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An Experimental Study on Partial Replacement f Cement by Aluminium Dross in Concrete

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Abstract: **The objective of this project is to study the replacement of aluminium dross in cement concrete. As all we know aluminium is one of the widely used construction material in the world,and during the aluminium production,the huge amount of waste is produced. The main advantage of using the aluminium dross in the concrete over the conventional concrete is the reduction in the quantity of raw materials. The result of this study indicates that aluminium deoss can be used as an ingredient in the range of certain limits to improve the corrosion resistivity of concrete. Aluminium dross have been used to replace cement by 5%,10%and 15%by its weight. Then using this concrete, concrete cubes are casted. The casted cubes are tested for compressive strength for 7days ,15days and 28days.**

Keywords: Aluminium dross,Cement concrete,Waste management, etc.

INTRODUCTION

Aluminium is one of the widely used construction material in the world, and during the aluminium production, the huge amount of waste is produced. For instance,in Qatar, Qatalum 635.000 millions tons aluminium ingots and billets, annually and this production causes approximately 350illion tons of dross which is sent to the neighbouring countries for Re-extraction and recycling of the remaining aluminium. Aluminium dross mainly consists of metal, salts oxides, and other non metallic substance. Normally aluminium dross is divided into two parts are black and white whil;e the black aluminium dross contents low metal with high amount of oxides, salts and granular-like in form similar to stand.The white aluminium deoss has very high amount of oxides and salts nd forms large blocks.Aluminium deoss is mainly produced from the meling of aluminium scrap such as used beverage containers, aluminium sliding, casting and the treating of the melt with salt flux.

This aluminium dross is toxic and hazardous waste for the environment and so the safe disposal of the aluminium dross as a waste is a burden to aluminium manufacturing companies because its improper and careless disposal affects the eco- system, surface and the ground water. When these dross particles are allowed to escape into the atmosphere, inhalation can cause health such as

1) Alzeheimers Disease
2) Silicosis
3) Bronchitis

Fig.1:
White dross in lumps form with high aluminium content

Fig.2: Black dross

Fig.3 Chemical composition of aluminium dross `

Mg	*Al*	*Si*	*Mn*	*Fe*	*Cu*	*Zn*
0,00	*90,28*	*5,93*	*0,34*	*1,10*	*1,82*	*0,53*

It is is envisaged that the process of recovery of useful metallic and non metallic residue will add to the cost of operation and will demand the application of a new technology of an existing one which may not be without a cost.However the conversion of the dross to refactory material will add value to the dross and convert waste to usable form.

PEOPERTIES OF MATERIALS

Cement

OPC 53 Grade cement is required to conform to BIS specification IS:12269-1987 with a designed strength for 28 days being a minimum of 53 MPa or 530 kg/sqcm.53 Grade OPC provides high strength and durability to structures because of its optimum particle size distribution and superior crystallized structure. Being a high strength cement, it provides numerous advantages wherever concrete for special high strength application is required, such as in the construction of skyscrapers, bridges, flyovers, chimneys, runways, concrete roads and other heavy load bearing structures. Not only is this grade of cement stronger than other grades / types, it is also more durable. Further, by substituting lower grade cement with OPC 53, overall

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savings can be obtained through reduced quantity of cement that would be required to be used.

5.1.2 Aggregates

5.1.2.1 Coarse Aggregates

Aggregates which are greater than 4.75 mm and retained in 4.75 mm I.S. sieve is considered as coarse aggregates. In the present study locally available crushed stone aggregate of size 20 mm and 10 mm has been used. The aggregates have been tested as per IS: 2386-1963(Part - 1&3) IS: 383-2016. Physical properties of coarse aggregate are tabulated below in Table.

Physical properties of coarse aggregate of 10mm are tabulated below in Table 1 - (A & B)

Table 1 (A) - Physical Properties of Coarse Aggregate (10mm)

Sr. no	Name of the test	Result	Unit	Requirments	Test method
1	Specific gravity	1.99	-	-	IS 2386 P: 3 -1963
2	Water absorption	1.00	%	-	IS 2386 P: 3 -1963
3	Dry loose Bulk density	1.68	Kg/lit	-	IS 2386 P: 3 -1963
4	Aggregate Impact Value	-	%	Max 45%-Non-wearing surface Max 30%-Wearing surface	IS 2386 P: 4 -1963
5	Aggregate Crushing value	-	%	Max 45%-Non-wearing surface Max 30%-Wearing surface	IS 2386 P: 4 -1963
6	Flakiness Index (FI)	-	%	Max 40% (Combine Flakiness & Elongation)	IS 2386 P: 1 -1963
7	Elongation index (EI)	-	%		IS 2386 P: 1 -1963

Sr. no	Seive Size mm	Percent passing %	Percentage passing as per IS -383 : 2016			
			10 mm	12.5 mm	20 mm	20 mm
			Single size	Single size	Single size	Grade
1	40	-	-	-	100	100
2	25	-	-	-	-	-
3	20	-	-	-	85-100	90-100
4	16	-	-	100	-	-
5	12.5	-	100	85-100	-	-
6	10	-	85-80	0-45	0-20	25-55
7	4.75	-	0-20	0-10	0-5	0-10
8	2.36	-	0-5	-	-	-

Table 1 (B) - Sieve Analysis of Coarse Aggregate (10mm)

Physical properties of coarse aggregate of 20mm are tabulated below in Table 2 - (A&B)

