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Research Article

Preliminary studies of common effluent treatment waste sludge in manufacturing of solid block

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Abstract: A common effluent treatment waste sludge being largest industry in India faces problem of sludge disposal. In this study an attempt is made to reuse common effluent treatment waste water sludge in solid blocks. Common effluent treatment waste water sludge is used to replace base material by weight up to15%. Blocks are casted by adding sludge after drying at 3000˚C to 6000˚C for 8, 16 and 24 hrs. Common effluent treatment waste water sludge can be added up to 15% as it gives compressive strength above 8.33 N/mm2 and water absorption ratio is 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.
Keywords: Effluent waste water sludge, solid blocks, compressive strength, water absorption

INTRODUCTION

Common effluent treatment waste water sludge is the sludge generated from the effluent treatment plant. 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 problems in 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 a huge quantity of effluent treatment sludge would pose another problem. Therefore this study was conducted to investigate the feasibility of using the common effluent treatment waste sludge for producing concrete aggregates and concrete products like solid concrete blocks. A concrete block is used as a building material in the construction of walls. It is sometimes called a Concrete Masonry Unit (CMU). The concrete block is one of several precast concrete products used in construction. The term precast refers to the fact that the blocks are formed and hardened before they are the main properties of the most common type of concrete are: (a) high compressive strength, resistance to weathering, impact and abrasion; (b) low tensile strength; (c) capability of being moulded into Components of any shape and size and (d) good fire resistance up to about 1200°C.The use of concrete hollow blocks has several advantages: (i) they can be made larger than solid blocks; (ii) they require far less mortar than solid block sand construction of walls is easier and quicker; (iii) achieving high seismic resistance; (iv) The cavities can be used as ducts for electrical installation and plumbing.

LITERATURE REVIEW

Many research studies were carried out for effective utilization of fly ash and pond ash in building industry as it possess suitable pozzolanic properties .They are produced in large quantities during the combustion of coal for energy production and recognized as an environmental pollution. Fly ash and Pond ash utilization in building materials have many advantages like cost effectiveness, environmental friendly, increases in strength and also conservation of natural resources and materials. The Thermal by product such as pond ash and fly ash waste material are effectively utilized in manufacturing of bricks. In this study, various mix proportions were arrived by using materials fly ash, pond ash, lime, gypsum and sand. The microstructure and composition of coal ash brick were studied by using scanning electron microscope (SEM) and X-ray diffraction (XRD) analysis. Experimental investigation was carried out for compressive strength, water absorption, weight density, efflorescence test and IRA. Fly ash, Pond ash, Water absorption, Compressive strength Weight density, Initial rate of absorption [1].

A study of reuse of textile mill sludge in burnt clay bricks Textile mill being second largest industry in India faces problem of sludge disposal. In this study attempt is made to reuse textile mill sludge in burnt clay bricks. Textile mill sludge is used to replace base material by weight upto35%. Analysis of textile mill sludge and soils is done for its chemical content. Bricks cast by adding sludge are fired after drying at 6000C to 8000C and for 8, 16 and 24 hrs. Textile sludge can be added up to 15% as it gives compressive strength above 3.5 N/mm2 and water absorption ratio less than 20%. Thus reuse of textile mill sludge in burnt clay bricks is better option so that problem of ultimate disposal of textile mill sludge can be solved up to greater extent. Textile mill, sludge, clay bricks, compressive strength, water absorption [2].

The textile waste composition falls within the range of 0.5-1% from the total composition of municipal solid waste collection in Sri Lanka. However, the garment industry may generate textile waste accumulating from 19,000 to 38,000 tons annually, since the garment cutting waste is approximately 10 - 20% of fabric consumption. Considerable amount of textile waste is dumped in open areas and incinerated after removing small percentage for recycling and reuse. This accumulation of textile waste from all over the country causes certain serious environmental problems and health hazards. Also, finding of alternatives for river sand has arisen due to over exploitation for construction purpose resulting in various harmful consequences. The focus of the current study was on making solid cement blocks as building material, by partially replacing river sand with textile waste. The two forms of textile waste; cut-and ground and cut pieces of 1cm x 2.5cm were incorporated to replace 25% sand on volume. Compressive strength, stress strain characteristics, weight and saving of sand were determined. The results showed that the effect of compressive strength and stress-strain characteristics of the textile waste used cement blocks are within the required standards and can be used for constructing one storied buildings. Though cut-and-ground textile showed slightly high compressive strength, it is difficult to use for construction due to its additional cost of production. The small square pieces of size 1cm x 1cm were the acceptable shape for making blocks. Finally, it can be concluded that replacing of river sand by small textile waste pieces is a good alternative and environment friendly solution [3].

