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Analysis of Fly Ash and Hypo-Sludge Combination for Brick Manufacturing

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***Abstract*- Hypo sludge is one of the waste from the paper industries which cannot be recycled hence a subsequent solution has to be found out to dispose these waste. Previous research work suggests that hypo-sludge can be used as replacement for the cement in concrete. So this work planned to use hypo sludge as an ingredient for bricks manufacturing and performing tests. Experiment is done on various set of mixing proportion of the material where different number of days samples are utilize for the examination of various properties of the brick. Results shows that proposed work has achieved good set of strength with increase in percentage of Fly-Ash and Hypo-Sludge. It was obtained that density of dry compacts decreases with increase in weight percentage of Fly-Ash and Hypo-Sludge. As the dry compacts are immersed in water at 1100C -1800C, then through capillary action voids are filled and it becomes hard and the porosity is eliminated. As a result of which the compacts become dense and finally the density increases with increase in Fly-Ash and Hypo-Sludge content. it is clear from SEM micrographs that 75 wt. % FA blend composite has splits which prompt decrement in compressive quality.**

***Keywords*- Environmental waste, Hypo sludge, Silica content, Compressive strength.**

I. INTRODUCTION

Bricks are widely used construction material around the world. Conventional bricks are sun dried and burnt bricks which have been used around since the beginning of civilization, around ten thousand years ago. In the manufacturing process of conventional bricks, a large amount of pollutants are released. There is limited storage of natural resource availablefor production of conventional bricks. For environmental protection and sustainable deve lopment extensive research has been conducted on the production of bricks from waste material.

The previous research works can be divided into three basic studies depending upon the type of material used for replacement of primary constituents and method of prod uction of bricks from waste material.

- Firing
- Cementing
- Geo-polymerization

The commercial production of bricks from waste material is still very limited. The possible reasons are related to the method for producing bricks from waste material. The standardizationand specification and government guidance related to potential contamination from the waste materials are absent. For wide production of bricks from waste material; future research and development are needed not only technical, economical and environmental aspects but also on standardization, government policy and specifica tions. Some basic waste materials which are popular for bricks manufacturing are Fly Ash, Rice husk, Hypo sludge (paper waste),Cigarette Buttes,Oil palm fruit bunch, Pine apple leaves,Glass fibers,electric wiring waste etc.As brick composition is much flexible so different types of waste have been successfully incorporated into fired clay bricks.

From place to place, the clay brick production varies wide ly in composition. Silica (grains of sand), alumina, lime, iron, manganese, sulphur and phosphates, with different proportions are composing mainly in the clays. Grinding or crushing the clay in mills and mixing it with water to make it plastic is the steps to manufactured bricks. Then, the plastic clay is molded, textured, dried and fired. Bricks are manufactured with various colors, such as dark red, brown and gray base on the firing temperature of the clay during manufacturing. The firing temperature for brick manufacturing varies from 9000C to 12000C.

II. RELATED WORK

S. j. Schneider and L. E. Mong in [9] have done work in Thermal Length Changes of Some Refractory Castables. In this research paper the amorphous alumina translates to "γ"alumina due to loss of water of hydration and the coil. The changes in length exhibited by a variety of refractory castables during complete heating and cooling cycles were determined.The thermal length-change properties of comm ercial brands of refractory Castables and laboratory pre pared Castables were determined by using dilatometer asse mblies that incorporated differential transformers as their sensing or indicating device. The effect of heat treatment

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was shown by length-change determinations on Castables initially heat treated at 110℃, 1050℃, or 1300℃.

K.H.Jadeja, K.D.Saradava in[10] have done work in Pro perties analysis of alumina refractory bricks.This paper provides review of research concerning the property of re fractory bricks which is manufactured by different mat erials compositions and adding some waste material and it investigates on the use of waste product of the industry to increase its property.it observed that techn ological advan cement has greatly improved and eased human life at the expanse of several by product and wastes which are haza rdous for not only human life as well as for flora and fauna .Here in this research paper wastes product in phosphoric acid plant and boron concentrators in producing structural bricks investigated.

The sensitivity analysis indicated that bulk density and app arent porosity were the most significant input affecting co mpression strength within the limit of the modal where as sintering temperature and brick volume were found to be relatively significant in the model.By reading this all paper it concludes that alumina has high refractory property, low cost,easily available so, it is suitable as refractory brick material.

