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Experimental Investigation on Effective Utilization of Natural Wastes with Lime for Making Light Weight Bricks

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Abstract: ***In this modern era considerable attention has been paid to the utilization of alternative materials, which bear higher engineering quality than traditional materials and are financially affordable. With that in mind, a research was conducted to investigate the behavior of orange peel, eggshell, quarry dust in the bricks and limestone powder is added for binding property, the size of the bricks were adopted was (200x100x100) mm for manufacturing of lightweight bricks. For this effort two different mix proportions are used based on quarry dust and limestone with constantly adding of orange peel and eggshell to make the lightweight bricks. The research involved the preparation of two mix proportions, which are Quarry dust (5%) and without quarry dust with constantly adding of orange peel (1%) and eggshell powder (1%, 2%, 3%) is added to the weight of the clay. The experimental investigations respectively to investigate some properties like compressive strength, weight test, water absorption, efflorescence test, dimensional test, hardness, soundness etc., by conducting the different tests on prepared bricks. While using these waste natural resources to make bricks, it reduces approximately 50% weight of the brick. Therefore these bricks will reduce the dead weight of the structure to considerable amount. So it changes our design and building cost as in economical point of view. Finally the test results of innovative bricks are compared to the control bricks.***
Keywords- Orange peel, Quarry dust, Eggshell powder, Lime powder, Clay and Light weight bricks

I. INTRODUCTION

In the present world there are many types of waste are generated day by day in our regular life. This wastes causing creation of several environmental problems. This is affecting our human life as well as wild life very seriously. Many engineers have investigated to reduce the waste and also to create new material for our industrial requirement. The huge amount of a project is mainly depend upon cost is spent for materials. Cost control is the only way to do the project as most economical with directly proportional to the materials used in construction. The purchase of low cost material can reduce the cost of the project, but it should ensure that the quality of materials will meet already available material in the market. There are many studies have been done by using the waste material for to reduce the cost of the project as well as producing light weight bricks.

The raw material is extracted from mines by usual processes for the exploitation of mineral deposits. Limestone may have high hardness, requiring the use of explosives followed by crushing, or low hardness requiring only the use of disintegrators to be reduced to the size of maximum particle diameter of 1 cm. Clays containing silicates, alumina, and iron oxide are usually capable of being directly mixed with limestone. Limestone and clays, in predetermined proportions, are sent to the grinding mill (ball, bar, and roller mill), where the intimate mixing of raw materials occurs and at the same time, they are turned into powder to reduce their particle size diameter to 0.050 mm, on average.

II. PRELIMINARY AND EXPERIMENTAL INVESTIGATIONS

A. General

This chapter explains about the practical of the progress in our project such as preliminary examination of materials like specific gravity, Sieve analysis, Liquid and Plastic limit. Also properties and specifications of material using such as clay, orange peel, eggshell, quarry dust and limestone powder were illustrated and studied detailed.

B. Materials used in Innovative bricks

1) Clay
2) Orange peel
3) Eggshell Quarry dust

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4) Limestone powder

C. *Properties and Investigations*

1) *Clay:* Clay is also known as cohesive soil, Frictionless soil or Expansive soil and it's composed of very fine particles which is less 0.002 mm size.

Table.1 Properties of Clay used

Sl.No.	Investigations	Results
1.	Specific gravity	2.85
2.	Liquid limit	33%
3.	Plastic limit	22%

Fig.1 Investigations of clay

2) *Orange Peel:* Firstly, bricks of orange peels are used for preparation of all innovative bricks with constant of 1% but orange peels are not getting bonded properly with clay and when the sample get dries, it crumbles. Thus orange peels are bonded with quarry dust, eggshell and limestone powder in various compositions are prepared with each other.

Table.2 Properties of Orange peel

Component	Percentage (%)
Ash	5.34
Moisture	11.86
Protein	4
Sugar	23.8

3) *Eggshell:* Eggshell powder in very small amount, is used in some part of the world as a calcium supplement since eggshell contain a lot of calcium carbonate (CaCO3).

