Utilisation of Latex Sludge with Fly Ash as Brick Ingredient

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Abstract

With the increase in population the use of natural resources increases day by day. The aim of this project is to study the use of Industrial sludge for making bricks. Different tests on bricks were conducted for analysing the strength of bricks. This study incorporated the use of latex sludge with Fly ash. Compressive strength, Water absorption, Hardness and Soundness of bricks were conducted on bricks. Compressive strength and water absorption of brick is satisfactory while using Fly ash with latex sludge. Hardness and soundness property of brick was found to be similar to common building bricks. Using Latex sludge as brick ingredient is a best method of its disposal.

Keywords — *Natural resources, Latex sludge, Common Building Bricks, Disposal.*

I. INTRODUCTION

The rapid increase in the rate of industries in developing countries causes deposition of waste materials such as sludge, fly ash, etc. Various disposal methods have been used extensively during the centuries all around the world. Sludge resulting from latex industry creates problems of disposal. However for highly urbanized cities, sludge disposal by land filling, discharging into stream might not be appropriate due to land limitations. Incineration might be an alternative solution. However a substantial amount of ash will be produced after the burning process and might be disposed by other means.

Industrial sludge is using nowadays for making bricks. As an alternative method of disposal this project presents the utilization of sludge with Fly ash for brick making. Fly ash is a residue resulting from the combustion of powdered coal and collected by electronic precipitators in various industries. Latex sludge generated from latex industries after certain chemical reactions are harmful to humans without proper disposal. These waste materials are effectively disposed by make use in brick manufacturing. In this study we have substitution of brick clay by sludge incorporated with and fly ash (FA).Fly ash is kept constant in the series of experiment as 10% and varying sludge proportions as 5%, 10%, 12%, 12.5%, 15% and find out the maximum compressive strength.

G Reddy Babu, N Venkata Ramana in 2011, were investigated the durability of brick cast with industrial sludge. In this paper the addition of sludge to the soil serves the twin benefits of safe disposal of sludge from industry and conservation of brick making earth. Nowadays the disposal of sewage has become a necessity for societies. The construction of treatment plants has caused problems with huge content of dry sludge. There are two methods to solve the problem such as disposal of solid waste including land filling and using dry sludge as fertilizers but by those this method some harmful material l0% by weight respectively. Beyond that, bonding the mixture is poor and extrusion of the bricks results in “dog-earing” of the products. Water absorption was found increasing as the percentage of sludge increases. This indicates that some remains in sludge which causes harm to environment including land, air and water as a whole.

Joo-Hwa Tay in 2015, were discussed on bricks manufactured from sludge. Sludge resulting from waste water treatment plants creates problems of disposal. This paper presents the results of the utilization of dried sludge ash as brick making materials. It was found that the maximum percentages of dried sludge and sludge ash that could be mixed with clay for brick making are 40% and 5durability of the bricks would be lower at higher percentages of sludge.

Mohammed O Ramadan, Fawad in 2013 studied the influence of bricks made by the Palm Oil Fuel Ash (POFA) and paper Sludge. They made the brick samples with the various proportions of the sludge, cement and POFA to study the laboratory results like compressive strength, Water absorption and heavy metal leach ate. According to this paper the bricks sample with 20% POFA and 20% Paper Sludge have the acceptable compressive strength and water absorption value. These kind of the bricks can be used for the masonry partition wall purpose to reduce the substantial cost. Alaa A. Shakir et.al (2013) represented a paper ‘Manufacturing of Bricks in the Past, in the Present and in the Future.’ They

