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Use of red mud in production of Self compacting concrete

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ABSTRACT

There is a common problem of dealing with the industrial waste disposal such as red sand, which are chief waste material from aluminum industries. It is a waste product of Bayer's process for the manufacturing of aluminum. Usually 2 – 4 tons of bauxite is used for production of 1-ton steel and 1 ton of red mud as waste. Dumping of these wastes is usually done in open spaces near manufacturing if possible and as result they act as an open threat even dissolving in ground water, as this waste's size is fine, hence they should be tried to be utilized in a useful manner. Various attempts have done in order to use these industrial wastes in several ways and as a result they are now used in construction, bricks, plastic and resins fillers, metallurgy etc. In this paper an attempt has been made to use foundry sand as mineral admixtures in different percentages. General properties of red mud has been studied. The whole composition of Self compacting concrete remains same including Portland cement , aggregates , water , admixtures , apart from them a combination of super plastisizer and viscosity modifying agent is used along with different percentages of red mud and foundry waste as mineral admixtures. Different percentages of red mud are checked for compressive , shear and flexural strengths .Various flow tests such as slump flow test , V- Funnel test , U-Box test , L-Box tests are done for various samples having various percentages foundry waste. Compressive strength of self compacting concrete with combination of admixtures of super plastisizer and viscosity modifying increases with 2% addition of red mud and decreases on further addition of red mud.

CONSTITUENTS OF SELF COMPACTING CONCRETE

Cement:- Generally Portland cement is used for SCC.

Aggregates:- The maximum size of aggregate is generally limited to 20mm . Aggregate of size 10 mm is desirable for structures having congested reinforcement. Wherever possible size of aggregate higher than 20 mm could also be used. Well graded cubical or rounded aggregate are desirable. Aggregates should be of uniform quality with respect to shape and grading. Fine aggregate can be natural or manufactured. The grading must be uniform throughout the work. The moisture content or absorption characteristics must be closely monitored as quality of SCC will be sensitive to such changes. Particles smaller than 0.125mm i.e. 125 micron size are considered as FINES which contribute to the powder content.

Mixing water: - Ordinary potable water of normally pH 7 is used for mixing and curing the concrete specimen.

Admixtures for SCC:-An admixture is a material other than water, aggregates and cement and is added to the batch immediately before or during its mixing. Admixtures are used to improve or give special properties to concrete. The use of admixture should offer an improvement not economically attainable by adjusting the proportions of cement and aggregates and should not adversely affect any properties of the concrete. The admixture consist chiefly of those which accelerate and those which retard hydration or setting of the cement, finely divided materials which improve workability, water proofers, pigments, wetting, dispersing and air-entraining agents and pozzolanic. Admixtures ranging from additions of chemicals to waste materials have been used to improve certain properties of concrete. The admixture is generally added in a relatively minute quantity. The degree of control must be higher to ensure that over dosages are unlikely to occur. Excess quantity of admixture may be detrimental to the properties of concrete. It may be mentioned here that concrete of poor quantity will not be converted to the good quality concrete by adding admixture. As mentioned briefly before basic properties of self compacting concrete are plastic viscosity, deformability, flow ability and resistance to segregation. Several components of concrete are used provide and control these properties. It is important to have a stable equilibrium between the plastic viscosity and the yield stress in the self compacting concrete. If this equilibrium is upset then we may have several problems such as, insufficient flow which will affect the filling

ability leading to incomplete filling of the forms or, too low a plastic viscosity which may cause segregation.

Chemical Admixtures:- Super plasticizer Glenium TM SKY 784 is used because it is essential component of SCC to provide necessary workability. Viscosity Modifying Agent (VMA) such as Glenium Sky is used for stability to improve freeze-thaw resistance and retarders for Control of Setting.

Mineral Admixtures:

Fly Ash: - Fly ash in appropriate quantity may be added to improve the quality and durability of SCC.

Red Mud: - Red mud is a residual product of aluminum from bauxite and can be used in appropriate quantity to improve the quality and durability of SCC.

METHODOLOGY

Foundry waste has been used as chemical admixture in the as 0 , 1 ,2 , 3 , 4 , 5 , 6 , 7 and 8 %. The samples are then checked for compressive , tensile and flexural strength. Various tests such as slump flow test , V Funnel test , U Box test , L Box test .

