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Study Paper on Use of Eco Bricks

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Abstract: *A common effluent treatment waste water sludge being largest industry in India faces problem of sludge disposal. In this attempt is made to reuse common effluent treatment waste water sludge in solid blocks. Common effluent waste water sludge is used to replace base material by weight up to 15%. Blocks are casted by adding sludge after drying at 100^{0}C to 150^{0}C for 24 hrs. Common effluent treatment waste water sludge can be added up to 15% as it can give compressive strength above 8.33 N/mm^2 and water absorption ratio can be obtained as less than 0.50 %. Thus reuse of common effluent treatment waste water sludge in solid block is better option so that problem of ultimate disposal of common effluent treatment waste water sludge can be solved up to greater extent. The overall objective of this study is to find an alternative solution for the disposal of large volume of sludge produced in the wastewater treatment plants. This large quantity of sludge is related to scarcely of land area and high population density represent the sludge problem. Many researchers worldwide have been trying to explore new and suitable solutions to solve part of sludge problem. One track of these solutions is to use sewage sludge in construction field. The current study presents the usage of sludge in concrete mixtures and in manufacturing interlock brick samples.*

Keywords: Bricks.

I. INTRODUCTION

1.1 Introduction of the Project Work

Sludge is generated in the sewage treatment plant of corporation area. In most of the treatment, sludge is used as land filling. In India there are many effluent treatment plants resulting in an increasing of sludge which in turn increasing problem is disposal. The final destination of effluent treatment sludge affects the environment. Since land is limited, alternative technologies to dispose of effluent treatment sludge are essential. Incineration may be a profitable alternative technology of disposal but the final disposal of the huge quantity of effluent treatment sludge will pose another problem. Therefore this study was conducted to investigate the feasibility of using the common effluent treatment waste sludge for producing concrete bricks.

In sewerage system, sewage sludge is inevitably generated through wastewater transportation and treatment. Appropriate treatment and disposal of generated sludge, as well as water quality control of treated wastewater, is essentially important for rational maintenance and operation of sewerage systems. The amount of generated sludge in Pimpri-Chinchwad has increased year by year in proportion to growing sewered population rate. In future, the amount will undoubtedly increase with further promotion of sewage works and implementation of advanced wastewater treatment.

To deal with the shortage of sanitary landfills area and follow the above-mentioned laws, continuous efforts to establish and promote the recycling-based society are needed in the field of sewage works. From report annual change of generated and reused amount of sewage sludge was shown in the following figure, in 2002, about 39% of generated sludge was disposed by sanitary landfill, and beneficial recycling rate of generated sludge about 60%. In recent years, the ratio of landfill is decreased. And the recycling rate has steadily increased.

1.2 Problem Statement

Rapid Industrialization and Urbanization is causing serious environmental problems. One of the major concerns amongst these is safe and sound disposal of solid wastes. This project reuses the water treatment sludge from a water treatment

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plant to make eco-friendly bricks. The main aim is to increase the value of the water treatment sludge from a water treatment plant and to make a sustainable and profitable disposal alternative for the water treatment sludge. Attempts were made to utilize the water treatment sludge as a replacement for fly-ash in the mix for the bricks.

1.3 Objective

To investigate the utilization of sewage sludge as supplementary cementitious material (SCM) and influence of this dried sludge on the strength on fly-ash brick made with different cement replacement levels.

1.4 Scope of Project

The main focus of this project is on project is on beneficial utilization of sewage sludge in concrete brick as complete replacement for fly ash. The method selected for beneficial reuse is based on consideration of amount of sewage sludge generated, local availability, cost benefit, testing requirement and logistics of moving this sewage sludge to the end user. In this project an attempt has been made to carry out experimental study to find the effects of partial replacement of sewage dried sludge in various percentage on the fresh concrete properties and compressive strength.