Table.3 Properties of eggshell

Components	Ranges
Water	0 to 5 g
Protein	1 to 2 g
Ashes	9 to 96 mg
Calcium	38 mg
Potassium	6 to 41 mg
Sodium	87 mg
Phosphorus	3 to 99 mg
Iron	0 to 5 mg
Magnesium	375 mg

4) Quarry Dust: The QD is a residue produced during crushing process of aggregates at quarries. The basic tests on quarry dust were conducted as per IS-383-1987 and its specific gravity was around 1.95. The physical properties of quarry dust were done

according to IS 2386-1963.

Table.4 Chemical Composition of Quarry Dust

Constituents	Percentage (%)
SiO_2	65.21
CuO	0.12
Fe_2O_3	10.52
CaO	0.74
MgO	4.27

Table.5 Sample Mix Proportioning

Orange Peel	Quarry dust	Lime powder	Eggshell powder	Clay	Water
0.033 kg	0.165 kg	NIL	0.033 kg	3.10 kg	0.66 lit

D. Experimental Investigations

1) *Compressive Strength:* The main test conducted to test the suitability of the brick for construction work. This test is executed with the help of compression testing machine. A brick is placed in a compression testing machine.

Fig.2 Compressive test

2) *Weight Test:* The various types of tests on bricks are conducted to check the qualities of bricks for construction purposes. Tests on bricks are conducted at construction site as well as in laboratory. One of the tests is weight test of brick here adopted in our researches for obtaining light weight bricks which is having the high compressive strength.

Fig.3 Weight test

3) *Water Absorption Test:* Clay Bricks should not absorb water more than 20%. The dry weight of the brick is taken and noted as

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w1.The brick is immersed in water for 24 hrs., after this was weighted and noted as w2.The following formula is used to find out the water absorption of brick

Water absorption in % by weight = (w2 – w1/w1) x 100

Fig.4 Water absorption test

4) *Efflorescence Test:* For this test, brick was placed vertically in water with one end immersed. The depth of immersion in water being 2.5 cm, then this whole arrangement should be kept in a warm-well-ventilated room temperature of 20-30˚ C until all evaporates.

Fig.5 Efflorescence test

5) *Dimensional Test:* The 15 bricks are taken and the loose particle of clay and small projections from the brick is removed. Arrange them on a level surface in contact with each other and in a straight line. The total dimensions of the brick are measured and the changes are noted.

Fig.6 Dimension test

6) *Hardness Test:* This test is carried out to see that the brick is sufficiently hard or not. We can judge hardness of the brick by making impression on the surface of the brick with the help of a finger nail. This test is carried out for all samples of bricks.
7) *Soundness Test:* This sound is carried out to find out that a clear ringing sound is produced or not when the two bricks are struck with each other without breaking any of the two bricks. If the two bricks are not broken after striking with each other and a clear ringing sound is produced then this means that the bricks are sufficiently sound. The Procedure of this test is self-explanatory.

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III. RESULTS AND DISCUSSIONS

A. *Compressive Strength*

Mix	Orange peel powder	Quarry dust	Lime powder	Eggshell powder	Compressive Strength (N/mm^2)
A	1 %	5 %	Nil	1 %	3.55
B				2 %	4.43
C				3 %	3.64
D		5 %	5 %	1 %	2.05
E				2 %	2.94
F				3 %	3.37
G		Nil	Nil	1 %	6.54
H				2 %	5.42
I				3 %	5.33
J		Nil	5 %	1 %	2.52
K				2 %	2.09
L				3 %	2.89

1) *Weight Test:*

Mix	Orange peel powder	Quarry dust	Lime powder	Eggshell powder	Weight (Kg)
A	1 %	5 %	Nil	1 %	2.90
B				2 %	2.88
C				3 %	2.89
D		5 %	5 %	1 %	2.85
E				2 %	2.87
F				3 %	2.85
G		Nil	Nil	1 %	2.98
H				2 %	2.95
I				3 %	2.92
J		Nil	5 %	1 %	2.81
K				2 %	2.74
L				3 %	2.87

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B. Comparison of Strength with Weight

