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Review Paper on Eco Bricks

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Abstract: *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.*

Keywords: Bricks.

I. INTRODUCTION

1.1 Introduction of the Project Work

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.

On the contrary, the available capacity of sanitary landfills for sludge disposal is on sufficient because of increasing amount of wastes with the progress of social economy and difficulties to secure and construct new dump yards.

Recently, the basic law for establishing a recycling-based society in which cyclical use of resources and principals of proper disposal of wastes are stated, has been established, and waste disposal law has been revised to strengthen the responsibility of polluter and prevent insufficient treatment of waste.

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.

Especially, sludge utilization for construction works as cement ingredient has been progressed. Also, sludge utilization for construction work like melted slag utilization as subbase course material, etc. has increased. The amount of sludge utilization for agriculture and green area has been almost constant.

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

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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.

From the study of above reference paper, Jamshidi eta concluded that on increasing the percentage of sludge in the concrete block the compressive strength of the block will decrease. 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%). The dry sludge which was taken for the test purpose 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. On the basis of results, it is proposed to use concretes containing more than 10% of dry sludge as non-constructional concretes such as paving and flooring concretes.

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.

The 50% water treatment sludge ratio in mixture to make a hollow non-load bearing concrete block reduce the maximum cost at 2.35 baht per block.

The production of the hollow concrete block mixed with water treatment sludge use as a fine aggregate in hollow concrete blocks, could be a profitable disposal alternative in the future and would be of the highest value possible for the foreseeable future. From the water absorption test Kaosol concluded that water absorption percentage increases with the increase in the percentage of dry sludge. Talking about the compressive strength, if we increase the percentage of sludge. The compressive strength of the concrete will decrease .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.

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.

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- 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 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.

(Cheng et al., 2006) investigated the properties of water permeable bricks made of water treatment sludge and bottom ash (BA) without involving an artificial aggregate step. The mechanical properties of the sintered bricks were examined with respect to relevant standards. It was found that 20 % by weight content of bottom ash under a sintering condition of 1150°C could generate a brick with a compressive strength of 256 kg/cm^2, a water absorption ratio of 2.78 % and a permeability of 0.016 cm/s. Bricks developed in this study could be used as water permeable, environmentally friend product as pavement brick in an urban area.

(Chiang et al., 2000) produced novel light weight bricks by sintering mixes of dried water treatment plant sludge and agricultural waste with rice husk ash. Bricks containing 40 % by weight rice husk sintered at 1100ºC produced low bulk density and relatively high strength that were compliant with relevant Taiwan standards for use as lightweight bricks in future green building. Results for toxic characteristic leaching procedure (TCLP) concentration indicated that TCLP concentrations of Cu, Zn, Cr, Cd, and Pb in the sintered products were lower than regulation thresholds.

(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.

(Raut et al., 2011) did a review study in developing bricks from various industrial and agricultural waste material like paper processed residues, cigarettes buts, fly ash- lime gypsum, cotton waste, limestone powder waste, textile effluent treatment plant, Organic residue, kraft pulp residue, petroleum effluent treatment plant sludge and recycled sludge welding flux. Water absorption and compressive strength of bricks developed from those waste were reviewed. It was concluded that the bricks developed from paper processing residues and waste paper pulp showed the highest compressive strength greater than 12 times from the minimum recommended by Indian Standard IS1007:1992.

The various wastes that are currently recycled in bricks manufacturing have been reviewed. The effects of those wastes on the bricks properties are reviewed. Enhance performance in terms of making more environmental and an economical brick neither consumes energy resources nor emits pollutant gases gives an economical option to design the green building.

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

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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.
- The proportion of sludge in the mixture and the firing temperature are the two key factors affecting the quality of brick.
- With up to 10% sludge added to the bricks, the strength achieved at 1000 ^{0}C can be as high as the normal clay bricks. When a 20% sludge is added in the brick, the achieved brick strength at 1000 ^{0}C lies in the scope of the 1st-class category. With up to 30% sludge added to the bricks, the strength measured at temperatures of 1000 ^{0}C, met the requirements of a 2nd class brick standard.
- On the basis of result the proportion of sludge in brick is 10%, with a 24% optimum moisture content, prepared in the molded mixtures and fired between 880 ^{0}C and 960 ^{0}C to produce a good quality brick.

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. Many attempts have been made to incorporate wastes into the production of bricks, for examples, limestone dust, wood sawdust, processed waste tea, fly ash, polystyrene and sludge. Recycling such wastes by incorporating them into building materials is a practical solution for pollution problems. This paper represents the utilization of stone sludge waste in manufacturing fly ash bricks. In this paper, an attempt is made to study the properties of stone waste fly ash bricks.
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.
- A better measure by an innovative Construction Material is formed through this research.
- It provides innovative use of class F fly ash which contains less than 20% lime.
- This study helps in converting the non-valuable stone waste into bricks and make it valuable.

Need of Study
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 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

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III. OBJECTIVES

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.

IV. METHODOLOGY

Materials & Properties
Sludge
Sludge Handling
Mix Design
Preparation of Bricks
Tests

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