1. Use of sewage dried sludge in brick manufacturing, apart from energy saving and reducing environmental pollution and is also an alternate means of disposing the sludge.
2. Using the sludge from the water treatment plants in useful manner.
3. Minimize the maximum degradation in environment due to cement and safeguard the ozone layer from greenhouse gases.

SLUDGE

CRUSHED SAND

CEMENT

BRICKS

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II. LITERATURE REVIEW

2.1. "Application of Sludge as Fine Aggregate in Concrete (Dec. 2011)"

Jamshidi A., Mehrdadi N., Jamshidi N. (University of Tehran- Iran)

ABSTRACT: Disposal of human sewage has become a necessity for societies, today. The construction of treatment plants has caused problems with huge contents of dry sludge. It has been found that each person produce 35 to 85 grams of solid sludge per day.

In recent years, waste production has increased dramatically in developing nations such as Iran. There are two methods for the disposal of solid waste (dry sludge) including landfilling and using the sludge as fertilizer. Both of these methods have been prohibited by Iran's Environmental Organization, due to the dangers of heavy metals present in the sludge. Due to these limitations, high volumes of dry sludge have been produced and collected in treatment plants. Alborz sewer treatment plant is an industrial-domestic unit which collects sewage of more than 500 factories. The production of dry sludge is about 2.5 to 3 tons a day in this treatment plant.

In the present research, the dry sludge of Alborz treatment plant was used as filler in concrete.

Worldwide, a great deal of research has been carried out to use dry sludge in concrete.

In Iran, the application of dry sludge in construction materials is a new method. In this research, the dry sludge of a sewage treatment plant was characterized, and its effects on the performance of concrete were evaluated.

To evaluate the effects of dry sludge on concrete performance, its physical and mechanical properties were studied. Thereafter, concrete specimens were produced with water to cement ratios of 0.45 and 0.55, and with sludge contents of 0, 5, 10, 20 and 30 percent. Finally, compressive strength of the specimens was measured.

Following were the conclusions made after going through the above reference paper:

- It was observed that the dry sludge of waste water treatment plant of Alborz city has a satisfying compatibility to concrete materials, due to high contents of SiO_2.
- The dry sludge due to low pozzolanic activity, acts as filler or fine aggregate in concrete.
- Utilization of 10% of dry sludge in concrete caused 8% decrease in compressive strength which was much lower than the decrease amount reported in previous researches (About 42%).
- On the basis of result, it is proposed to use concretes containing more than 10% of dry sludge as non-constructional concretes such as paving and flooring concretes.

2.2 "Reuse water treatment sludge for hollow block Manufacture (Feb 2010)"

Thaniya Kaosol (Prince of Songkla University, Songkhla, Thailand)

Thaniya Kaosol concluded that the water treatment sludge mixtures can be used to produce hollow non-load bearing concrete blocks, while 10% and 20% water treatment sludge mixtures can be used to produce the hollow load bearing concrete blocks. Economically, the 10% and 20%water treatment sludge mixtures can reduce the cost at 0.64 and 1.05 Thai baht per block, respectively.

Following conclusions can be made from Kaosol reference paper:

- About 10% and 20% of the water treatment sludge ratio in mixture to make a hollow loadbearing concrete block can reduce the cost at 0.64 and 1.05 baht block-1,respectively
- 50% of water treatment sludge ratio in mixture to make hollow non-load bearing concrete block can reduce the maximum cost at 2.35 baht block-1
- Dewatered water treatment sludge can be used for construction works such as hollow non-loading blocks and hollow load bearing concrete blocks.
- Production of various mixed ratio of hollow concrete blocks from dewatered water treatment sludge used as a fine aggregate in hollow concrete blocks, could be a profitable disposal alternative in the future and will be of the highest value possible for the foreseeable future.