Wamei Lin, Jinliang Yuan, Bengt Sunden in [11] have done work in Review on graphite foam as thermal material for heat exchanger. This paper describes the structure of the graphite foam. Based on special structure, the thermal properties and the flowing characteristic of graphite foam outlined and discussed.

There are some problems blocking the development of gra phite foam heat exchanger is high pressure drop.The seco nd problem is that the mechanical properties of grap hite foam are not as good as those of the metal foam.The third foam is dust block. In order to mixing other materials with graphite foam might be helpful to reinforce the mechanical properties of graphite foam and also reduce the pressure drop.

Afzal Khan et.al.in[12]utilized hypo-sludge as cementing material and rice husk ash is used as fine aggregate. In this research work, different variations of hyposludge and rice husk ashRHAis used for manufacturing bricks sample afte r that bricks physical properties is compare by ordinary cla ybricks,fly ash bricks,and with their different composition.

For this research work Dimension Analysis, Initial Rate of Absorption,Compressive Strength Test, Water Absorption Test, Soundness Test, and Efflorescence Test is conducted for the analysis of the physical properties of the bricks. from the analysis by etabs conclusion can be made that bending moments and shear forces are less in structure made up of hypo sludge bricks as compare to conventional structures(structure those are made up of either clay bricks or fly ash bricks) on every storey of building structure.

III. MANUFACTURING PROCESS OF HYPO SLUDGE BRICKS

1. Mix Proportioning Of Hypo Sludge Bricks:
Percentage composition of hypo sludge, fly ash and cement in the brick and keeping the percentage of sand constant. Different samples prepared are tabulated below:

Table 1. Compositional analysis of Fly ash.

Mix Composition (Wt. %)	Dimensions			Average Value of dimensions		
	Length	Width	Height	Length	Width	Height
Type-A Brick(10% Hypo sludge,10% cement, 10% lime & 70% fly-ash)	20	10	10	20	10	10
	20	10	10			
	20	10	10			
Type-B Brick(15% Hypo sludge,15% cement,10% lime &60% fly-ash)	20	10	10	20	10	10
	20	10	10			
	20	10	10			
Type-C Brick(20% Hypo sludge,20% cement, 10% lime &50% fly-ash)	20	10	10	20	10	10
	20	10	10			
	20	10	10			
Type-D Brick(25% Hypo sludge,25% cement, 10% lime &40% fly-ash)	20	10	10	20	10	10
	20	10	10			
	20	10	10			
Type-E Brick(30% Hypo sludge,30% cement, 10% lime &30% fly-ash)	20	10	10	20	10	10
	20	10	10			
	20	10	10			

2. Concept Used For Hypo Sludge Brick:
In local industrialareas, hypo sludgeis obtained from a paper industry where alarge mass of hypo sludgeis prod uced. Its disposal is a major concern as it has an adverse impact on the environmentand is often proved as a life-threatening for thenearby people of where it is dumped. However, they can be ideally used in bricks manufacturing as similar to clay and fly ash. The bricks manufactured are similar to fly ash and clay bricks in terms of strength and lightweight.

These hypo sludge bricks can be easily made available in the nearby area to be used in construction regarding partition wall as well as theframed type and economical

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budgets projects work. Brick manufactured from hypo-sludge are likely to be eco-friendly in nature and imparts good strength to building construction with apleasing appearance which helps to control soil exploi tation and increase soil capacity for agricultural purpose. Now a day's waste is most commonly used for such alte rnatives materials in the construction industry.

Following procedure has been adopted for the manufacturi -ng of hypo sludge bricks:

- Procurement of materials
- Preparation of sample
- Moulding
- Mixing
- Drying

They are further tested for the quality and they are dispa tched to the sites.

1. Procurement of Materials:
Bricks required materials for manufacturing of bricks. Therefore, procurement of material is the first stage for pre paring of bricks. Hypo sludge bricks raw materials such as hypo sludge, fly ash, lime and cement should be easily ava ilable near the location where bricks are being prepared.

2. Preparation of Samples:
The samples were prepared by Powder metallurgy route.

3. Moulding process:
Bricks are mainly molded by two methods

- Hand Moulded.
- Machine Moulded.

These works have used hand molding practice for molding of sample mix on the ground shell. This practice includes use of (225×105×75) mm mold box made up of shishum wood.