are trying to cover the gap between the art work of manufacturing the bricks with the past trends and current trends with point of view to the use of raw materials in the bricks industry. After the study, authors come to know that still there is a gap between the earlier researches which are to be contemplated. As per this review paper, Billet scale, Quarry dust, Fly ash, Bio solids, Bottom ash to be utilized as the main constituents in the bricks. Halil Murat Algin et.al (2007) represented a paper 'Cotton and limestone powder waste as brick material'. In this paper the author is representing the use of cotton and limestone waste powder in the manufacturing of bricks. Water absorption, compressive strength and flexural strength of cubes were tested for all the samples. According to this paper, 10%-40% of cotton waste in bricks as a alternate of the clay is acceptable. Replacement of Cotton waste and Lime powder waste with clay in bricks also reduces the cost of the bricks. Rohan Rajput et.al (2016) represented a review paper 'utilization of Bagasse ash as a brick material, a review'. In this paper the authors have investigated that use of bagasse ash in the brick can solve the problem of disposal. It can reduce the cost of the brick. Use of Bagasse ash in the brick can produce eco-friendly green bricks. According to the author by this method maximum compressive strength can be attained. Bagasse ash bricks can also reduce the seismic load of the structure Sludge resulting from wastewater treatment plants creates problems of disposal. Generally, dewatered sludge's are disposed of by spreading on the land or by land filling. However, for highly urbanized cities, sludge disposal by land filling might not be appropriate due to land limitation. Incineration might be an alternative solution. However, a substantial amount of ash will be produced after the burning process and must be disposed of by other means. This paper presents the results of The utilisation of dried sludge and sludge ash as brick making materials. The maximum percentages of dried sludge and sludge ash that can be mixed with clay for brick making are 40% and 50% respectively. The compressive strength of the bricks is 87.2 N/mm^2 for 0% sludge, decreasing to 37.9 N/mm^2 for 40% dried sludge, and 69.4 N/mm^2 for 50% sludge ash.

By Badr El-Din Ezzat Hegazy, Hanan Ahmed Fouad and Ahmed Mohammed Hassanain were experimented the incorporation of water sludge, silica fume and rice husk ash in brick making. From the results it was concluded that a mixture consists of 50% of sludge, 25% of SF, and 25% of RHA was the optimum materials proportions to produce brick from water sludge incorporated with SF and RHA; by operating at the temperatures commonly practiced in the brick factories and based on the experimental scheme such as tested materials and testing procedures employed in this research. It was concluded that the maximum percentage of WTP sludge, which can be used in the mixture, should be determined by the practiced firing temperature.

Shrikant S Jahagirdar et.al in 2013 represented a paper 'Utilization of Textile Mill Sludge in Burnt Clay Bricks.' In this paper they are introducing the Textile mill sludge in the manufacturing of the bricks my mixing the clay soil and textile mill sludge together. He took the sludge for bricks by mixing with the clay soil as 0% to 35% by weight. Different samples of each percentage undergone through the various tests like compressive strength test, water absorption test, efflorescence as per the procedures of Bureau of Indian Standards. After the testing, the author concludes that the dry sludge can be used in the bricks as the partial replacement for the clay in the well burnt bricks. Hence it may reduce some cost of brick also. Textile mill sludge can be used up to 15% without compromising the chemical and physical properties of the bricks as per the IS code. As the organic matter is present in the sludge, when the brick is burnt at the 5500 ^{O}C temperature, it created the voids in the bricks. Which reduces the compressive strength of the brick and it increases the water absorption capacity as well. Anyakora Nkolika Victoriaet.al (2013) represented a paper 'characterisation and performance evaluation of water works sludge as bricks material.' In this paper they are saying that the use of sludge in the well burnt bricks is a long term approach as point of view of the disposal, economy, and environmental

Er.Vineet Garg, Er. Rajan Vinayak, Sandeep Maan in 2014, were discussed the proportion of Sludge-clay and Temperature of firing the bricks are two main factors which affect the quality of the bricks. Aeslina Binti et.al (2014) represented a paper 'An Overview of Sludge Utilization into Fired Clay Brick.' In this paper they are saying that the use of waste sludge in the bricks is showing very positive results. Use of sludge in the brick is very beneficial for the environment point of view. Sludge bricks have very good physical properties as well as the chemical properties. The fired clay bricks made up of the mixture of sludge and clay are tested for the water absorption, efflorescence, compressive strength etc and it shows very positive results. By which the bricks are acceptable for the construction of buildings and other structures. As per the author use of sludge in the bricks may be an alternative method for the disposal of waste sludge and we can prevent the natural resources up to some limits. B.Shobha (2015) represented a paper 'Utilization of Water Treatment Plant Sludge in the Brick Manufacturing. In this paper she is saying that due to urbanization of the areas, it is very serious problem to dump the Waste sludge. We can drastically reduce the dumping problem of sludge by using it in to the

manufacturing of bricks by partially replacing it with the clay soil.

