IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

EXPERIMENTAL STUDY ON BRICK MANUFACTURING BY USING SLUDGE & PULP PRODUCTION RESIDUE

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Abstract: Bricks are the major concern building material used for constructional purpose. In earlier day's mud blocks & in now a day clay bricks are being used. In the manufacturing of clay bricks the CO2 emission is more, since they are burned and the clay is exhausting. More than 300 million tons of industrial waste per annum in India mainly by chemical & industrial waste. Waste water treatment sludge is a type of waste obtained by industries. Paper pulp residue dominated during manufacturing of paper. Disposal of these waste into the environment causes land pollution. Many attempts have been made to overcome these problems. So the industrial waste materials & by products are used in the manufacturing of bricks. Here we have incorporated hypo sludge & the paper pulp residue along with fly ash, lime, quarry dust & gypsum to manufacture the bricks. The bricks are made without burning, CO2 emission is controlled. Hype sludge & paper pulp residue are randomly added at different percentages and the tests are conducted & the optimum percentage is obtained from the results. This attempt will be a better solution for the pollution problem.

Keywords **– Paper Pulp Residue, Waste Water Treatment Sludge, Fly Ash, Quarry Dust.**

1.INTRODUCTION

In the manufacturing of clay bricks the Carbon dioxide emission is more, since they are burned and the clay is exhausting. More than 300 million tons of industrial waste per annum in India mainly by chemical & industrial waste. Waste water treatment sludge is a type of waste obtained by industries. Paper pulp residue dominated during manufacturing of paper.Disposal of these waste into the environment causes land pollution. Many attempts have been made to overcome these problems. So the industrial waste materials & by products are used in the manufacturing of bricks.The bricks are made without burning, Carbon dioxide emission is controlled. Waste sludge & paper pulp residue are randomly added at different percentages such as 7.5%, 10%the tests are conducted & the optimum percentage is obtained from the results. This attempt will be a better solution for the pollution problem.

2.OBJECTIVES

To utilize the waste materials in brick manufacturing and reduce disposal hazards. To decrease the emission of Carbon dioxide during burning of bricks. To check the feasibility of sludge in brick manufacturing. To check the class of bricks.

3 TYPES OF BRICKS

- Common Burnt Clay Bricks
- Sand Lime Bricks (Calcium Silicate Bricks)
- Engineering Bricks
- Concrete Bricks
- Fly ash Bricks.

3.1 Common burnt clay bricks

Common burnt clay bricks are formed by pressing in molds. Then these bricks are dried and fired in a kiln. Common burnt clay bricks are used in general work with no special attractive appearances. When these bricks are used in walls, they require plastering or rendering.

3.2 Sand lime bricks

Sand lime bricks are made by mixing sand, fly ash and lime followed by a chemical process during wet mixing. The mix is then molded under pressure forming the brick. These bricks can offer advantages over clay bricks such as:

Their colour appearance is gray instead of the regular reddish color. Their shape is uniform and presents a smoother finish that doesn't require plastering. These bricks offer excellent strength as a load-bearing member.

3.3 Engineering bricks

Engineering bricks are bricks manufactured at extremely high temperatures, forming a dense and strong brick, allowing the brick to limit strength and water absorption.

Engineering bricks offer excellent load bearing capacity damp-proof characteristics and chemical resisting properties. These bricks are used in specific projects and they can cost more than regular or traditional bricks.

3.4 Concrete bricks

Concrete bricks are made from solid concrete and are very common among homebuilders. Concrete bricks are usually placed in facades, fences, and provide an excellent aesthetic presence. These bricks can be manufactured to provide different colors as pigmented during its production.

3.5 Fly ash bricks

Fly ash brick is a building material, specifically masonry units containing class C or class F fly ash & water, the bricks last for more than 100 freeze – thaw cycles. Owing to the high concentration of calcium oxide in class C fly ash, the brick is described as "Self-Cementing". The manufacturing method saves energy, reduces Pollution & costs 20% less than traditional clay brick manufacturing

4.MATERIAL COLLECTION

(i) Pulp Production Residue collected from Erode Paper Industry

Fig 1 Pulp residue

(ii) Waste Water Treatment Sludge collected from SRM water treatment plant

Fig 2 Waste Sludge

(iii) Quarry Dust obtained from local quarries while crushing stones

(iv) Fly Ash obtained from waste byproduct of thermal power plant which use coal as fuel

5.CHEMICAL COMPOSITION OF MATERIALS

TABLE 5.1 CHEMICAL COMPOSITION OF FLYASH

Component	Bituminous Coal	Sub bituminous Coal	Lignite Coal
SiO_2 (%)	20-60	40-60	15-45
Al_2O_3 (%)	5-35	20-30	20-25
Fe_2O_3 (%)	10-40	4-10	4-15
CaO (%)	1-12	5-30	15-40

TABLE 5.2 CHEMICAL COMPOSITION OF QUARRY DUST

Constituents	Quarry Dust (%)	Natural Sand(%)
SiO_2	65.73	82.37
Al_2O_3 (%)	19.31	8.23
Fe_2O_3 (%)	5.27	1.39
CaO (%)	3.64	2.79
LOI (%)	0.35	1.47

TABLE 5.3 CHEMICAL COMPOSTION OF SLUDGE

COMPONENTS	AMOUNT %
SiO_2	52.78
Al_2O_3	14.38
Fe_2O_3	5.20
CaO	4.39
K_2O	3.62
MgO	3.08
NaO_2	0.97
TiO_2	0.61

6.PROPERTIES OF MATERIALS

TABLE 6.1 PROPERTIES OF FLYASH

S.NO	PROPERTY	VALUE
1	Fineness modulus	6%
2	Specific gravity	2.62

TABLE 6.2 PROPERTIES OF QUARRY DUST

S.NO	PROPERTY	VALUE
1	Fineness modulus	2.82%
2	Specific gravity	2.24
3	Water absorption	2.46%