2.3 "Development of Bricks from Waste Material"

Cheng, Chiang, Badr, Raut

ABSTRACT: Since the large demand has been placed on building material industry especially in the last decade owing to the increasing population which causes a chronic shortage of building materials, the civil engineers have been

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challenged to convert waste to useful building and construction material. Recycling of such waste as raw material alternatives may contribute in the conservation of non-renewable resources, improvement of the population health and security preoccupation with environmental matters and reduction in waste disposal costs. In the review of utilization of those waste, this paper reviews recycling various waste material in bricks production. The effects of those wastes on the bricks properties such as physical, mechanical properties will be reviewed and recommendations for future research as out comings of this review will be given. This reviewed approach on bricks making from waste is useful to provide potential and sustainable solution.

(Badr et al., 2012) investigated the complete substitution of clay brick by sludge mixed with rice husk ash (RHA) and silica fume (SF). Bricks were fired at 1000°C. Bricks contained 25% SF and 50% sludge showed superior mechanical properties as compared with conventional bricks and with those available in the Egyptian code.

2.4 "Utilization of sludge as brick materials"

Shrikant S Jahagirdar, S. Shrihari, B Manu (NITK, Surathkal, India)

Bricks manufactured from dried sludge collected from an industrial wastewater treatment plant were investigated. Results of tests indicated that the sludge proportion and the firing temperature were the two key factors determining the brick quality. Increasing the sludge content results in a decrease of brick shrinkage, water absorption, and compressive strength. Results also showed that the brick weight loss on ignition was mainly attributed to the organic matter content in the sludge being burnt off during the firing process. With up to 20% sludge added to the bricks, the strength measured at temperatures 960 and 1000 ^{0}C met the requirements of the Chinese National Standards. Toxic characteristic leaching procedure (TCLP) tests of brick also showed that the metal leaching level is low. The conditions for manufacturing good quality bricks is 10% sludge with 24% of moisture content prepared in the molded mixtures and fired at 880–960 ^{0}C.

Following were the conclusions made after going through the above reference paper:

- As the amount of sludge increases, the specific surface area of the mixture increases proportionally.
- The water absorption for the bricks increases with increased sludge addition and decreased firing temperature, thereby decreasing its weathering resistance. When the mixture contains less than 15% sludge and is fired at a temperature higher than 960 ^{0}C, the percentage of absorbed water in the produced brick should lie in the 1st class category. With 30% sludge in replacement of clay and fired at 1000^{0}C, the brick produced in this condition meets the 2nd class brick water absorption criteria.

2.5 "Stone Sludge: Economical Solution for Manufacturing of Bricks"

Mamta Rajgor, Jayeshkumar Pitroda (BVM, Sardar Patel University)

ABSTRACT:

A new approach to the production of brick was carried out by using Class F fly ash. Marble and granite industry has grown significantly in the last decades with the privatization trend in the early 1990s.Accordingly, the amount of mining and processing waste has increased .Stone waste is generally a highly polluting waste due to both of its highly alkaline nature, and its manufacturing and processing techniques ,which impose a health threat to the surroundings. Brick is one of the most common masonry units as a building material due to its properties.

Following were the conclusions made after going through the above reference paper:

- As the percentage of stone waste increases, compressive strength increases up to a certain point and then after the decreases. The optimum point at which we get maximum strength is replaced **30%** stone waste by class F fly ash.
- Use of Stone waste in brick can solve the disposal problem; reduce cost and produce a greener Eco-friendly bricks for construction.
- Environmental effects of wastes and disposal problems of waste can be reduced through this research.

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2.6 "Utilization of sludge in manufacturing Energy Efficient Bricks"

Mary Lissy P N, Dr. M S Sreeja (MITS, Varikoli, India)

ABSTRACT: The bricks are obtained by moulding clay in rectangular blocks of uniform size and then by drying and burning these blocks. Burnt clay bricks have good resistance to moisture, insects and erosion and create a good room

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environment. They are medium in cost and have medium to high compressive strength. In brick making the major input is fuel followed by labour. Bricks manufactured from dried sludge collected from textile wastewater treatment plant were investigated. Results of tests indicated that the sludge proportion and the firing temperature were the two key factors determining the brick quality.

