PERFORMANCE OF CONCRETE USING ALUMINIUM DROSS

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Abstract-Aluminium dross is a by-product of aluminium production. At present, dross is processed in rotary kilns to recover the aluminium. The objective of present work is to utilize the aluminium dross in the natural cycle (closed loop) by using it as an engineered material and to investigate the mechanical properties of new concrete type obtained by adding aluminium dross which is an impure aluminium mixture that results from metals melting and mixing with flux. The main advantage of this type of concrete over the conventional ones is the reduction in the quantity of raw materials.

Keywords:-Aluminium dross, natural sand, water absorption,compressive strength.

I. INTRODUCTION:-

Aluminum dross is one of the waste products obtained during aluminum refining. It consists of metal, salts oxides and other non metallic substances. Basically, aluminum dross is classified as either black or white while the black (dry) dross has low metal content with high amounts of oxides, salts and granular-like in form similar to sand. The white (wet) dross has extremely high metal content with small amounts of oxides and salts and form large clumps or blocks. Aluminum dross is usually produced from the melting of aluminum scrap such as used beverage containers, aluminum siding, castings and the treating of the melt with salt flux. The salt flux accumulates on top of the melt and forms dross or skim which contains aluminum and other elements such as magnesium, silicon and others in trace amount. The potential use of dross (as filler) in concrete products such as, non-aerated concrete, concrete cube has being investigated. According to the non-metallic residues produced during processing of aluminum dross could be used as a source of aluminum oxide in cement's recipe.

The aluminum-bearing scrap for recycle may be either reclaimed metallic aluminum products (e.g. castings or used beverage containers) or metal-bearing aluminum oxide dross skimmed from primary aluminum melting furnaces. Dross obtained from primary melting operations (so-called "white dross") consist primarily of aluminum oxide (with some oxides of other alloying elements such as magnesium and silicon) and may contain from 15 to 70% recoverable metallic aluminum. Dross from secondary smelting operations (so-called "black dross") typically contain a mixture of aluminum/alloy oxides and slag, and frequently show recoverable aluminum contents ranging from 12 to 18%. Commercial smelting of both white and black dross is often done in a rotary salt furnace.

II. LITERATURE REVIEW:-

Nesibe Gozde Ozerkan, Omar Liqaa Maki, Momen Wael Anayeh, Stian Tangen, Aboubakr M. Abdullah[1]- It is the objective of this project is to investigate the mechanical and schemical behaviour of new concrete type obtained by adding aluminium dross which is an impure aluminium mixture that results from metals melting and mixing with flux. The main advantage of this type of concrete over the conventional ones is the reduction in the quantity of raw materials. The results of this study indicate that aluminium dross can be used as an ingredient in the range of certain limits to improve expanded concrete/mortar and to improve the corrosion resistivity of concrete/mortar.The most interesting finding was that aluminium dross accelerates the setting time of concrete/mortar. Because of these findings it is suggested that aluminium slag added concrete/mortar may be used in the manufacturing of buildings subfloors, panels, blocks etc.[1]

Samson Oluropo Adeosun, Olatunde Israel Sekunowo, Omotayo Oluwaseyi Taiwo,Wasiu Ajibola Ayoola, Adebowale Machado[2] - The study on the physio-mechanical behavior of aluminum dross has been carried out. The amount of aluminum dross used varied between 50 and 90 wt %, while bentonite added to the dross varied from 10- 50 wt % with a fixed amount of water. Using dross particle sizes of 106 μm and 184 μm, 10 samples are produced from each particle size. The bricks are dried in still air for 24hrs at 31oC, oven drying at 110ºC for 24hrs and sintered at 450ºC for 8hrs. The bricks characteristics in terms of volume shrinkage, apparent porosity, bulk density, cold crush strengths and permeability are then evaluated. The results show that the 106μm particle size dross brick has the highest volume shrinkage of 24%, apparent porosity of 15% and peak bulk density of 1.9g/c.c. However, the dross brick exhibits relatively low cold crush strength of 940KN/m². The 106μm size bricks demonstrate a minimum of 85% permeability compared with 70 wt% of 184 μm bricks which may be due to variation in dross particles agglomeration. Given these results, the 106μm particle size brick can serve as acid refractory because its properties compared well with medium-alumina fireclay.[2]