7.MIX PROPORTIONS

TABLE 7.1 METHOD 1

MIX PROPORTION	FLY ASH	QUARRY DUST	PULP RESIDUE	WASTE SLUDGE	LIME	GYPSUM
M1	65%	10%	7.5%	7.5%	5%	5%
M2	60%	10%	10%	10%	5%	5%

TABLE 7.2 METHOD 2

MIX PROPORTION	FLY ASH	QUARRY DUST	PULP RESIDUE	WASTE SLUDGE	LIME	GYPSUM
M3	10%	65%	7.5%	7.5%	5%	5%
M4	10%	60%	10%	10%	5%	5%

8. BRICK MOULDING

Fig 3 MOULD

Fig 4 MIXING

Fig 5 MOULDING

Fig 6 CURING

9.EXPERIMENT AND RESULTS

9.1 Compressive strength test

Compressive strength test on bricks are carried out to determine the load carrying capacity of bricks under compression with the help of compression testing machine. Bricks are generally used for construction of load bearing masonry walls, columns and footings. These load bearing masonry structures experiences mostly the compressive loads.

Fig 7 Compression test

TABLE 9.1

Mix proportion	Sample Number	Load(P) (X 10^3 N)	Area(A) (X 10^2mm^2)	Compressive strength(N/mm^2)	Average Compressive strength(N/mm^2)
M1	1	75	253	2.9	2.79
	2	69		2.72	
	3	70		2.76	
M2	1	65	253	2.56	2.56
	2	66		2.60	
	3	64		2.52	
M3	1	79	253	3.1	3
	2	75		2.9	
	3	77		2.9	
M4	1	69	253	2.7	2.7
	2	72		2.8	
	3	67		2.6	

9.2 Water Absorption test

Water absorption test on bricks are conducted to determine durability property of bricks such as degree of burning, quality and behaviour of bricks in weathering. A brick with water absorption of less than 7% provides better resistance to damage by freezing. The degree of compactness of bricks can be obtained by water absorption test, as water is absorbed by pores in bricks. The water absorption by bricks increase with increase in pores. So, the bricks, which have water absorption less than 3 percent can be called as vitrified.

Fig 8 Water absorption test

TABLE 9.2 Water absorption test

Mix proportion	Sample Number	Weight of Bricks (Kg)		Water Absorption (%)	Average water absorption (%)
		Wt. of Dry brick (W1)	Wt. of Wet brick (W2)		
M1	1	2.42	2.81	16.1	17.3
	2	2.43	2.87	18.1	
	3	2.39	2.82	17.9	
M2	1	2.31	2.72	17.7	15.7
	2	2.29	2.65	15.7	
	3	2.36	2.69	13.9	
M3	1	3.41	3.88	13.7	16
	2	3.32	3.92	18	
	3	3.23	3.76	16.4	
M4	1	3.16	3.71	17.4	17
	2	3.13	3.69	17.8	
	3	3.09	3.58	15.8	

9.3 Efflorescence test

This test is carried out to obtain the presence of alkaline substances in bricks. First, bricks are fully submerged in fresh water for 24 hours. After 24 hours they are collected from water and let them to dry. After completely dried, the bricks are closely observed to find the presence of alkali. If a white or grey layer is formed on the brick surface, it means alkali is present in the brick.

1. Nil – 0%
2. Slight – less than 10 %
3. Moderate – 50 %
4. Heavy – more than 50%

TABLE 8.3

Mix proportion	Efflorescence
M1	Slight
M2	Moderate
M3	Slight
M4	Slight

9.4 Soundness test

Soundness test of bricks shows the nature of bricks against sudden impact. In this test, 2 bricks are chosen randomly and struck with one another. Then sound produced should be clear bell ringing sound and brick should not break. Then it is said to be good brick.

Fig 9 Soundness test

TABLE 9.4

Mix proportion	Result
M1	No damage on brick but no sound arose while struck with other brick
M2	No damage on brick but no sound arose while struck with other brick
M3	No damage on brick but no sound arose while struck with other brick
M4	No damage on brick but no sound arose while struck with other brick

9.5 Hardness test

A good brick should resist scratches against sharp things. So, for this test a sharp tool or finger nail is used to make scratch on brick. If there is no scratch impression on brick then it is said to be hard brick.

Fig 10 Hardness test

TABLE 9.5

Mix proportion	Result
I	Shows no impression
II	Shows impressions minute
III	Shows impressions minute
IV	Shows impressions minute

9.6 IMPACT TEST

In this test, few bricks are dropped from 1m height. If bricks are broken it indicated low impact value and not acceptable for construction work. Good quality bricks do not break at all.

Fig 11 Impact test

TABLE 9.6

Mix proportion	Result
M1	High
M2	Low
M3	High
M4	High

10.CONCLUSIONS

- Use of fly ash, quarry dust in brick can solve the disposal problem, reduce cost and produce a Eco-friendly brick for constructions.
- The compressive strength of bricks named as M1 is 2.9N/mm^2, M2 is 2.56N/mm^2, M3 is 3N/mm^2, M4 is 2.7N/mm^2
- Hence the bricks made in mix proportion 3 has a good compressive strength and suitable for non-load bearing construction works.
- Environmental effects of wastes and disposal problems of waste can be reduced through this brick manufacturing process.
- This study helps in utilizing the Sludge, quarry dust, pulp production residue, fly ash, for manufacturing of construction materials.
- Paper pulp bricks gives an economical option to green building.
- Strength of bricks decreases with increase in sludge concentration
- Bricks with sludge did not have any effect on efflorescence

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