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ECO-FRIENDLY CONCRETE IN CORPORATING VALUE ADDED MATERIAL

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ABSTRACT
The cement has changed the history of the construction industry since its invention. With the civilization, the construction industries have developed like never before. The technology has opened the doors of opportunities for the construction industries in last decade. Despite of all the technology available, one of the unavoidable materials for construction is nothing but the concrete. The concrete used is such a high volume in construction works, which made it necessary to find some material which can replace the concrete. Although much experimentation carried out in this domain, still no one has succeeded to replace the concrete completely with other material. The suitable solution found out is addition of some other materials to concrete in order to reduce the environmental effects of the concrete.

KEYWORDS: Concrete, tensile strength test, Compressive strength test, tensile flexure strength test, Slump test, etc.

INTRODUCTION
The disposal of the waste materials has become very severe problem when we think of the cement manufacturing. Although the replacement of the cement has become very severe issue, no one has succeeded to replace it yet. Process has been started to replace the cement partially with some supplementing material. The material to be added to the cement must have similar properties to the cement. Aluminium dross is one of the materials which are economical. This material is mixed with the cement to prepare a high performance concrete mixture.
The experimentation carried out is to study the properties of the concrete with the addition of the aluminium dross to the cement. The results are studied over the period of 28 days as a period of experimentation. The same results are presented in this paper to understand the performance of the concrete. The main purpose of this addition of material to the concrete is to make the eco friendly concrete.
The study carried out to check the compressive, tensile and flexure test. Optimum replacement ratio of the cement with aluminium dross is identified. The process has started from the preparation of the aluminium dross, mixing it with the concrete, and performing the various tests on the mixture.

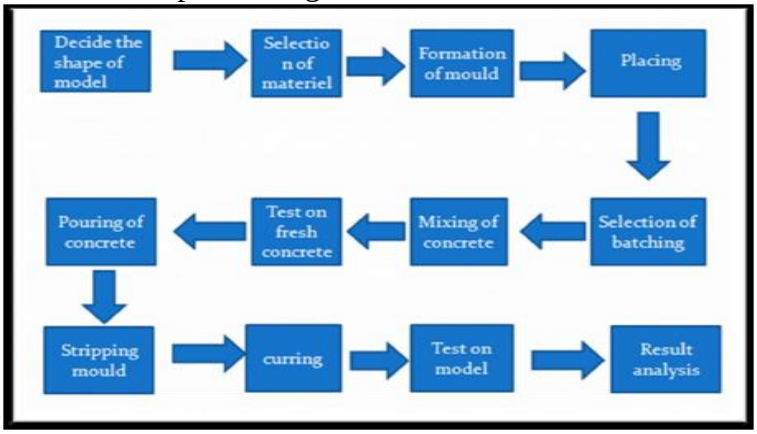

Figure 1: A Flow Diagram of Experimental Work

A specimen is prepared with the mixture of the different materials in the proportion. Different tests are carried out on the mixture upon preparation.

RESULTS AND DISCUSSION

a. SLUMP TEST VALUES

Table 1: Slump Values

S/N	Replacement ratio %	Water / Cement ratio	Final Height of Concrete (mm)	Slump Value (mm)
Mix1	0	0.59	270	30
Mix2	10	0.59	285	15
Mix3	20	0.59	290	10
Mix 4	30	0.59	297	3
Mix 5	40	0.59	299	1
Mix 6	50	0.59	300	0

b. COMPRESSIVE STREGHT TEST RESULTS FOR CUBE

Table 2: Compressive Strength Result for 7 Days

CUBE NO	DATE OF CAST	DATE OF TEST	CRUSHING LOAD (kN)	COMPRESSIVE STRENGHT (N/mm)
A_7 - 1	02/04/18	09/04/18	360.225	16.01
A_7 - 2	02/04/18	09/04/18	342.00	15.20
A_7 - 3	02/04/18	09/04/18	365.40	16.24
B7 - 1	04/04/18	11/04/18	290.025	12.89
B7 - 2	04/04/18	11/04/18	297.225	13.21
B7 - 3	04/04/18	11/04/18	299.92	13.13
C7 - 1	06/04/18	13/04/18	320.40	14.24
C7 - 2	06/04/18	13/04/18	296.32	13.17
C7 - 3	06/04/18	13/04/18	333.67	14.83
D7 - 1	16/04/18	23/04/18	335.92	14.93

D7 - 2	16/04/18	23/04/18	290.025	12.89
D7 - 3	16/04/18	23/04/18	311.63	13.85
E7 - 1	18/04/18	25/04/18	226.125	10.05
E7 - 2	18/04/18	25/04/18	218.92	9.73
E7 - 3	18/04/18	25/04/18	213.51	9.49
F7 - 1	20/04/18	27/04/18	193.27	8.59
F7 - 2	20/04/18	27/04/18	209.02	9.29
F7 - 3	20/04/18	27/04/18	216.22	9.61