Figure-Slump flow test

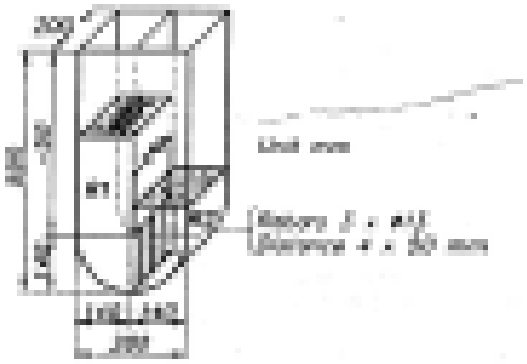


Figure – U Box test

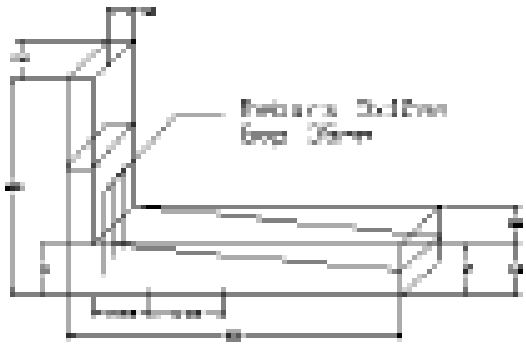


Figure- L Box test

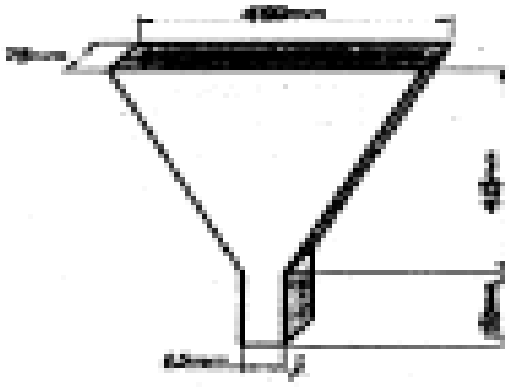


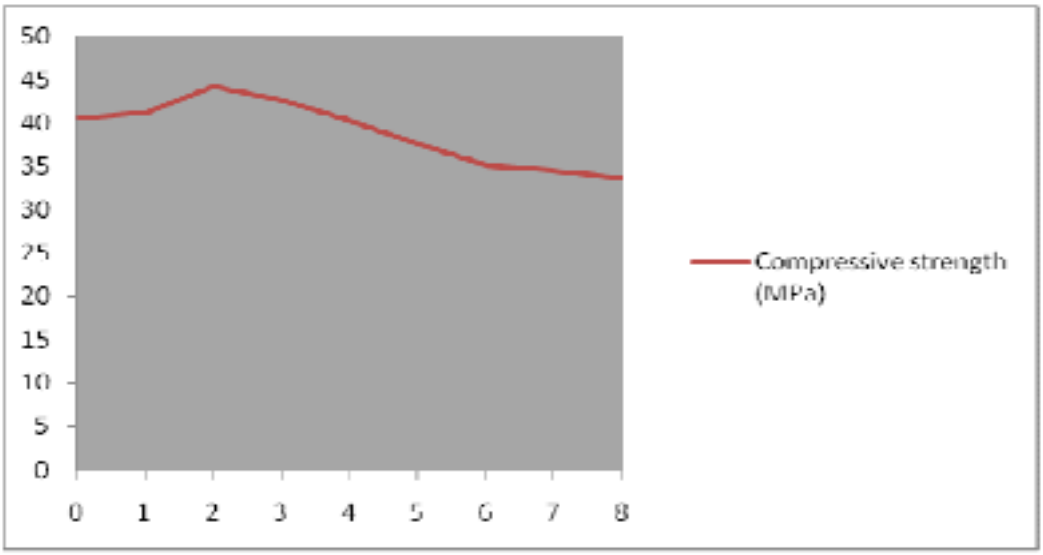
Figure – V Funnel Test

Table : Chemical composition of red mud

Chemical compostion	Bauxite residue (%)	Typical values worldwide (%)
$Fe_2 O_3$	51	30-60
$Al_2 O_3$	15	10-20
CaO	13	2-8
Sio_2	10	3-50
NaO	0.20	2-10

Table - Overall Result of Compressive Strength

Percentage addition of red mud	Compressive strength (MPa)	Percentage increase or decrease of compressive strength w.r.t. ref mix
0(REF.)	40.59	-
1	41.18	+1.45
2	44.29	+9.11
3	42.66	+5.10
4	40.29	-0.74
5	37.62	-7.32
6	35.11	-13.50
7	34.51	-14.98
8	33.62	-17.17

