ISSN: 2455 – 4200
International Journal of Engineering Research and Modern Education
Impact Factor 6.525, Special Issue, April - 2017
6th National Conference on Innovative Practices in Construction and Waste Management
On 25th April 2017 Organized By
Department of Civil Engineering, Sri Ramakrishna Institute of Technology, Coimbatore, Tamilnadu

MANUFACTURING OF CLAY BRICKS WITH ALUM SLUDGE AND GRANITE POWDER

V. Venugopalan*, Dr. N. Balasundaram & B. Chokkalingam***
* Assistant Professor, Department of Civil Engineering, Karpagam University, Coimbatore, Tamilnadu
** Professor, Department of Civil Engineering, Karpagam University, Coimbatore, Tamilnadu

Cite This Article: V. Venugopalan, Dr. N. Balasundaram & B. Chokkalingam, "Manufacturing of Clay Bricks with Alum Sludge and Granite Powder", Special Issue, April, Page Number 284-287, 2017.

Abstract:
Infrastructure development is one of the major component in fast growing countries. Development and construction of high raise buildings like apartments, shopping malls, industrial complex, estates etc. needs more quantity of construction materials. As we are exploiting our material resources, it is necessary to reduce usage of natural resources and hence we have to increase the usage of non-degradable solid wastes as construction material. Based on this consideration, in this research work we are using alum sludge and granite powder with clay for manufacturing of bricks. Large amount of granite powder are producing from granite polishing industry and alum sludge are produced from water treatment plants. We have manufactured bricks with various percentage of alum sludge and granite powder with clay. The strength of the bricks were tested and the bricks were classified accordingly.

1. Introduction:

Reducing, reusing and recycling are the concept of integrated solid waste management system and this concept decrease the amount of waste on the planet and preserve natural resources. Various industrial activities produces large amount of wastes including solid wastes and liquid wastes as effluent. Under these wastes, effluent and degradable solid wastes are possible to treat and easy to its disposal. Non degradable wastes are not able to treat and hard to its disposal. Good example for reuse of non degradable waste is fly ash. After many more research works, from last decade onwards fly ash is using as main ingredient in the manufacturing of cement. This research work concentrates the disposal of alum sludge and granite powder as useful product. Alum sludge is a large quantity of waste produced from the water treatment plants during treatment process. Granite powder is also a solid waste which are generated during the different process including polishing in granite industry. These non degradable solid wastes are suitable for making building materials. Rapid growth of industries, increasing population and higher living standards are the major factors for the demand of construction materials. Due to this demand, presently non renewable natural resources like river sand, soil and etc. are under scarcity. To meet this demand and for saving our natural sources we are push to innovate new building materials other than natural sources. Based on this, our main objectives of this research work was manufacturing of burnt clay Brick using with alum sludge and granite powder as an ingredients.

Brick:

Brick is one of the major building material to construct walls, pavements and other elements in masonry construction. Traditional bricks are purely made by using clay with less quantity of medium fine sand. Presently different types of bricks are manufacturing using main ingredients as different non degradable materials like fly ash, quarry dust and manufacturing sand materials with lime, gypsum, cement and etc. with required amount and strength. Bricks are generally classified based on materials used, method of manufacturing, shape and strength. Among these classifications bricks are selected based on its strength classification.

2. Materials and Its Properties:

Clay: Weathering or decomposition of rock produces clay. Rain, wind, earthquakes, volcanic eruptions and other physical and chemical processes all cause weathering in one form or another. All rocks contain minerals, and when rocks containing iron oxides weather, they produce red clay. Granite and basalt are examples of rocks containing iron oxides. Red clay consists of very fine particles that are more than 1,000 times smaller than grains of sand. Clay particles contain silica (SiO2) and a mixture of other minerals, such as quartz, carbonate, aluminum oxides and iron oxides.

Granite Powder: Granite belongs to igneous rock family. The density of the granite is between 2.65 to 2.75 g/cm^3 and compressive strength will be greater than 200MPa. Granite powder obtained from the polishing units and the properties were found. Since the granite powder was fine, hydrometer analysis was carried out on the powder to determine the particle size distribution. It was found that coefficient of curvature was 1.95 and coefficient of uniformity was 7.82. The specific gravity of granite powder was found to be 2.5.

Figure 1: Alumsludge

Figure 2: Granite Powder

ISSN: 2455 – 4200
International Journal of Engineering Research and Modern Education
Impact Factor 6.525, Special Issue, April - 2017
6th National Conference on Innovative Practices in Construction and Waste Management
On 25th April 2017 Organized By
Department of Civil Engineering, Sri Ramakrishna Institute of Technology, Coimbatore, Tamilnadu

Alum Sludge: Sludge is relatively concentrated suspension into which the residual solids fraction arising from water or wastewater treatment is concentrated in the course of purification. Sludges are derived from the processes of chemical coagulation and softening at drinking water treatment plants and from the preliminary, primary and secondary stages of waste water treatment. Most of these sludges are of an unstable organic nature and readily undergo active microbial decomposition with consequent generation of nuisance odours. They all have the common characteristic of a high water content, usually greater than 95% by weight. Most of the water treatment plants discharges the sludge in to the rivers or as land fill with no treatment .The discharging of sludge in to water body leads to accumulative rise of aluminum concentrations in water, aquatic organisms, and human bodies.