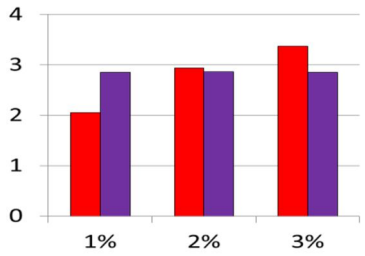

Fig.6 with quarry &with lime

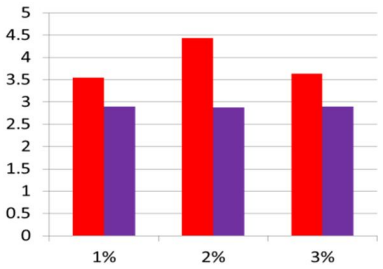

Fig.7 with quarry &without lime

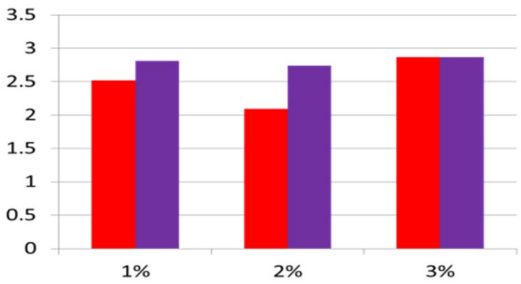

Fig.8 without quarry & with lime

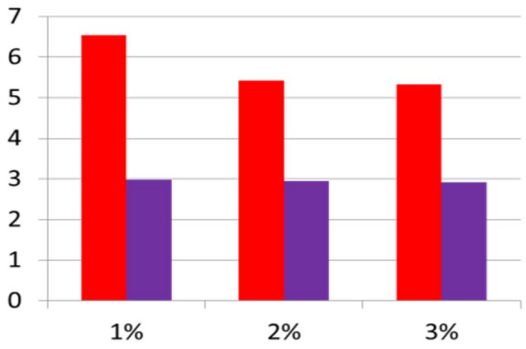

Fig.8 without quarry &without lime

Compressive strength (N/mm^2)

Weight (Kg)

C. Weight Test

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Mix	Dry weight (Kg)	Wet weight (Kg)	Water Absorption (%)	Average W.A. (%)
A	2.88	3.19	11	11.33
	2.86	3.19	10	
	2.80	3.22	13	
B	2.84	3.27	15	13.33
	2.86	3.26	14	
	2.81	3.11	11	
C	2.86	3.26	14	11.66
	2.96	3.32	12	
	2.88	3.14	9	
D	2.86	3.12	12	13
	2.82	3.13	11	
	2.75	3.19	16	
E	2.87	3.24	13	15.33
	2.76	3.22	17	
	2.80	3.24	16	
F	2.85	3.31	16	13
	2.90	3.25	12	
	2.95	3.27	11	
G	2.92	3.27	12	12
	3.01	3.34	11	
	2.95	3.33	13	
H	2.92	3.42	17	15
	3.01	3.40	13	
	3.00	3.45	15	
I	2.94	3.41	16	12.66
	2.99	3.35	12	
	2.91	3.20	10	
J	2.91	3.20	10	10.33
	3.01	3.34	11	
	3.02	3.32	10	
K	2.66	2.95	11	11.66
	2.76	3.09	12	
	2.81	3.15	12	
L	2.91	3.32	14	12.66
	2.77	3.10	12	
	2.93	3.28	12	

D. Efflorescence Test

Sl.No.	Mix	Observed Values
1	A	slight
2	B	slight
3	C	slight
4	D	nil
5	E	nil
6	F	nil
7	G	nil
8	H	nil
9	I	nil
10	J	nil
11	K	nil
12	L	nil

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E. Dimensional Test

Sl.No.	Particulars	Length (mm)	Width (mm)	Depth (mm)
1	Original	3450	1350	1050
2	Actual	3451	1352	1050
3	Error	1	2	0

F. Hardness Test

Sl.No.	Hardness test	
	Passing	Non-Passing
1	All mix	Nil

G. Soundness Test

Sl.No.	Soundness test	
	Passing	Non-Passing
1	All mix	Nil

IV. CONCLUSION

From the observed results of all mixes the optimum mix is selected. In this, our researches terminates at with quarry & without lime mix is having high compressive strength of 4.43 N/mm^2 with lesser weight of 2.88 Kg is considered as optimum mix (B) in all aspects including economy. This brick is suitable for using the construction works because all natural resources are effectively utilized in this innovative brick for making light weight structure.