N Vamsi Mohan, Dr K Shrinivasa Rao in 2012, analysed as the percentage of rice husk ash increased, water absorption of brick will be remarkable. Recycling such wastes by utilizing them into building materials is a moderate solution for the pollution issues. Much of an emphasis is laid on energy saving and economy. This paper presents an effort for an alternate approach in the manufacturing of brick.

II. MATERIALS AND METHODOLOGY

A. *Brick Earth*

Clay used for making bricks was collected from Aluva. Preliminary tests were done after drying and crushing. After crushing sieved through designated sieve for various tests.

Brick earth was collected from a brick manufacturing site in Kolancherry. A good brick earth should contain clay and sand in such a way that when water is added, it can be easily moulded and dried without cracking or warping. The main constituents of good brick earth are:

1. Silica- 50% to 60% by weight. Presence of this constituent prevents cracking, shrinking and warping of raw bricks. It imparts uniform shape to bricks. If silica is in excess, it makes the brick brittle.
2. Alumina-20% to 30% by weight. It imparts plasticity to so that it can be moulded easily. If alumina is present in excess, raw bricks shrink and warp during drying and burning.
3. Lime-2% to 5% by weight. Lime causes the grains of sand to melt and bind the particles of clay together. It prevents shrinkage of raw bricks. If lime is excess, it will cause the brick to melt and hence shape is lost.
4. Iron oxide-5% to 6% by weight. It acts as a flux to cause the grains of sand to melt and this helps to bind the particles together. It imparts red colour to brick on burning. Excess amount of iron oxide makes the brick dark blue.
5. Magnesia- Less than 1% by weight. It imparts yellow colour to brick and it decreases shrinkage. Excess magnesia leads to decay of bricks.

➢ Selection of brick burning site

Site for burning moulded sundried brick was selected at Thettaly, Aluva.

Bricks are burned in a kiln which makes them durable. A brick clamp is a traditional method of baking bricks, done by stacking the unbaked bricks with fuel under or among them and then setting the fuel on fire. The clamp is considered a type of kiln.

➢ Mix design of bricks:-

Percentage proportion of sludge, soil, and water to be mixed together to make bricks were decided. To select suitable proportion to be made into bricks and tested.

B. *Sludge:*

Sludge was collected from Njavelil latex binanipuram, Aluva region. It was then dried and crushed. After crushing passed through 20 mm Sieve. It contains sugar, resin, protein & ash.

The sludge for the study was collected from Njavallill Latex industry, Binanipuram, Kerala. The main raw material used in this industry is latex. Latex is a colloidal suspension of very small polymer particles in water. Natural latex is produced from the rubber tree and is the protective fluid contained beneath the bark. It is a cloudy white liquid, similar in appearance to cow milk. It is collected by cutting a thin strip of bark from the tree and allowing the latex to exclude into a collecting vessel over a period of few hours.

About the industry Njavallill latex Pvt. Ltd was established during the peak of latex boom in the year 1992. They procure natural rubber in large quantities in accordance with the very best industry practices and supply best quality 60% centrifuged natural rubber latex for surgical and examination gloves, balloons, foam adhesives and other rubber products manufacturers. The main constituent of sludge collected for the study was calcium.