J.Y. Hwang, X. Huang, and Z. Xu[3]- Various aluminum-smelting by-products from three production sources were received and characterized. The waste materials were tested for compound identification and environmental acceptance. A coarse metallic aluminum recovery test using an Eddy Current separator (ECS) was performed using two different Circuit configurations. White dross performed equally well with either Circuit, while black dross processing shows significant difference on the separation results. It was found that ECS technology was effective for particle sizes down to 6-10 mesh.[3]

M.SATISH REDDY, Dr. D. NEERAJA Dr. B. KOTAIAH[4]-Aluminium dross is a by product of aluminium production. At present, dross is processed in rotary kilns to recover the aluminium. Aluminium dross in the form of salt cake is sent to landfi lls, although it is sealed to prevent from leaching. Leaching of aluminium dross could harm the environment as it contains fluorides and other salts. Furthermore, much ener gy is consumed to recover the aluminium from the dr oss, this energy can be saved if the dross could be diverted and utilized as an engineering material.The objectiv e of present work is to utilize the aluminium dross in the natural cycle (closed loop) by using it as an engi neered material

and to investigate the mechanical properti es of new concrete type obtained by adding aluminium dross which is an impure aluminium mixture that results from metals melting and mixing with flux.[4]

III. MATERIAL USE:-

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

- Cement
- Sand
- Aggregate
- Aluminium Dross

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	33%

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. Thesource for fine aggregate used is from natural river bed. Thefine aggregate used which have fineness modulus of 3.1,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 7.5.

3***) Aluminium dross:***

Table 2 Properties of Aluminium Dross

Sr.No.	Chemical Composition	Aluminium Dross
1	Al O (%)	77.15
2	SiO (%)	1.34
3	Na O (%)	6.57
4	CaO (%)	0.56
5	TiO (%)	0.14
6	MgO (%)	1.86
7	K O (%)	1.48
8	Zn	0.05
9	Cu	0.48
10	Mn	0.03
11	Fe	1.02
12	Alnetallic	1.26
13	AIN	8.06

IV. RESULT AND DISCUSSION:-

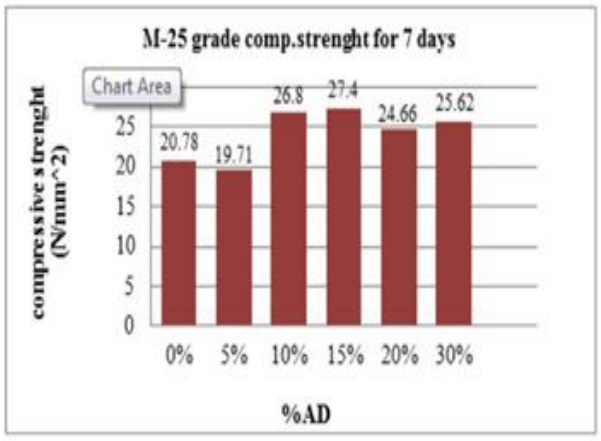
M25 Grade Compressive Strength:

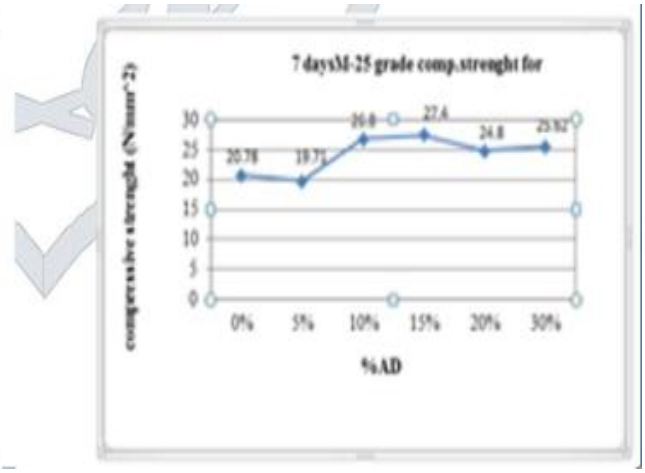
Test Results of Control mix:-

Mix Praportion	Curing Days	Compressive Strength N/mm^2		Avg. of Compressive Strength N/mm^2
		1	2	
1:1.55:3.02	7 days	19.7	21.7	20.8
	14 days	26.2	28	27.2
	28 days	30	31.6	33.11

Test Result for 7 days:-

Mix Praportion	Curing Days	Compressive Strength N/mm^2		Avg. of Compressive Strength N/mm^2
		1	2	
5%	7 days	19.64	19.7	19.77
10%	7 days	25.6	28	26.8
15%	7 days	25.33	29.5	27.4
20%	7 days	24.4	25.33	24.8
30%	7 days	24.64	26.6	25.62





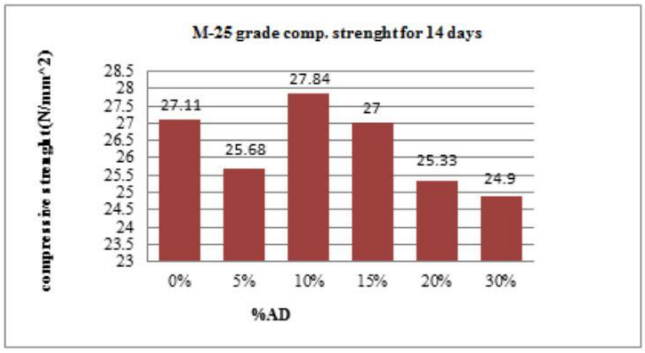
Observation:

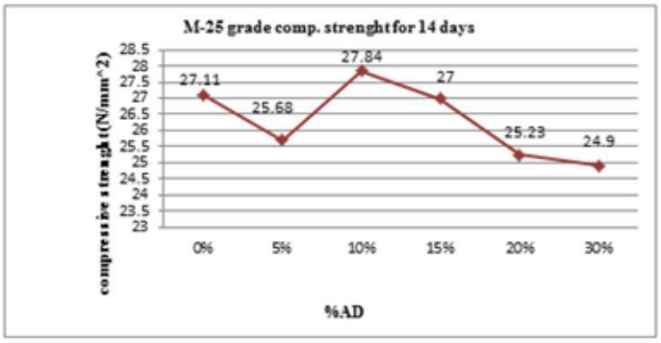
In this graph we can see that the compressive strength of control mix is maximum. After addition of 5% of Aluminium dross the strength is occur minimum.

The strength is again increased in 10% Aluminium dross and it is maximum at 15% Aluminium dross but greater than control mix. . In last mix proportion i.e. 20% Aluminium dross the strength is again reduced.

Test Result for 14 Days:-

Mix Praportion	Curing Days	Compressive Strength N/mm^2		Avg. of Compressive Strength N/mm^2
		1	2	
5%	14 days	25.15	26.22	25.68
10%	14 days	26.22	29.46	27.84
15%	14 days	24.44	29.7	27
20%	14 days	24.44	26.22	25.33
30%	14 days	24.22	25.5	24.9





Observation:-

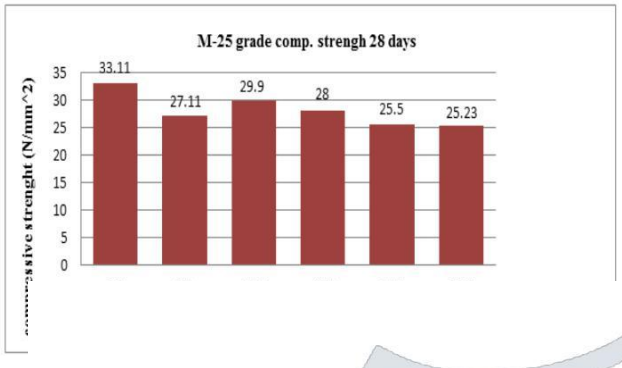
In this graph we can see that the compressive strength of 10% Aluminium dross mix is maximum. In addition of 5% Aluminium dross the strength is occur minimum.

