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Improving Properties of Concrete by Foundry Slag as a Partial Replacement in Place of Cement

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Abstract—*The point of this examination is to assess the execution of Foundry Slag a modern waste as halfway substitution of bond in concrete. Foundry slag contain high caliber of silica, alumina and ferrous. It is gotten from the steel factories heater in metal throwing industry. It produces tones of slag every year and its enormous amount is dumped on purge lands which make a natural issue. This examination explores the execution of foundry slag as halfway substitution of bond in solid blend as far as Compressive quality, Flexural quality and part rigidity of M-25 review concrete. The OPC is supplanted by Foundry Slag as 10%, 20% and 30% by weight. "Midway substitution of bond in M-25 survey concrete from Foundry Slag may augment in all quality (Compressive, Flexural and Splitting Tensile quality) and solidness of vibrational blend of cement on all age when contrasted with ordinary cement. Quality of the distinctive blend extent of foundry slag must be check. "It will reasons that by usage of foundry slag as halfway substitution of bond in concrete , there might be a ton of positive outcomes as far as quality", durability as well environmental friendly.*

Keywords: *Foundry Slag, Compressive Strength, OPC.*

1. INTRODUCTION

All the building materials such as cement, sand, aggregates are derived from the natural resources. In recent years there has been a boom in construction which has increased the demands of these resources and has also led to the chances of their depletion. The cement production with an amount of 330 million tonnes per year put India to the second largest cement producing country in the world. The increase in production of cement put tremendous pressure on natural resources. Besides this its consumption is also leading to generation of large quantity of waste and environmental pollution. The increase in metal casting industries is also making the conditions worst and problems like Land filling, soil losing its fertility, environmental pollution is seen nowadays. To make the best use of these natural resources of these materials is best alternative. With increasing awareness about the environment and scarcity for land filling due to its increasing cost, waste by product utilization has become an attractive alternative to its disposal. The slag produced annually is around 1.7 million, it is estimated around 5000 foundries are operating all over India. "The Materialistic properties of foundry slag is its high calibre of ferrous, Alumina and ferrous. Its physical and compound properties will rely upon the crude materials utilized." Foundry slag is a combination of limestone and metal impurities in casting in metal casting industry [1] Foundry slag is use in concrete as partially replacement of cement. In this project we have to take M25 concrete mix design and prepare sample of concrete at variation proposition .In this, we prepare sample of cement replacement [2]. Whole study was done in two phases, i.e. replacement of cement with foundry slag. The investigation revealed improvement in compressive strength, spit tensile and flexural strength over control mixes[3] "The use of foundry slag as total, street bed materials, soil richness conditioner and as clinker materials rely upon their substance and mineralogical attributes"[4]

2. MATERIAL USED

Ordinary Portland cement of grade 43 is used to prepare the mix design of Different grade. The cement used was fresh and without any lumps. Water – cement ratio is 0.43 for this mix design. Clean river sand of maximum Size 4.75 mm are used as a fine aggregate. The coarse aggregates are locally available was used maximum size of 20 mm. "The examination was made on foundry Slag acquired from metal throwing industry situated in Parwatsar, Naguar area in Rajasthan." The table (1) below shows the physical properties of foundry slag

Table 1 Physical Properties of Foundry Slag

Sr. no.	Property	Result
1	Specific gravity	2.69
2	Water absorption	0.45
3	Moisture content	1.30
4	Fine modulus	3.65

The table (2) below shows the chemical properties of foundry slag

Table 2 Chemical Properties of Foundry Slag

Sr. no.	Description	%
1	SiO2	41.92%
2	Al2O3	20.55%
3	Fe2O3	18.92%
4	CaO	7.01%
5	MnO	6.61%
6	TiO2	1.49%
7	MgO	1.24%
8	Cr2O3	0.53%

The table (3) below shows the physical properties of OPC

Table 3 Physical Properties of OPC

Sr. No.	Properties	Detail
1	Specific gravity	3.15
2	pH	9
3	Colour	Gray

The table (4) below shows the chemical properties of OPC

Table 4 Chemical Properties of OPC

Sr. No.	Chemical` Composition	OPC
1	SIO2	18.62%
2	Al2O3`	4.75%
3	Fe2O3	3.02%
4	CaO	61.42%
5	MgO	3.21%
6	Na2O	1.51%
7	K2O	1.42%
8	SO4	2.29%
9	LOI	3.55%

3. METHODOLOGY

Experimented were conducted on concrete prepare by partial replacement of cement by foundry slag of practical size 150 µm (for cement) .cement are replaced by 10%,20% and 30% of foundry slag and mix design was prepared and compressive strength, , Flexural Strength, Splitting Tensile Strength are find out. The compressive strength find out at 7 days and 28 days. The split tensile strength was find out at 28 days this is done for cylinder. The flexural strength was find out at 28 days, this is done for beam.The concrete mix design was proposed according to Indian standard for control concrete. The grade was M20 and the ratio of cement, sand and aggregate is 1:1.5:3 and water – cement ratio is 0.43 which is constant for all mix design. Natural course and fine aggregate were use. The replacement level of cement to foundry slag was used in the term of 0%, 10%, 20% and30%.

"3D squares which arranged with various dubstitution of foundry slag is tried following 7 days and 28 days of curing for compressive quality esteem." For each mix, three different cubes are prepare and average final value of compressive strength is calculated which is shown in table (5)

Table 5 Compressive Strength of Cube

Mix	Foundry Slag(%)	Load (KN)	Compressive Strength (N/mm^2)
Ref.	00%	560.33	24.92
C10	10%	565.66	25.14
C20	20%	568.16	25.25
C30	30%	572.83	25.45

Pillars which arranged with various substitution of foundry slag is tried following 28 days of curing for flexural quality esteem." For each mix three different cylinders are prepare and average final value of flexural strength is calculated which is shown in table (6)

Table 6: Flexural Strength of Beam

Mix	Foundry Slag(%)	Load (KN)	Flexural Strength (N/mm^2)
Ref.	00%	11.185	3.48
C10	10%	11.442	3.56
C20	20%	11.764	3.66
C30	30%	11.925	3.71

Cylinders which prepared with different replacement of foundry slag is tested after 28 days of curing for splinting tensile strength value. For each mix three different cylinders are prepare and average final value of splinting tensile strength is calculated which is shown in table(7)

Table 7 Split Tensile Strength of Cylinder

Mix	Foundry Slag (%)	Load (KN)	Split Tensile Strength (N/mm^2)
Ref.	00%	105.268	1.49
C10	10%	118.692	1.68
C20	20%	126.463	1.79
C30	30%	132.822	1.88

4. RESULT

When cement is replaced by foundry slag Compressive strength of reference mix is observed 24.92 MPa and further mixing of foundry slag it would increase at 30% replacement of foundry slag it gain maximum value which is observed 25.45 MPa.

5. CONCLUSION

The following conclusions can be drawn from this investigation.

The project provide quantified data on strength a of concrete containing foundry slag form basis for its utilization in structural concrete.

"Using of foundry slag causes sparing of bond and addresses the issue of transfer of foundry slag and resolve ecological issues."

Use of foundry slag minimizes the greenhouse gases and lead to sustainable construction.

The increased strength of concrete can be used in heavy structures.

Use of Foundry slag in concrete causes saving of cement and address the problem of disposal of Foundry slag and resolve environmental problems.

It decreases the metal mechanical waste and transfer issue identified with it.

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