Table 2 (A) - Physical Properties of Coarse Aggregate (20mm)

Sr. No	Name Of The Test	Result	Unit	Requirements	Test Method
1	Specific gravity	2.02	-	-	IS2386 P: 3 -1963
2	Water Absorption	0.43	%	-	IS2386 P: 3 -1963
3	Dry Loose Bulk Density (DLBO)	1.66	Kg/lit	-	IS2386 P: 3 -1963
4	Aggregate Impact Value	-	%	Max 45%-Non-wearing surface Max 30%-wearing surface	IS2386 P: 4 -1963
5	Aggregate crushing value	-	%	Max 45%-Non-wearing surface Max 30%-wearing surface	IS2386 P: 4 -1963
6	Flakiness index	-	%	Max 40% (Combine Flakiness & Elongation)	IS2386 P: 1 -1963
7	Elongation index	-	%		IS2386 P: 1 -1963

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Table 2 (B) - Sieve Analysis Of Coarse Aggregate (20mm)

Sr.no	Sieve Size	Percent Passing	Percentage Passing as per IS – 383 : 2016			
			10mm	12.5mm	20mm	20mm
	mm	%	Single Size	Singles Size	Single Size	Single Size
1	40	-	-	-	100	100
2	25	-	-	-	-	-
3	20	-	-	-	85-100	90-100
4	16	-	-	100	-	-
5	12.5	-	100	85-100	-	-
6	10	-	85-100	0-45	0-20	25-55
7	4.75	-	0-20	0-10	0-5	0-10
8	2.36	-	0-5	-	-	-

Fine Aggregates

A) Crushed Sand

Aggregate most of which passes through 4.75 mm IS sieve is known as fine aggregate. Fine aggregate shall consist of natural sand, crushed stone sand. It shall be hard, durable, chemically inert, cleaned free from adherent coatings, organic matter etc. and shall not contain any appreciable amount of clay balls or pellets and harmful impurities e.g. iron pyrites, alkalies, salts, coal, similar laminated materials in such form or in such quantities as to cause corrosion of metal or affect adversely the hardening, the strength, the durability or the appearance of mortar, plaster or concrete. The sum of the percentages of all deleterious material shall not exceed 5%. Fine aggregate must be checked for organic impurities such as decayed vegetation humps, coal dust etc.

Table 3 (A) - Physical Properties Of Crushed Sand

Sr. no	Name of test	Result	Unit	Requirements	Test Method
1	Specific gravity	2.64	-	-	IS 2386 P:3 - 1963
2	Water Absorption	3.12	%	-	IS 2386 P:3 - 1963
3	Dry Loose Bulk Density	1.91	Kg/lit	-	IS 2386 P:3 - 1963
4	Bulking	-	%	-	IS 2386 P:3-1963
5	Fineness Modulus	-	-		IS 2386 P:1 - 1963
7	Matreial finer than 75	-	%	Max 3%- uncrushed (Natural) Max 15%- Crushed	IS 2386 P:1 - 1963

Table 3 (B) - Sieve Analysis Of Crushed Sand

Sr. no	Sieve Size (mm)	Percent Passing (%)	Percentage Passing as per IS – 383 : 2016			
			Grading zone I	Grading zone II	Grading zone III	Grading zone IV
1	10	-	100	100	100	100
2	4.75	-	90-100	90-100	90-100	95-100
3	2.36	-	60-95	75-100	85-100	95-100
4	1.18	-	30-70	55-90	75-100	90-100
5	600 u	-	15-34	35-59	60-79	80-100
6	300 u	-	5-20	8-30	12-40	15-50
7	150 u	-	0-10	0-10	0-10	0-15

Aluminium Dross

Aluminium dross is a by-product of aluminium production. It represents a residue from primary and secondary aluminium production. Today much energy is consumed to recover the aluminium from dross, energy could be saved if the dross was diverted and utilized as an engineering material. There are two forms of aluminium – white dross and black dross. White dross is formed during the primary aluminium process while black dross is formed during the secondary refining process, which uses relatively large amounts of chloride salt fixes. Subsequently the dross is processed in rotary to recover the aluminium and the resultant salt cake is sent to landfill.

There is much merit if the aluminium dross that is formed could be used as an engineering product for specific applications. The driving force to use an industrial waste such as aluminium dross and to use it as an engineering material is not only an issue environmental, but also an economic one.

Table 4 - Chemical Properties Of Aluminium Dross

Element	Composition n%
SiO_2	7.1
CaO	20.94
Na_2O	0.36
Al_2O_3	63.84
Fe_2O_3	0.32
MgO	0.45
MnO	0.73

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MIX PROPORTION

Cement = 350 kg.
Fine aggregate = 896 kg.
Chemical admixture = 7 kg.
Water cement ratio = 0.4
C : FA : CA = 1 : 2.56 : 3.26

CONCLUSION

Diverse modern waste materials are utilized as fractional substitution of cement at various levels delivered concrete with high quality and satisfactory supporting review concrete. Curing conditions accepted in this examination delivered critical changes in the properties of cements particularly those containing diverse substitution levels.

The compressive test of concrete reductions with expanding aluminum dross content when differ with the conventional cement. High volume aluminum dross substitution isn't proper on account of its high water absorption limit. Curing impact on the quality pick up of aluminum dross included cement concern to be additionally considered.

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