Table 3: Compressive Strength Result for 28 Days

CUBE NO	DATE OF CAST	DATE OF TEST	CRUSHING LOAD (kN)	COMPRESSIVE STRENGHT (N/mm^2)
A_{28} - 1	02/04/18	30/04/18	542.47	24.11
A_{28} - 2	02/04/18	30/04/18	562.72	25.4
A_{28} - 3	02/04/18	30/04/18	544.95	24.22
B_{28} - 1	04/04/18	02/05/18	469.80	20.88
B_{28} - 2	04/04/18	02/05/18	490.05	21.78
B_{28} - 3	04/04/18	02/05/18	494.100	21.96
C_{28} - 1	06/04/18	04/05/18	515.70	22.92
C_{28} - 2	06/04/18	04/05/18	531.45	23.62
C_{28} - 3	06/04/18	04/05/18	511.425	22.73
D_{28} - 1	16/04/18	14/05/18	483.300	21.48
D_{28} - 2	16/04/18	14/05/18	472.95	21.02

D_{28} - 3	16/04/18	14/05/18	497.70	22.12
E_{28} - 1	18/04/18	16/05/18	319.50	14.18
E_{28} - 2	18/04/18	16/05/18	402.53	17.89
E_{28} - 3	18/04/18	16/05/18	360.90	16.04
F28- 1	20/04/18	18/05/18	261.90	11.64
F2- 2	20/04/18	18/05/18	257.40	11.44
F28- 3	20/04/18	18/05/18	278.55	12.38

Note: the cube strength in N/mm^2 is derived from dividing the force by 150mm x 150mm.

c. BENDING STREGHT TEST RESULTS FOR BEAM:

Table 4: Tensile Strength Result For 7 Days

CUBE NO	DATE OF CAST	DATE OF TEST	TENSILE LOAD (kN)	TENSILE STRENGHT (N/mm^2)
A_7 - 1	02/04/18	09/04/18	125.00	1.71
A_7 - 2	02/04/18	09/04/18	120.05	1.64
A_7 - 3	02/04/18	09/04/18	130.45	1.84
B_7 - 1	04/04/18	11/04/18	81.99	1.16
B_7 - 2	04/04/18	11/04/18	125.82	1.78
B_7 - 3	04/04/18	11/04/18	104.61	1.48
C_7 - 1	06/04/18	13/04/18	120.16	1.70

C_7 - 2	06/04/18	13/04/18	72.80	1.03
C7 - 3	06/04/18	13/04/18	135.00	1.91
D_7 - 1	16/04/18	23/04/18	111.68	1.58
D_7 - 2	16/04/18	23/04/18	113.80	1.61
D_7 - 3	16/04/18	23/04/18	98.96	1.40
E_7 - 1	18/04/18	25/04/18	71.79	1.01
E_7 - 2	18/04/18	25/04/18	72.80	1.03
E_7 - 3	18/04/18	25/04/18	78.76	1.11
F_7 - 1	20/04/18	27/04/18	65.73	0.93
F_7 - 2	20/04/18	27/04/18	69.27	0.98
F_7 - 3	20/04/18	27/04/18	77.75	1.10

TABLE 5: TENSILE STRENGTH RESULT FOR 28 DAYS

CUBE NO	DATE OF CAST	DATE OF TEST	TENSILE LOAD (kN)	TENSILE STRENGHT (N/mm^2)
A_{28} - 1	02/04/18	30/04/18	191.55	2.71
A_{28} - 2	02/04/18	30/04/18	173.18	2.95
A_{28} - 3	02/04/18	30/04/18	133.59	1.89

B_{28} - 1	04/04/18	02/05/18	170.35	2.41
B_{28} - 2	04/04/18	02/05/18	149.85	2.12
B_{28} - 3	04/04/18	02/05/18	144.90	2.05
C_{28} - 1	06/04/18	04/05/18	139.95	1.98
C_{28} - 2	06/04/18	04/05/18	180.95	2.56
C_{28} - 3	06/04/18	04/05/18	203.57	2.88
D_{28} - 1	16/04/18	14/05/18	143.49	2.03
D_{28} - 2	16/04/18	14/05/18	173.88	2.46
D_{28} - 3	16/04/18	14/05/18	154.09	2.18
E_{28} - 1	18/04/18	16/05/18	81.99	1.16
E_{28} - 2	18/04/18	16/05/18	93.30	1.32
E_{28} - 3	18/04/18	16/05/18	101.08	1.43
- F28 1	20/04/18	18/05/18	72.80	1.03
- F28 2	20/04/18	18/05/18	90.47	1.28
- F28 3	20/04/18	18/05/18	92.59	1.31