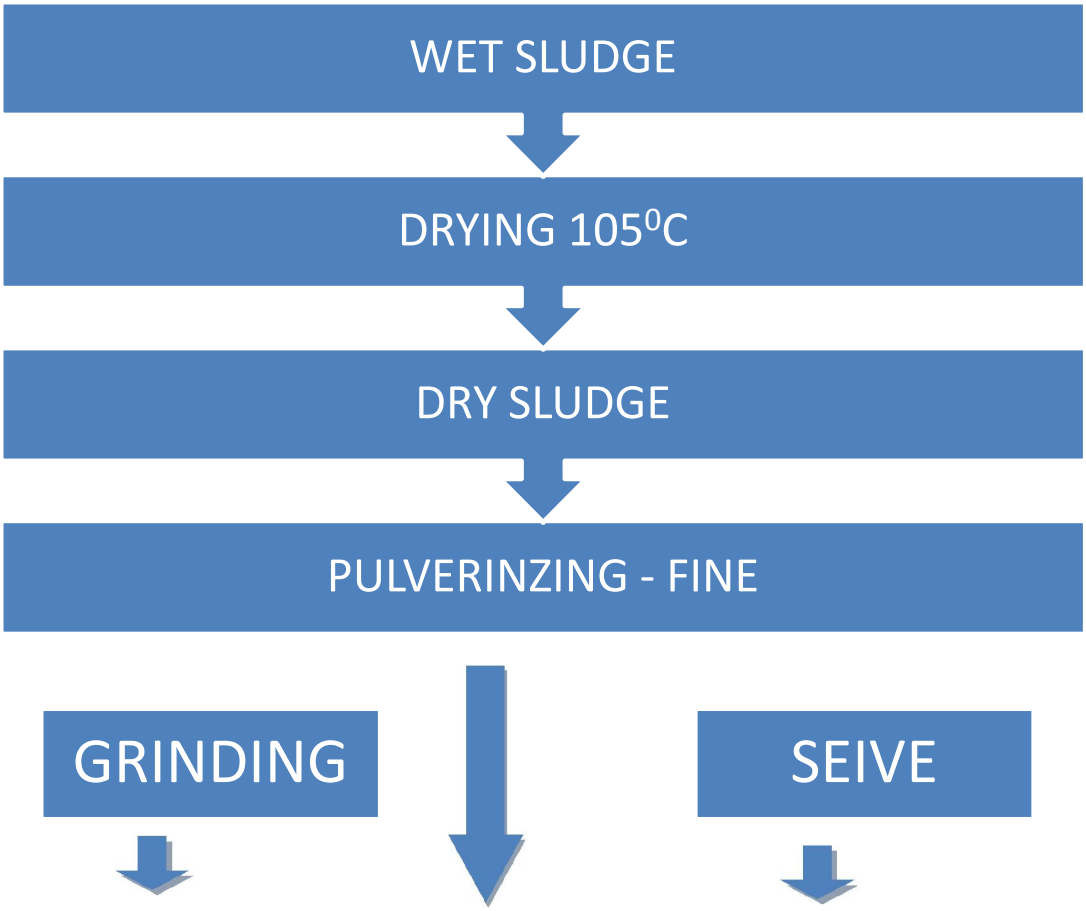
Following were the conclusions made after going through the above reference paper:

- The most energy efficient bricks were casted using sludge as raw materials at a temperature of 500^0C. By casting bricks with different raw materials, sludge bricks showed the maximum compressive strength when compared to control bricks. The sludge bricks were kept for sundry for three nights and four days.
- The control bricks and sludge bricks were casted with same condition for comparison. Since the test results showed more than the minimum compressive strength of an ordinary brick, it can be concluded that energy efficient bricks made of sludge can be used for construction purposes due to its good strength.