This study examined the potential reuse of textile effluent treatment plant (ETP) sludge in building materials. The physio-chemical and engineering properties of a composite textile sludge sample from the southern part of India have been studied. The tests were conducted as per Bureau of Indian Standards (BIS) specification codes to evaluate the suitability of the sludge for structural and non-structural application by partial replacement of up to 30% of cement. The cement–sludge samples failed to meet the required strength for structural applications. The strength and other properties met the Bureau of Indian Standards for non-structural materials such as flooring tiles, solid and pavement blocks, and bricks. Results generally meet most ASTM standards for non-structural materials, except that the sludge-amended bricks do not meet the Grade NW brick standard. It is concluded that the substitution of textile ETP sludge for cement, up to a maximum of 30%, may be possible in the manufacturing of non-structural building materials. Detailed leach ability and economic feasibility studies need to be carried out as the next step of research [4].

A large quantity of sludge rich in nutrients and microorganisms is generated every year from water and wastewater treatment plants, the final destination of which affects the environment. Generally, dewatered sludge is disposed of by spreading on the land or by land filling. However, space limitations on existing landfill sites and problems of waste stabilization have prompted investigation into alternative reuse techniques and disposal routes for sludge. A more reasonable approach is to view the sludge as a resource that can be recycled or reused. Many researchers have exploited the reuse of lime sludge from water treatment plant and sewage sludge ash as an inexpensive source of soil stabilizer in sub grade stabilization and soft cohesive soil respectively. Sewage sludge pellets (SSP) has replaced sand in concrete manufacturing for pavements. The use of SSP as substituting material in raw mix formulation in Portland cement manufacturing has been studied by many researchers. Experimental results showed the feasibility of the partial replacement (15 and 30%) of cement by sewage sludge ash (SSA) in mortars. This paper highlights the potential of dried sludge, sludge pellets and sludge ash in various building materials for construction. Landfill, sewage sludge ash, sewage sludge pellet, sludge [5].

A study Reuse Water Treatment Sludge for Hollow Concrete Block Manufacture This research reuses the water treatment sludge from a water treatment plant to make hollow concrete blocks. The main objectives are 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 fine aggregate in the concrete mix for hollow concrete blocks. This study presented the results of these studies on potential applications of the water treatment sludge for beneficial uses. A concrete block is used as a building material in the construction of walls. The concrete block construction is gaining importance in developing countries.The results in this study showed 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% of water treatment sludge ratio in mixture to make a hollow non-load bearing concrete block can reduce the maximum cost at 2.35 baht per block. Finally, the production of the hollow concrete blocks 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. Water treatment sludge, reuse, hollow concrete block, compressive strength [6].

A study the main objective of this study is to investigate the potential use of various solid wastes for producing construction materials. The paper is based on the comprehensive review of available literature on the construction materials including different kinds of solid wastes. The traditional methods for producing construction materials are using the valuable natural resources. Besides, the industrial and urban management systems are generating solid wastes, and most often dumping them in open fields. These activities pose serious detrimental effects on the environment. To safeguard the environment, many efforts are being made for the recycling of different types of solid wastes with a view to utilizing them in the production of various construction materials. This paper discusses the environmental implications caused by the generation of various solid wastes, and highlights their recycling potentials and possible use for producing construction materials. In addition, this paper shows the applications of solid waste based construction materials in real construction, and identifies the research needs. Construction, construction materials, environment, recycling, solid wastes [7].

MATERIALS AND METHODS

Collection of sludge

Dried sludge from sludge drying beds is collected from Common effluent waste water treatment in Veerapandi. Tirupur district, Tamilnadu State. In India. Collected sludge is packed and stored in polyethylene buckets and used for further investigation. Crusher sand required for manufacturing of concrete solid blocks is procured from one of local brick manufacturers in Tirupur, Tamilnadu India.


