1	Control Mix	Control Mix	21.22	27.88	32.78
2	10%	40%	21.67	28.22	33.22
3	20%	50%	22.78	30	35.11
4	30%	60%	19.67	25.78	31.56

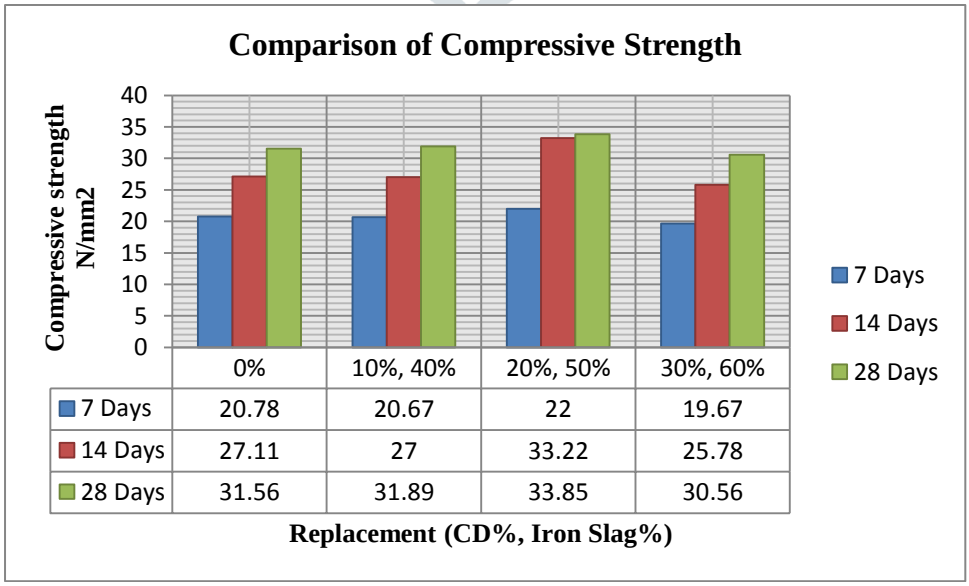

Fig. 2 Comparison of compressive strength for M30 grade

Observation -

In M30 grade of concrete, 7 days compressive strength of 20% CD and 50% Iron slag is maximum than control mix. In last mix proportion i.e30% Coal Dust & 60% Iron Slag the strength is again reduced.

The 14 days comp. strength of M 30 grade is again increased at of 20% Coal Dust & 50% Iron Slag proportion. It occurs maximum strength more than control mix. In last mix proportion i.e. 30% Coal Dust & 60% Iron Slag the strength is again reduced.

The maximum strength is achieved at the mix proportion of 20% Coal Dust & 50% Iron slag. In addition of 30% Coal Dust & 60% Iron Slag the strength is occur minimum.

The strength is more than control mix by 1.96 %. In last mix proportion i.e. 30% Coal Dust & 60% Iron Slag the strength is again reduced.

V. CONCLUSION

The strength and durability characteristics of concrete mixtures have been computed in the present work by replacing 10%, 20% and 30% coal dust with the cement and iron slag with sand. On the basis of present study, following conclusions are drawn.

1. The compressive strength of cubes were increased with addition of coal dust and iron slag up to 20% & 50 % respectively by weight in place of cement and sand, further any addition of coal dust and iron slag the compressive strength decreases.
2. The workability of the concrete with Aluminium dross did not show appreciable changes as compared to the control mix.
3. The Coal dust and iron slag waste can be utilized in concrete and hence solve a potential disposal problem.
4. The use of coal dust and iron slag in concrete might be cost effective because this material is available at half the rate of sand and cement respectively.
5. In M25 grade of concrete, the maximum compressive strength is obtained at 28 days for the mix proportion of 20% Coal Dust & 50% Iron Slag. The strength is increased by 1.96 % as compare to the control mix.
6. Similarly, In M30 grade of concrete, the maximum compressive strength is obtained at 28 days for the mix proportion of 10% Coal Dust & 40% Iron Slag. The strength is increased by 1.55 % as compare to the control mix.
7. Use of coal dust in concrete can save the coal & thermal industry disposal costs and produce a 'greener' concrete for construction.

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