Table 1: Chemical Properties of Granite and Sludge

Content	Granite	Sludge
PH	7.7	6.66
EC(dS m^{-1})	2.4	0.16
Organic Carbon(%)	12	14
Total potassium(%)	-	0.92
Calcium(mg/l)	480	68
Magnesium(mg/l)	201.6	38.4
Sodium(mg/l)	-	8
Cholride(mg/l)	-	4.26
Copper(ppm)	5.275	6.45
Manganese(ppm)	5.25	8.1
Zinc(ppm)	11.75	19.52
Iron(ppm)	57.85	43.5

3. Manufacturing of Bricks:

Bricks are manufacturing with different mix proportions of clay, granite powder and alum sludge. The following table represents the different proportions of clay, alum sludge and granite powder.

Table 2: Mix Proportions Used

Clay	Alum Sludge	Granite Powder
90%	5%	5%
80%	10%	10%
70%	15%	15%
60%	20%	20%
50%	25%	25%

For replacement of clay with sludge and granite powder different propotion are sepreately mixed with weight basis ie.187.5 gm(5%) of alum sludge and 187.5 gm(5%) of granite powder of mix M1 ,375 gm(10%) of alum sludge and 375 gm(10%) of granite powder of mix M2,562.5 gm (15%) of alum sludge and 562.5 gm (15%) of of gm of granite powder of mix M3,750 gm (20%) of alum sludge and 750 gm (20%) of granite powder of M4,937.5 gm (25%) of alum sludge and 937.5 gm (25%) of granite powder. Each mix is kept undisturbed for 24 hours after addition of water so as to allow the clay particles to absorb water and soften. For brick casting, a mould of size 225mm x 100mm x 80mm made. A set of 15 bricks in each mixing proportion is cast resulting in a total of 75 sample bricks.

4. Testing of Bricks:

Bricks under different mix propotions are taken for different type of test. The test procedures are followed as the specifications given in IS 3495-Part 1.The compressive strength is evaluated by using compression testing machine. We did the following tests

- ✓ Water Absorption Test
- ✓ Compressive Strength Test

5. Water Absorption Test:

Water absorption is a key parameter that establishes the durability of brick. It is an indicator of sustainability of the brick against moist environment. Lower the absorption indicates presence of % of pores are less. Increases absorption indicates presence of % of pores are large, and hence reduced strength and weight. Large number of pores increases acoustic properties of the brick and also facilitates good thermal insulation, but may not be suitable for structural applications.

Table 3: Experimental Results

S.No	% of Sludge	% of Granite Powder	Weight of Dry Bricks (in kg)	Weight of Wet Bricks (in kg)	% of Water Absorbed
1	0	0	3.2	3.63	13.43
2	5	5	3.17	3.67	15.77
3	10	10	3.15	3.645	15.71
4	15	15	3.15	3.64	15.55
5	20	20	3.09	3.6	16.5
6	25	25	3.085	3.615	17.17

ISSN: 2455 – 4200
International Journal of Engineering Research and Modern Education
Impact Factor 6.525, Special Issue, April - 2017
6th National Conference on Innovative Practices in Construction and Waste Management
On 25th April 2017 Organized By
Department of Civil Engineering, Sri Ramakrishna Institute of Technology, Coimbatore, Tamilnadu

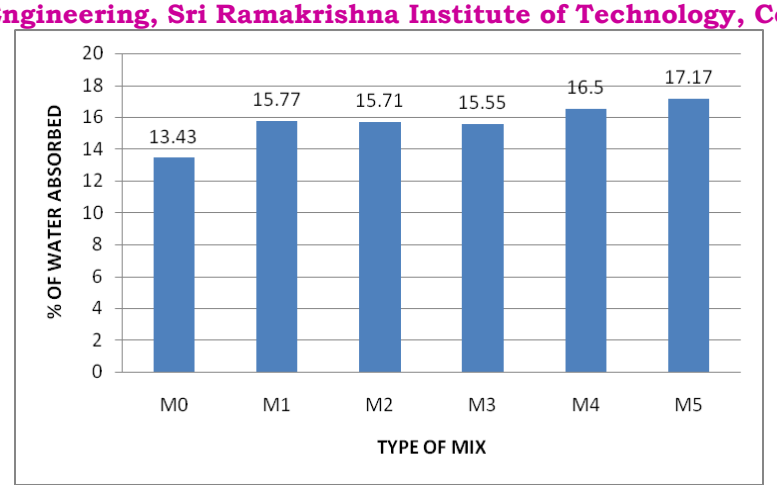

Figure 3: Experimental Results

6. Compressive Strength Test:

A compression test results provides behaviour of materials under crushing loads. The specimen is compressed and deformations at various loads are recorded. Compressive stress and strain are calculated and plotted as a stress-strain diagram which is used to determine elastic limit, proportional limit, yield point, yield strength and etc.