III. SLUDGE HANDLING

Sludge is collected from the water treatment plant. As this sludge is harmful some sort of precautions are to be taken, such as using hand gloves and mask when handling this sludge. After collecting this sludge, we have to dry this sludge in the oven or in the hot sunlight as this sludge contains lot of moisture so to reduce this water content we have to dry. Transportation of the sludge is also a major task it should be also done with care.

After the sludge is dewatered and the water content is reduced there is need to remove some impurities such as plastic carry bags, stone chips, and all such impurities which will affect the quality of concrete after mixing. If possible use sieve for removing certain impurities. And then again allow the sludge to dry till all the moisture goes off. Then after that crush the sludge as after drying it becomes coarser and we need to use this sludge in concrete and to replace it with the fine aggregates we need to crush the dried sludge.



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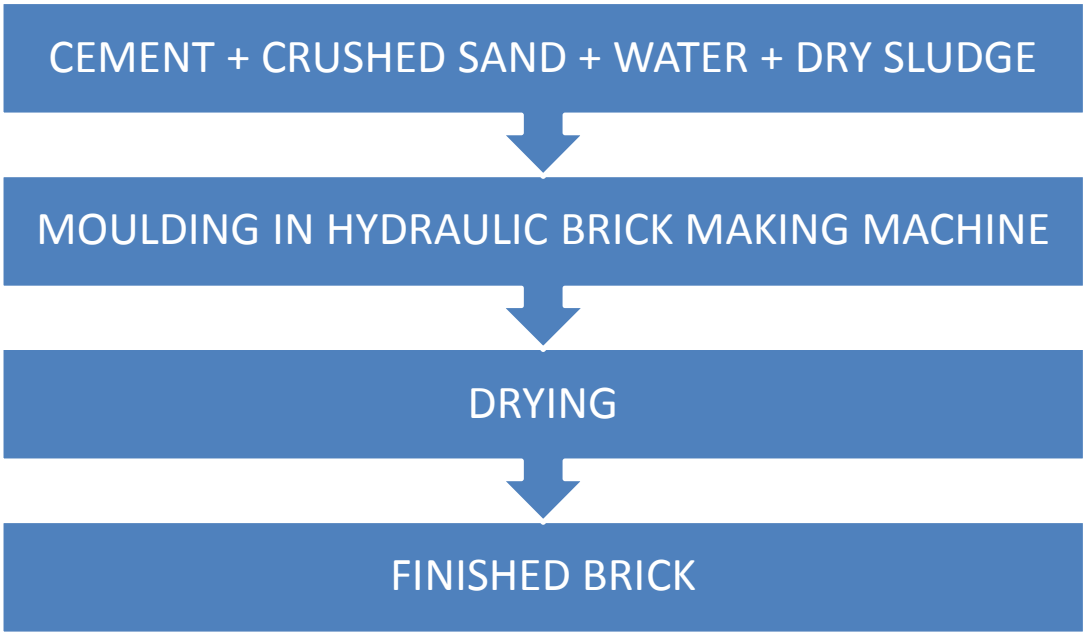

IV. CASE STUDY

Objective

The objectives of the eco-friendly brick are to compare the results of flyash brick with sludge brick.

Plant Selection

We have taken from sludge from Sewage Treatment Plant for our project from Sewage Treatment Plant, Bhatnagar Pimpri Chinchwad Link Road Pimpri,Pune. The sludge collected from Gokhale Park, Keshav nagar, Kakade Park, Deulmala. The capacity of Plant is 30 MLD.