Table 1 Chemical Test Result of Sludge

SL No :	Component	Symbol	Percentage (%)
1	Silica	SiO_2	8.30
2	Alumina	Al_2O_3	3.24
3	Ferric oxide	Fe_2O_3	3
4	Calcium oxide	CaO	1.36
5	Magnesium oxide	MgO	2
6	Sulphur	S	2
7	Zinc, chromium, selenium, lead, cadmium, barium and silver	Zn, Cr, Pb, Cd, Au, Ba	<0.01

C. *Fly ash:*

Ash produced in small dark flecks by the burning of powdered coal and paper wastes &other materials and carried into the air. Ash was collected from Kottayam.

Table 2 Chemical Test Result of Fly Ash

SL No	Component	Symbol	Percentage (%)
1	Silica	SiO_2	56.9
2	Alumina	Al_2O_3	22.9
3	Ferric oxide	Fe_2O_3	5.96

4	Calcium oxide	CaO	1.85
5	Magnesium oxide	MgO	1.63

Table 3 Physical Properties of Fly Ash (IS 1727:1967)

Property	Value
Fineness of Fly ash	3%

➢ Selection of brick burning site

Site for burning moulded sundried brick was selected at Thettaly, Aluva.

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➢ Mix design of bricks:-

Percentage proportion of sludge, soil, and water to be mixed together to make bricks were decided. To select suitable proportion to be made into bricks and tested

Making of brick

Measurement of materials for making is known as batching. Casted bricks with two combinations with various proportions. The mix consisting of clay, sludge and fly ash. Percentages we taken to obtain maximum compressive strength are 5%, 10%, 15% and also taken 12 & 12.5% to obtain an expected maximum compressive strength.

Mixing

Mixing was done manually by using the mix design of brick making materials.

Placing

Place the mould on a firm, level surface. The sample is placed in a mould of size (size 200*20*20mm) in three layers of approximately equal volume. Move the scoop around the top edge of the mould to ensure a symmetrical distribution of the material mix within the mould. Top is firmly levelled by using trowel.

III. TEST RESULTS

A. *Compressive strength of brick*

Table 4. Compressive Strength of Bricks using Fly Ash.

Clay (%)	Sludge (%)	Rice Husk Ash (%)	Compressive Strength (N/Mm)^2
100	0	0	7.13
85	5	10	4.56
80	10	10	3.7
78	12	10	2.36
77.5	12.5	10	3.75
75	15	10	3.03

We obtained a maximum value of 4.56 N/mm^2 at 5 % sludge and 10 % Fly ash. Compressive strength decreases up to 12% sludge and increases to 3.03.The obtained compressive strength is below and within the range of 3.5.So it can be used for construction purposes.

Table 5. Water Absorption of Bricks using Fly ash.

CLAY (%)	SLUDGE (%)	FLY ASH (%)	WATER ABSORPTION (%)
100	0	0	15.766
85	5	10	23
80	10	10	24.90
78	12	10	21.44
77.5	12.5	10	19.489
75	15	10	14.583

As per Indian standard the permissible limit is 20%.The obtained water absorption is within the limit and it is durable.

B. *Efflorescense Test On Bricks*

➢ From conducting the efflorescence test on bricks we found that there is no such content of any chemical salt by using rice husk ash and Fly ash.

C. *Hardness Test On Bricks*

➢ The tested brick have no impression is left on the surface; the brick is sufficiently hard in both Rice husk ash and Fly ash.

D. *Soundness Test On Bricks*

➢ The brick does not break and a clear ringing sound was produced by both Rice husk ash and Fly ash.

IV. CONCLUSIONS

1. In this project we have incorporated the use of dry sludge with Fly ash. (Dry Sludge 0%, 5%, 10%, 12%, 12.5% and 15%).
2. The study suggests that the sludge can be effectively used for manufacturing of brick to required shape and size by adopting the percentage of sludge up to15%.
3. Dry sludge and Fly ash and Rice husk ash is available free of cost so, we will reduce cost of brick.
4. Bricks show positive results for efflorescence, soundness and hardness test.
5. Fly Ash bricks can be effectively used for construction.
6. It also shows that replacement of soil with this Dry Sludge material reduce the weight of brick slightly. And it's become light weight product.
7. Environmental effects from wastes and disposal problems of waste can be reduced or controlled through this research.

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