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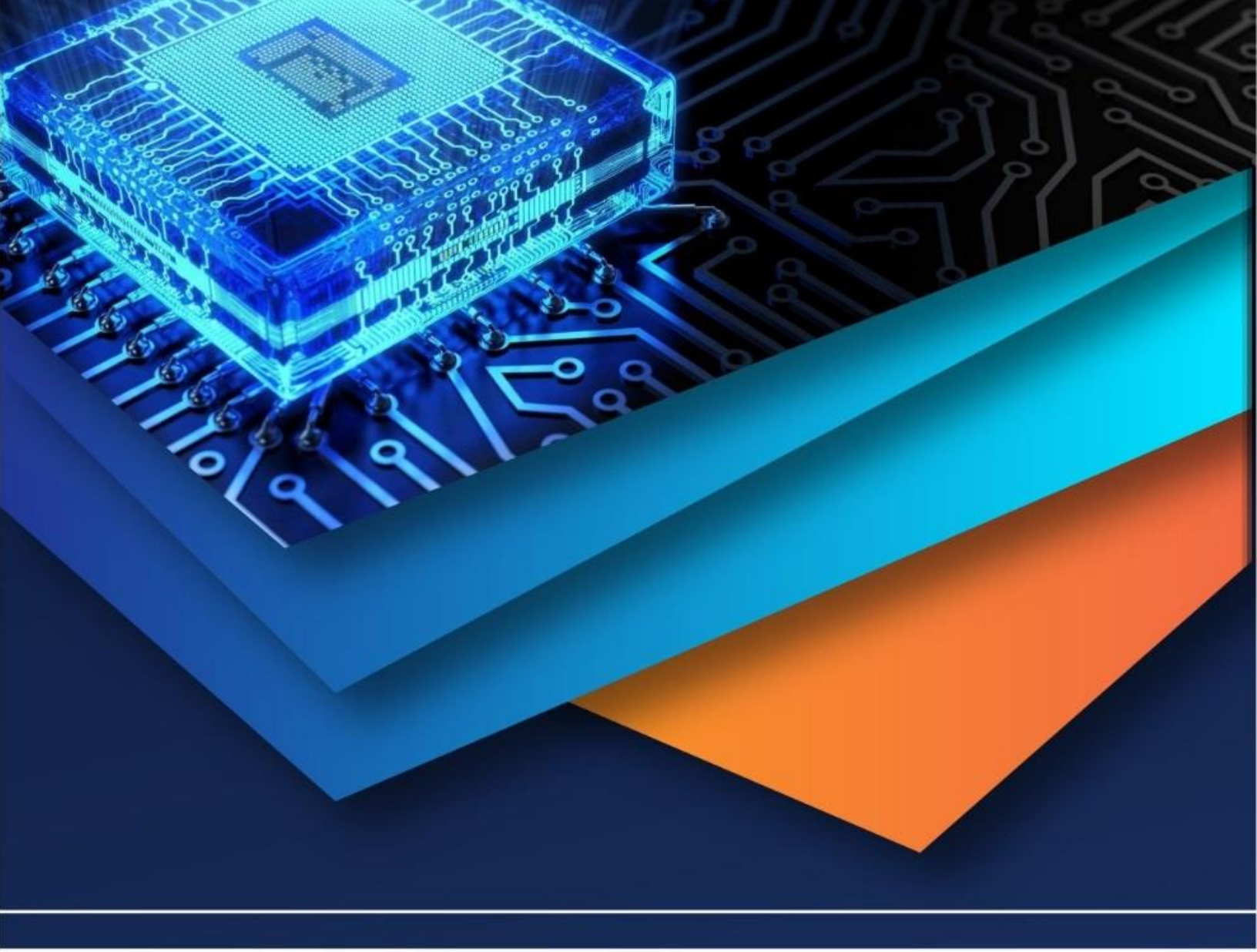

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