Specimen Size = 225mm X 100mm X 80mm

Table 4: Experimental Results Load of failure and Compressive strength

S.No	% of sludge	% of granite powder	Load of failure (in kN)			Compressive strength (in n/mm^2)	
			S1	S2	S3	Actual	Minimum
1	0	0	83	69	70	4.61 3.83 3.88	3.83
2	5	5	90	106	89	5 5.8 4.93	4.93
3	10	10	90	105	114	5 5.83 6.3	5
4	15	15	103	98	85	5.72 5.44 4.72	5.44
5	20	20	65	74	64	3.61 4.11 3.55	3.55
6	25	25	40	50	56	2.22 2.77 3.11	2.22

S1 - Specimen -1 (Brick Sample -1)
S2 - Specimen -2 (Brick Sample -2)
S3 - Specimen -3 (Brick Sample -3)

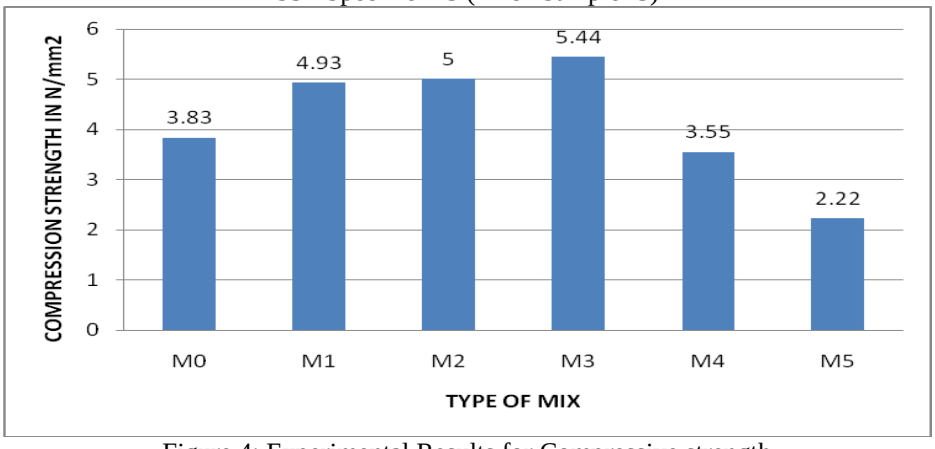

Figure 4: Experimental Results for Compressive strength

7. Result and Discussion:

From the test results, the mix proportions M1(5%),M2(10%) & M3(15%) absorbs nearly 2.5% to 3% of water more than conventional bricks. At the same time M1(5%),M2(10%) & M3(15%) mix proportions withstands high compressive strength particularly 10% replacement of clay provide good result compared with conventional bricks. Hence 5%,10% and 15% replacement of clay with alum sludge and granite powder are suitable for structural works like as conventional bricks. This bricks are under the category of third class. Other mix ratio bricks are suitable for the structural works like compound wall and gardening purpose and etc.

8. Conclusion:

The bricks which are made up of clay, alum sludge and granite powder are also suitable for various types of structural works based on the strength. Hence usage of these non degradable wastes reduces the landfill areas and also reduce the environmental pollution. Based on the results it is possible to use as construction material and also possible way to protect our natural resources.

9. References:

1. Utilization of granite and marble sawing powder waste as brick materials (2009){Carpathian journal of earth and environmental sciences}, Swaminathan Dhanapandian, Balasubramni Gnanavel and Thirunavukkarasu, Ramkumar.
2. Reuse of water treatment plant sludge in brick manufacturing (2008){journal of applied sciences research},Mohammed O. Ramadan, Hanan A. Fouad and Ahmed M. Hassanain
3. Utilization of marble and granite waste in concrete bricks (2011){International conference on environmental and bioscience} Rania Hamza, Salah El-Hagger , Safwan Khedr
4. Effect of marble and granite sludge in clay materials (2006){Material science and engineering} W. Acchar, F. A. Vieria, D. Hotza
5. Reuse of water treatment sludge and silica fume in brick manufacturing(2011){Journal of American science}, Badr El-Din E. Hegazy, Hanan A. Fouad and Ahmed M. Hassanian
6. S. V. Ribeiro, J. N. F. Holanda Soil-cement bricks incorporated with granite cutting sludge(2014){International journal of engineering science and innovative technology.
7. IS 3495-PART 1-1992 Compressive strength of brick
8. Civil engineering materials-sanjay kumar sharma.