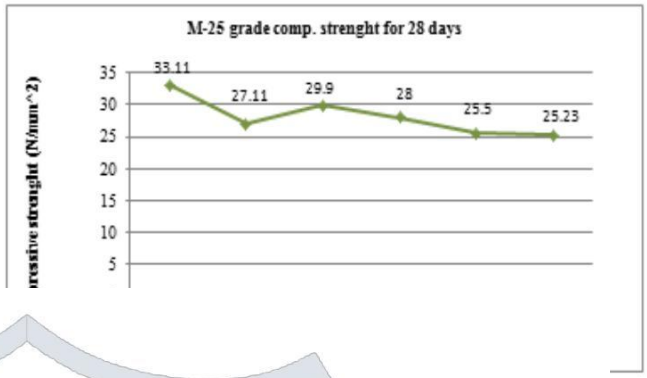
The strength is again decreased in 10% Aluminium dross and 15% & 20% the strength is less than control mix. In last mix proportion i.e. 30% Aluminium dross the strength is again reduced.

Test Result for 28 Days:-

Mix Praportion	Curing Days	Compressive Strength N/mm^2		Avg. of Compressive Strength N/mm^2
		1	2	
5%	28 days	26.22	28	27.11
10%	28 days	29.6	30.22	29.9

15%	28 days	26.22	29.77	28
20%	28 days	25.5	25.8	25.5
30%	28 days	25.13	25.33	25.23

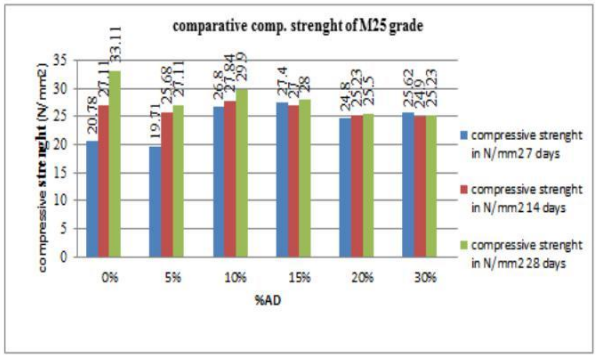


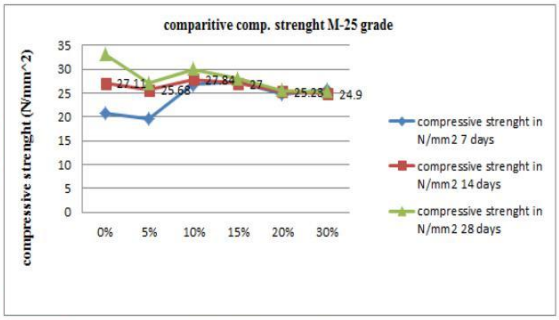


Observation:-

The maximum strength is achieved at the control mix .In addition of 5% Aluminium dross the strength is occur minimum.

The strength is again increased in 10% Aluminium dross and it is maximum at 15% and the strength is less than control mix. In last mix proportion i.e. 30% Aluminium dross the strength is again reduced.





Observation:-

From this graph we can concluded that, the compressive strength of M25 Grade concrete for mix proportion is found 10% maximum at 28 day.

V. CONCLUSION:-

1.The compressive strength of cubes were increased with addition of Aluminium dross up to 10% & 15 % respectively by weight in place of cementand sand, further any addition of Aluminium dross the compressive strength decrease.

2. The workability of the concrete with Aluminium dross did not show appreciable changes as compared to the control mix.

3. The workability due to absorption of water over the high specific surface area of Aluminium dross.

4. The Aluminium dross improve the durability of concrete.

5. The water absorption of Aluminium dross concrete is significantaly less as compered to that of control mix concrete.

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