Before molding, the mold was dipped every time in water to make it free from soil and cement particles. Subsequ ently, lubricants are applied on it, to make brick perfectly smooth surface after which hypo-sludge paste is inserted into it with pressure and mold are tempered with rod 25 times. After proper smoothing, the top surface the mold is left for 24 hours for setting the cement hypo-sludge paste. After 24 hours sample is de-molded from the mold.

4. Mixing Process:
Five different weight percentages of Fly ash and hypo-sludge with (70%, 60%, 50%, 40% and 30%) and (10%, 15%, 20%, 25% and 30%) were taken respectively. These compositions were mixed thoroughly by hand mixing, to get a homogenous mixture. Different compositions of Fly ash along with hypo-sludge were kept in three different small size bottles. Around 6-10 small steel balls are kept inside for proper mixing.

5. Compaction:
The compaction tests were executed to make barrel shaped FA compacts. Tube shaped bite the dust and punch having 15 mm width made of stainless steel was utilized to make round and hollow Fly fiery debris compacts.A blend of roughly 5 gm. was taken for every piece. At that point the punch and bite the dust was cleaned with cotton took after byCH3)2CO so all the tidy is expelled from within surface of the kick the bucket and outside surface of the punch. At that point lubing was done to abstain from staying. The blend arranged before was poured inside deliberately. Amid the pressing slight shaking was done to suit the most extreme conceivable measure of material. At long last, the entire framework was subjected to pressure driven seal valve made tight, mounting was done coaxially.

Most extreme of 6tons of theload was connected to it gradually. Once the most extreme load was accomplished, the mechanical assembly was controlled off. The entire framework was casual for5 minutes which at that point took after by emptying. Minimized was catapulted from theDie an indistinguishable way from the pressure and was kept in anormal air for1 day.The icy setting fluid (hard ener) was connected on the surface of the compacted tests with the assistance of a dropper, in order to solidify the recently made compacts. The measure of Hardener utilized was 1/6th or 1/4th of the blend. Subsequently along these lines, twelve examples for every arrangement were made. Everyone of the exampleswere dried in open air for2 days.

6. Curing process:
According to code, formed bricks are left to cure on the floor for 28 days as prescribed in IS 456:2000. Bricks dry in stacks for a further time of 7to 15 days till the dampness content is decreased to 5to 7 percent approximately. Three tests from every piece were cured in water at 27±2 °C till testing day.

IV. EXPERIMENT AND RESULTS

1. Measurement of Dimensions of Brick:
Based on Clause 5.2.1, IS 12894:2002. The bricks were placed in contact with each other in a straight line upon a level surface.The method of arranging the bricks depended on which dimension tobe measured;length,width or height.

The dimension result obtain from dimension test present in table 4.2

1.1 Initial Rate of Absorption: Initial Rate of Absorption test conducted each Composition for 2 number of sample and the result is shown in table 4.3

Table 2. Percentage (%) water absorbed for IRA by various FA and HS compacts.

Table Percentage (%) water absorbed for IRA by various FA and HS compacts.			
Mix Composition	Weight (gm.)	Initial Rate of	Average Initial

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(Wt. %)	Dry	Wet	Absorption (%)	Rate of Absorption Value (%)
Type- A Brick (10% Hypo sludge, 10% cement, 10% lime & 70% fly-ash)	3.286	3.390	3.16	3.04
	3.284	3.380	2.92	
Type- B Brick (15% Hypo sludge, 15% cement, 10% lime &60% fly-ash)	3.284	3.382	2.97	2.94
	3.284	3.379	2.89	
Type- C Brick (20% Hypo sludge, 20% cement, 10% lime &50% fly-ash)	3.286	3.381	2.89	2.98
	3.287	3.388	3.07	
Type- D Brick (25% Hypo sludge, 25% cement, 10% lime &40% fly-ash)	3.290	3.395	3.19	3.15
	3.293	3.396	3.12	
Type- E Brick (30% Hypo sludge, 30% cement, 10% lime &30% fly-ash)	3.310	3.410	3.02	2.99
	3.330	3.429	2.97	

1.2 Water Absorption Test: Table 4.3 shows the amount of water absorbed corresponding to different Fly-Ash and Hypo-Sludge composition. The water absorption values of Fly-Ash and Hypo-Sludge composites lies in the range of 14.5% to 16.25%. It can be seen that all the composition met the absorption criteria set by IS code specification. IS code permits the maximum of 20 % water absorption when compacts are immersed for 24 hours.