Sludge


Cement


Aggregate


Crusher sand


Mixed materials


Solid block

Table 1: Properties of effluent sludge

S.NO	PARAMETER	RESULTS %
1	Loss of ignition	55.5%
2	Silica as sio2	12.3 %
3	Iron	3.30 %
4	Calcium	15.53 %
5	Magnesium	7.41 %
6	Sodium	0.02 %
7	Potassium	0.01 %
8	Aluminium oxide	1.20 %
9	Titanium di oxide	4.20 %
10	Manganese tri oxide	0.06 %

Methods

To study the effect of temperature common effluent treatment waste sludge, white and yellow sludge are analysed by solid block local brick manufacturers in and around Tirupur, Tamilnadu. Sludge used for block making is taken in various ratios (5%, 8%, 10%, 12%, 15%) by mixing Crusher sand, Coarse aggregate, Cement, Sludge (above mixing proportion is called as *base material*). As per above proportions sample is prepared for block with water content from 15% to 23% to get good better workability. Replacement is done by weight, starting from 5% up to 15% (increments of 2% to 3%).Blocks are casted for different proportions as,

Table 2: **Table showing quantity of materials used**

S.no	Percentage of sludge replacement	Weight of cement (Kg)	Weight of curser sand (Kg)	Weight of aggregate(Kg)
1	5	9.5	14.25	30.98
2	8	9.2	14.25	30.98
3	10	9	14.25	30.98
4	12	8.8	14.25	30.98
5	15	7.8	14.25	30.98

The Block

It has been observed that a block weighing about 16 to 18 kg can be handled by a mazdoor or a mason. The nominal size of the block is 30x20x15 cm and the actual size is 29x20x14 cm. These dimensions are assumed for commonly occurring 20 cm wall thicknesses. Thus, each block with 10 mm thick horizontal and vertical joints occupy effective measurements of 30x20x15 cm.

RESULTS AND DISCUSSION

Compressive strength

Compressive strength and density tests were performed on both normal and common effluent treatment waste sludge blocks. Compressive strength test was carried out to determine the load bearing capacity of the blocks. The blocks that have attained the ripe ages for compressive strength test of 7, 14, and28 days were taken from the curing or stacking area to the laboratory, two hours before the test was conducted, to normalize the temperature and to make the block relatively dry or free from moisture. The weight of each block was taken before being placed on the compression testing machine in between metal plates. The block was then crushed and the corresponding failure load was recorded. The crushing force was divided by the sectional area of the block to give the compressive strength. The density of the block was determined by dividing the weight of the block prior to crushing, with the net volume. The compressive strength for 7, 14, and 28 days are calculated and tabulated for various samples.

Table 4: Table showing compressive test results for 7, 14 and 28 days

S.no	Percentage of sludge adding(%)	Strength achieving on 7 days (N/mm^2)	Strength achieving on 14 days (N/mm^2)	Strength achieving on 28 days (N/mm^2)
1	5	6.378	6.51	8.33
2	8	5.84	6.41	7.4
3	10	5.45	5.97	6.77
4	12	5.05	6.33	6.57
5	15	4.77	5.37	6.37