Sludge Produced

Winter Season: 2 truck =16cubic meter/day
Summer Season: 3 truck=24cubic meter/day
Monsoon Season: 2truck=16 cubic meter/day

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Sewage Produced in below given areas are tested,
Gokhale Park, Keshav nagar, Kakade Park, Devulmala

Sludge uses

1. Landfilling
2. Fertilizer

Dumping Site

Moshi Kachra Depot

Treated water used

- Gardening Purpose
- Water treated from this plant is discharged to Pawana River
- Sludge Transportation Cost: Rs 200-300/Truck
- Monthly Electricity Bill: Rs 7 Lakhs.
- Contracter: HNB Engineers Pvt Ltd, Sukravar Peth, Pune

Sludge Consumption in Bricks

Production area: Ravet, Tathavade
No. of bricks produced in one plant in a day: 1000
No. of brick plants in area: 10 units
No. of bricks produced in one day: 10000 units
Sludge consumed by 1 brick, 10% of its weight i.e 500gm per brick
Total sludge consumed in one day: 500kg

V. RESULTS & DISCUSSIONS

Compression Test:

From the following test we concluded that bricks having 5% sludge has an average compression strength of 6.66 N/mm^2, the specimen which contains 10% of sludge has an average strength of 4.32 N/mm^2 and the specimen which contains 12.5% of sludge has an average compressive strength of 3.16 N/mm^2, that implies if we add more sludge in the concrete compressive strength will decrease.

Density of Bricks:

In this test we calculated the density of specimen having different sludge content. Sample (1) has density of 2.15 gm/cc, Sample (2) has density of 2.11 gm/cc, Sample (3) has density of 2.07 gm/cc. Which indicates that density of brick having different sludge percentage differs to only some limited extent there is no gradual decrease or increase in density.

Water Absorption:

After conducting this test we calculated that Sample (1) is having 5.66% of water absorption, Sample (2) has 6.26% of water absorption, Sample(3) has 7.23% of water absorption. Which shows that brick having more sludge contents absorbs more water.

5.1 Results

Table: Result of compressive strength

SR.NO	Description	Age in days	Area of brick	Actual load	Compressive strength	Average strength in N/mm^2
	Sample no.1 (5%)					
1.	Sludge bricks	28	35420	220	6.21	
2.	Sludge bricks	28	35805	250	6.98	

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3.	Sludge bricks	28	35496	270	7.61	6.66
4.	Sludge bricks	28	35112	210	5.98	
5.	Sludge bricks	28	35343	230	6.51	
	Sample no. 2 (10%)					
1.	Sludge bricks	28	35882	160	4.46	
2.	Sludge bricks	28	35496	150	4.23	
3.	Sludge bricks	28	35190	150	4.26	4.32
4.	Sludge bricks	28	35574	160	4.50	
5.	Sludge bricks	28	36115	150	4.15	
	Sample no. 3 (12.5%)					
1.	Sludge bricks	28	35880	125	3.48	
2.	Sludge bricks	28	36115	110	3.05	
3.	Sludge bricks	28	35728	110	3.08	3.16
4.	Sludge bricks	28	35802	115	3.21	
5.	Sludge bricks	28	35032	105	3.00	

Table: Test report

Sr. No.	Name of test	Result	Units
1.	Density of bricks		
	Sample 1 (5%)	2.15	gm/cc
	Sample 2 (10%)	2.11	gm/cc
	Sample 3 (12.5%)	2.07	gm/cc
2.	Water absorption test		
	Sample 1 (5%)	5.66	%
	Sample 2 (10%)	6.26	%
	Sample 3 (12.5%)	7.23	%

VI. CONCLUSION

As we know disposal of sludge is a big issue nowadays so using sludge in the bricks its disposal problem is solved satisfactorily. And the conclusions reached in this study re as follows:

- From the above sample test we got know that adding 5% of sludge of the total weight of brick gives satisfactory results.
- Increase in % of sludge reduces the strength of brick and also increases the water absorption which gave idea that they cannot be used for the construction purpose.
- The blocks can be used in construction industry, in the cases such as partition walls, compound walls etc.
- The incorporation of sludge wastes in building blocks production has proven to be safe for health and environmentally friendly.
- The above study give us the idea, if with proper proportion sludge is added it will give required compressive strength and water absorption.

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