Note: the cylinder strength in N/mm^2 is derived from dividing the force by 150mm x 300mm.

d. FLEXTURE STREGHT TEST RESULTS FOR CYLENDER:

Table 6: Flexture Strength Result for 7 Days

CUBE NO	DATE OF CAST	DATE OF TEST	FLEXTURE LOAD (kN)	FLEXTURE STRENGHT (N/mm^2)
A_7 - 1	02/04/18	09/04/18	3.64	1.82
A_7 - 2	02/04/18	09/04/18	3.50	1.75
A_7 - 3	02/04/18	09/04/18	3.24	1.62
B_7 - 1	04/04/18	11/04/18	3.08	1.54
B_7 - 2	04/04/18	11/04/18	2.64	1.32
B_7 - 3	04/04/18	11/04/18	3.66	1.83
C_7 - 1	06/04/18	13/04/18	3.18	1.59
C_7 - 2	06/04/18	13/04/18	3.22	1.61
C_7 - 3	06/04/18	13/04/18	2.64	1.32
D_7 - 1	16/04/18	23/04/18	3.14	1.57
D_7 - 2	16/04/18	23/04/18	3.34	1.67
D_7 - 3	16/04/18	23/04/18	3.46	1.73
E_7 - 1	18/04/18	25/04/18	2.48	1.24
E_7 - 2	18/04/18	25/04/18	2.62	1.31
E_7 - 3	18/04/18	25/04/18	2.64	1.32

F_7 - 1	20/04/18	27/04/18	1.98	0.99
F_7 - 2	20/04/18	27/04/18	2.02	1.01
F7 - 3	20/04/18	27/04/18	2.16	1.08

Table 7: Flexture Strength Result for 28 Days

CUBE NO	DATE OF CAST	DATE OF TEST	FLEXTURE LOAD (kN)	FLEXTURE STRENGHT (N/mm^2)
A_{28} - 1	02/04/18	30/04/18	4.64	2.32
A_{28} - 2	02/04/18	30/04/18	4.60	2.30
A_{28} - 3	02/04/18	30/04/18	5.16	2.58
B_{28} - 1	04/04/18	02/05/18	5.64	2.82
B_{28} - 2	04/04/18	02/05/18	4.76	2.38
B_{28} - 3	04/04/18	02/05/18	4.16	2.08
C28 - 1	06/04/18	04/05/18	4.40	2.20
C28 - 2	06/04/18	04/05/18	4.36	2.18
C28 - 3	06/04/18	04/05/18	5.96	2.98
D28 - 1	16/04/18	14/05/18	5.24	2.62

D_{28} - 2	16/04/18	14/05/18	4.24	2.12
D_{28} - 3	16/04/18	14/05/18	4.36	2.18
E_{28} - 1	18/04/18	16/05/18	3.00	1.50
E_{28} - 2	18/04/18	16/05/18	2.82	1.41
E_{28} - 3	18/04/18	16/05/18	3.62	1.81
F28 - 1	18/04/18	16/05/18	2.04	1.02
F28 - 2	18/04/18	16/05/18	2.26	1.13
F28 - 3	18/04/18	16/05/18	3.04	1.52

RESULTS AND ANALYSIS OF DATA

TEST RESULTS OF CONTROL MIX:

Table 8: Test Results of Control mix

Mix Proportion	Curing Days	Compressive Strength N/mm^2			Avg. of Compressive Strength N/mm^2
		1	2	3	
Mix1	7days	16.01	15.20	16.24	15.81
Mix2	28 days	24.11	25.01	24.22	24.44

Table 9: Avg. of Compressive Strength Test Result for 7 Days

mix Proportion	Compressive Strength N/mm^2			Avg. of Compressive Strength N/mm^2
	1	2	3	
10%	12.89	13.21	13.33	13.14
20%	14.24	13.17	14.83	14.08

30%	14.93	12.89	13.85	13.89
40%	10.05	9.73	9.49	9.75
50%	8.59	9.29	9.61	9.16

Average Test Result for 28 days:

Table 10: Avg. of Compressive Strength Test Result for 28 Days

Mix Proportion	Compressive Strength N/mm^2			Avg. of Compressive Strength N/mm^2
	1	2	3	
10%	20.88	21.78	21.06	21.40
20%	22.92	23.62	24.73	23.09
30%	21.48	21.02	22.12	22.54
40%	14.18	17.89	16.04	16.03
50%	11.64	11.44	12.38	11.82

SPLIT TENSILE STRENGTH:

TEST RESULTS OF CONTROL MIX:-

Table 11: Test Result for Control Mix

Mix Proportion	Curing Days	Tensile Strength N/mm^2			Avg. of Tensile Strength N/mm^2
		1	2	3	
Mix1	7 days	1.91	1.10	1.84	1.61
Mix2	28 days	2.71	2.95	1.89	2.51

TEST RESULT FOR 7 DAYS:-

Table 12: Avg. of Tensile Strength Test Result for 7 Days

Mix Proportion	Tensile Strength N/mm^2			Avg. of Tensile Strength N/mm^2
	1	2	3	
10%	1.16	1.78	1.48	1.47
20%	1.70	1.03	1.91	1.54
30%	1.58	1.61	1.40	1.52
40%	1.01	1.03	1.11	1.05
50%	0.93	0.98	1.10	1.003

AVERAGE TEST RESULT FOR 28 DAYS:

Table 13: Avg. of Tensile Strength Test Result for 28 Days

Mix Proportion	Tensile Strength N/mm^2			Avg. of Tensile Strength N/mm^2
	1	2	3	
10%	2.41	2.12	2.05	2.19
20%	1.98	2.56	2.88	2.48
30%	2.03	2.46	2.18	2.23
40%	1.16	1.32	1.43	1.31
50%	1.03	1.28	1.31	1.20

GRADE FLEXTURE STRENGTH:

Table 14: Test Result for Control Mix

Mix Proportion	Curing Days	Flexture Strength N/mm^2			Avg. of Tensile Strength N/mm^2
		1	2	3	
Mix1	7 days	1.82	1.75	1.62	1.73
Mix2	28 days	2.32	2.30	2.58	2.40

TEST RESULT FOR 7 DAYS:

Table 15: Test Result for 7 Days

Mix Proportion	Flexture Strength N/mm^2			Avg. of Flexture Strength N/mm^2
	1	2	3	
10%	1.64	1.32	1.83	1.56
20%	1.59	1.61	1.52	1.58

30%	1.57	1.67	1.73	1.67
40%	1.24	1.31	1.32	1.29
50%	0.99	1.01	1.08	1.026

AVERAGE TEST RESULT FOR 28 DAYS:-

Table 16: Avg. of Flexture Strength Test Result for 28 Days

Test result for 28 days-Mix Proportion	**Flexture Strength N/mm^2**			**Avg. of Flexture Strength N/mm^2**
	1	2	3	
10%	2.82	2.38	2.08	2.42
20%	2.20	2.18	2.98	2.46
30%	2.62	2.12	2.18	2.38
40%	1.50	1.41	1.01	1.57
50%	1.02	1.13	1.52	1.23

MATERIAL RATES:

Cement: Rs.280.00 per bag

Sand: Rs.5000 per brass

For 1 m3 = Rs.1766 ≈ Rs.1800/-

Aggregate: Rs.2000 per brass

For 1 m3 = Rs.706 ≈ Rs.710/-

COST ANALYSIS OF M20 GRADE CONVENTIONAL CONCRETE:

Wet volume of concrete – 1 cum

Dry volume of concrete – 1.55 cum

A. Cement = 1 x1.55/11+2.20+3.70

=0.22 cum.

No. of bags =0.22/0.035

=7 bag

B. Sand= .0.22 concrete – 1.55 cum.

C. Aggregate = 3.70x x1.55/11+2.20+3.70

= 0.832 cum

Sr. No.	Material	Quantity	Unit	Rate in Rs.	Amount in Rs.
1	Cement	7	Bags	280	1960
2	Sand	0.495	Cum	1800	891
3	Aggregate	0.832	Cum	710	590.72
		Total			3441.72

Cost of manufacturing of 1 concrete cube of M20 grade

Volume of one cube = 0.15 X 0.15 X 0.15

= 0.003375 cum.

Cost for one cube = Rs. 11.88 ≈ Rs.12/-

Cost of manufacturing of 1 concrete beam of M20 grade

Volume of one beam = 0.1 X 0.1 X 0.5

= 0.005 cum.

Cost for one beam = Rs. 17.5 ≈ Rs.18/-

Cost of manufacturing of 1 concrete cylinder of M20 grade

Volume of one cylinder = 0.01767 X 0.30

= 0.0530 cum.

Cost for one cylinder = Rs. 18.55 ≈ Rs.19/

CONCLUSION

Addition of the aluminium dross to the concrete mixture is very suitable now a day in order to reduce the cost with considerations of the environmental aspects. Authors have studied the performance of the concrete mixture over the period of 28 days. The study is carried out to for various tests over the mixture and the results are presented in this paper. The aluminium dross mixture is helpful for the sustainable development in the construction industry by considering the factors like cost, environmental effects and strength.

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