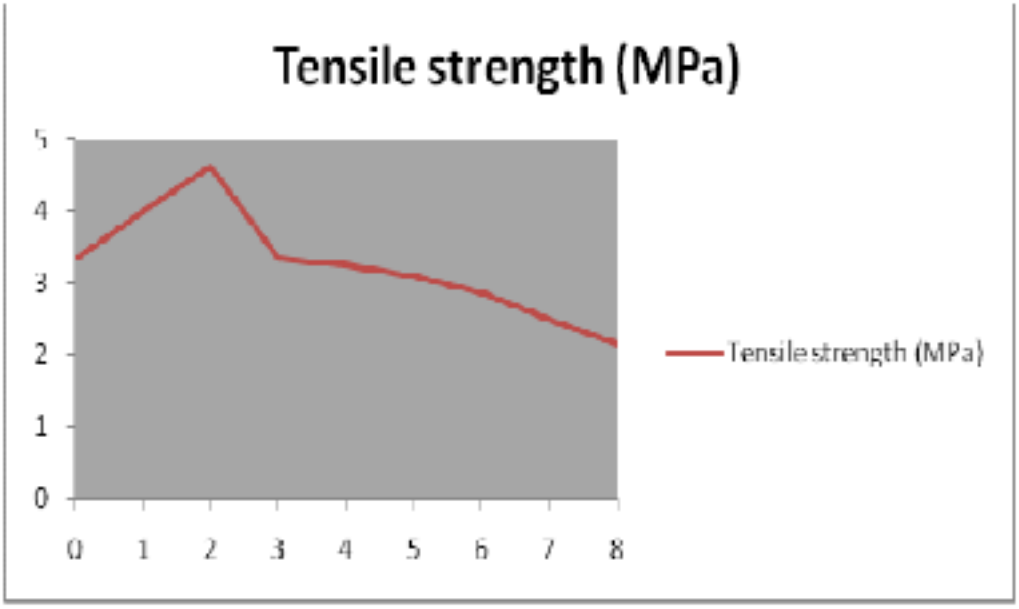


The variation of compressive strength can be depicted in the form of graph

Table - Overall Result of tensile Strength

Percentage addition of red mud	Tensile strength (MPa)	Percentage increase or decrease of tensile strength w.r.t. ref mix
0 (REF.)	3.34	-
1	4.00	+19.76
2	4.62	+38.32
3	3.34	0
4	3.25	-2.69
5	3.10	-7.19
6	2.87	-14.07
7	2.50	-25.15
8	2.16	-35.33

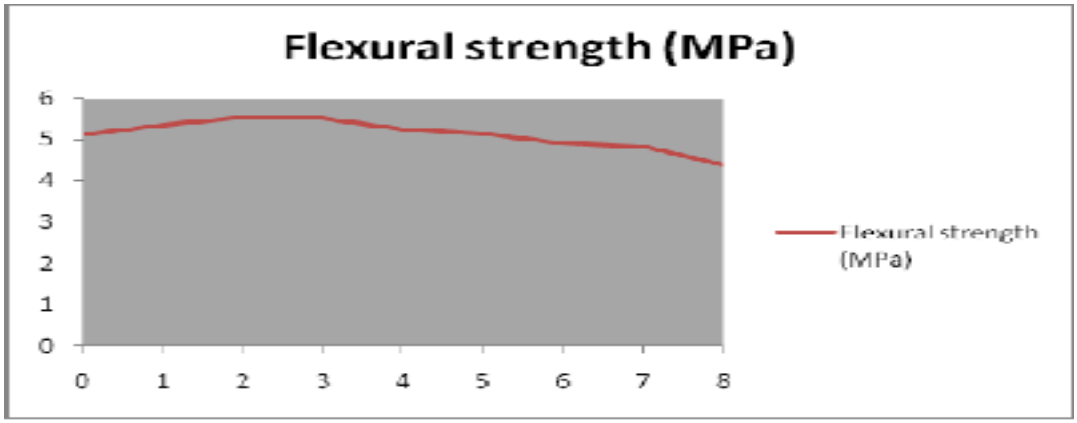
The variation of tensile strength can be depicted in the form of graph



Overall Result of flexural Strength

Percentage addition of red mud	Flexural strength (MPa)	Percentage increase or decrease of tensile strength w.r.t. ref mix
0(REF.)	5.12	-
1	5.36	+4.69
2	5.53	+8.01
3	5.50	+7.12
4	5.26	+2.73
5	5.15	+0.59
6	4.92	-3.91
7	4.83	-5.66
8	4.40	-14.06

The variation of flexural strength can be depicted in the form of graph



FLOW TEST RESULTS

Slump Flow Test Results

Percentage of red Mud	Slump flow (mm)	Time in sec T50
0	680	4.8
1	700	4.9
2	720	4.4
3	710	4.5
4	680	5.4
5	650	5.7
6	630	8.8
7	590	12.3
8	560	13.1

Funnel Test Results

Percentage of red mud	Flow time sec
0	33.11
1	24.62
2	18.71
3	32.81
4	34.61
5	36.81
6	42.01
7	52.81
8	66.53

U - Box Test Results

Percentage of red mud	Height of conc. In 1st compartment H1 (mm)	Height of conc. In 2st compartment H2 (mm)	Filling height H1-H2 (mm)
0	290	290	0
1	290	290	0
2	290	290	0
3	290	285	5
4	290	285	5
5	290	280	10
6	290	280	10
7	290	275	15
8	290	270	20

Box Test Results

Percentage of red mud	Height H1	Height H2	Blocking ratio H2 /H1	Time taken for conc. To reach a distance of 200 mm (T20) sec	Time taken for conc. To reach a distance of 400 mm (T40) sec
0	80	65	0.812	9.24	15.7
1	75	66	0.88	6.30	10.1
2	80	76.8	0.96	3.80	6.4
3	70	60	0.85	4.60	8.7
4	72	60	0.83	5.20	9.1
5	70	55	0.78	5.50	1112
6	80	48	0.60	6.30	13.3
7	82	32	0.39	7.20	15.5
8	95	15.2	0.16	9.40	25.1

CONCLUSION

Compressive strength of self compacting concrete with combination of admixtures of super plastisizer and viscosity modifying increases with 2% addition of foundry waste and decreases on further addition of foundry waste

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