Table 3. Percentage (%) water absorbed by various FA and HS compacts.

Table Percentage (%) water absorbed by various FA and HS compacts.				
Mix Proportion (Wt. %)	Weight (gm.)		Water Absorption (%)	Average Water Absorption Value (%)
	Dry	Wet		
Type- A Brick (10% Hypo sludge, 10% cement, 10% lime & 70% fly-ash)	3.286	3.778	15	14.5
	3.284	3.744	14	
Type- B Brick (15% Hypo sludge, 15% cement, 10% lime &60% fly-ash)	3.284	3.898	16	15.75
	3.284	3.793	15.5	
Type- C Brick (20% Hypo sludge, 20% cement, 10% lime &50% fly-ash)	3.286	3.828	16.5	16.25
	3.287	3.813	16.1	
Type- D Brick (25% Hypo sludge, 25% cement, 10% lime &40% fly-ash)	3.290	3.790	15.2	15.45
	3.293	3.810	15.7	
Type- E Brick (30% Hypo sludge, 30% cement, 10% lime &30% fly-ash)	3.310	3.846	16.2	15.8
	3.330	3.843	15.4	

Table shows a relation between the amount of water absorbed and density of dry composite with respect to Fly-Ash and Hypo-Sludge composition. It is evident from the graph that the water absorption increases with increase in Fly-Ash and Hypo-Sludgecontent20%. Fly-Ash and Hypo-Sludge absorb water to a maximum of 16.25 %. This ind icates that that most of the openings of the compacts are open to outside.

Table 4. Shows a relation between the amount of water absorbed and density of dry composite with respect to Fly-Ash and Hypo-Sludge composition.

S.No	Mix Composition (Wt. %)	Observations
1.	Type- A Brick (10% Hypo sludge, 10% cement, 10% lime & 70% fly-ash)	Little Impresion on surface

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2.	Type- B Brick (15% Hypo sludge, 15% cement, 10% lime &60% fly-ash)	No Impresion on surface
3.	Type- C Brick (20% Hypo sludge, 20% cement, 10% lime &50% fly-ash)	No Impresion on surface
4.	Type- D Brick (25% Hypo sludge, 25% cement, 10% lime &40% fly-ash)	Little Impresion on surface
5.	Type- E Brick (30% Hypo sludge, 30% cement, 10% lime &30% fly-ash)	Little Impresion on surface

1.3 Hardness Measurement: Hardness test for all the Fly-Ash and Hypo-Sludge bricks should be done with the help of steel knife.

1.4Compressive Strength: The compressive strength meas uement of the cylindrical samples was done as per stand ard practiced. The test was conducted on the three samples of each composition and the average value of all is eval uated.Table4.5 shows the strength values of different com positions of Fly-Ash and Hypo-Sludge, both in the dry and wet state.

Table Compressive strength values of different FA resin mix compacts.

S.No	Mix Composition (Wt. %)	Compressive Strength (MPa) (7 days sample)
1.	Type- A Brick (10% Hypo sludge, 10% cement, 10% lime & 70% fly-ash)	1.22
2.	Type- B Brick (15% Hypo sludge, 15% cement, 10% lime &60% fly-ash)	1.44
3.	Type- C Brick (20% Hypo sludge, 20% cement, 10% lime &50% fly-ash)	1.81
4.	Type- D Brick (25% Hypo sludge, 25% cement, 10% lime &40% fly-ash)	1.68
5.	Type- E Brick (30% Hypo sludge, 30% cement, 10% lime &30% fly-ash)	1.98

V. CONCLUSION

Hypo sludge behaves like cement because of silica and magnesium properties. Hypo sludge may be used as partial replacement of cement. Hypo sludge is the waste of paper industry which is cause of environmental issues during dis posal so use of it as a building material can help in reduci ng pollution.

So this work planned to use hypo sludge as an ingredient for bricks manufacturing and performing tests. As a result of which the compacts become dense and finally the den sity increases with increase in Fly-Ash and Hypo-Sludge content. it is clear from results that blend composite has splits which prompt decrement in compre ssive quality.

As the level of FA is expanded there is a decent holding between the interfaces which prompts change in quality of the compacts. These perceptions affirm that expansion of frosty setting pitch powder in overabundance to fly fiery debris may not be valuable. Here tar powder is just utilized asa coupling specialist.Water treatment demonstrates some what negative effect on the quality of the composite.

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