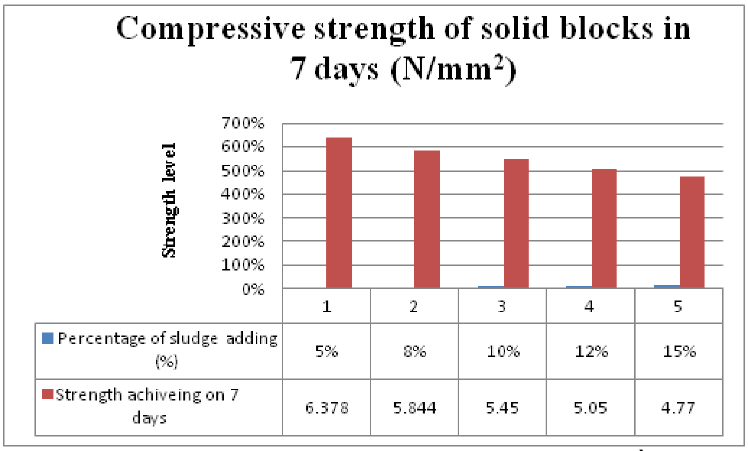

Figure 1: **Figure showing compressive test at 7th day**

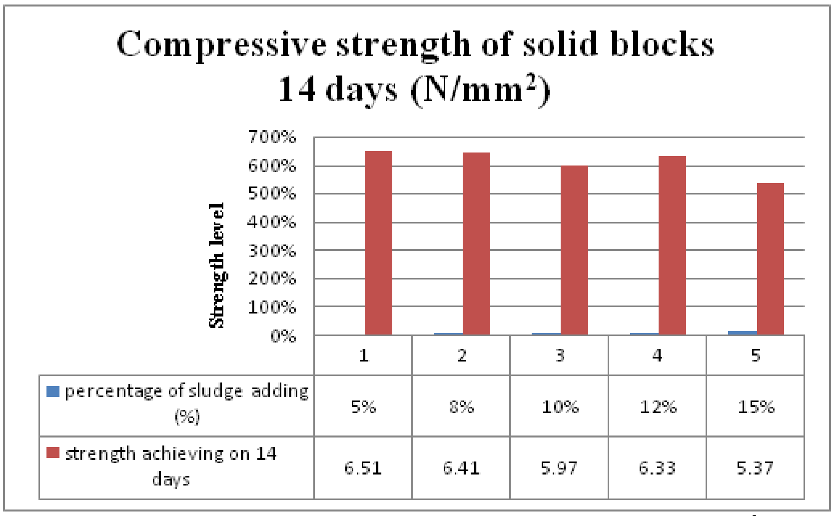

Figure 2: Figure showing compressive test at 14th days

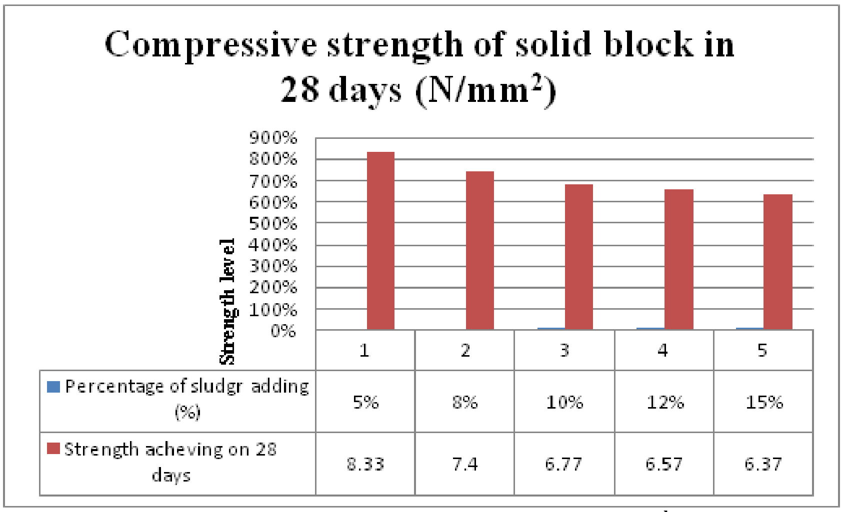

Figure 3: **Figure showing compressive test at 28th day**

Manufacturing of solid blocks by adding sludge has a good compressive strength compared to the normal block. It has more than 19N/mm^2 and also the water absorption is very less in sludge added block. It has more amount of lime component so the additive strength also gets increased for block.

Water absorption

Water absorption was also evaluated based on the drying period and the addition of sludge to the ceramic mass. Water absorption is based on the drying period. Considering the water absorption process it was observed that the drying period had little influence. It was also verified that this influence was even more significant for the blocks manufactured with the sludge mixture. It is interesting to highlight that the water absorption process was dry sludge were used. Such a process inversely occurred. The sludge humidity may have influenced this process, since the retention during drying was much higher for the blocks manufactured with, causing a higher absorption of water during the drying process.

In our project the water absorption for all the samples the readings are taken and tabulated in table 3.

Table 3: Table showing water absorption test results

S.no	Sample no	Percentage of sludge adding %	Normal weight of solid block (k.g)	24 hrs water immersion weight (k.g)
1	1	5	20.120	20.640
2		5	19.960	20.620
3		5	20.150	20.670
4	2	8	19.940	20.260
5		8	20.210	20.740
6		8	20.120	20.640
7	3	10	20.020	20.420
8		10	20.040	20.440
9		10	20.060	20.640
10	4	12	19.920	20.640
11		12	19.940	20.660
12		12	20.120	20.640
13	5	15	20.040	20.430
14		15	20.060	20.630
15		15	20.100	20.620

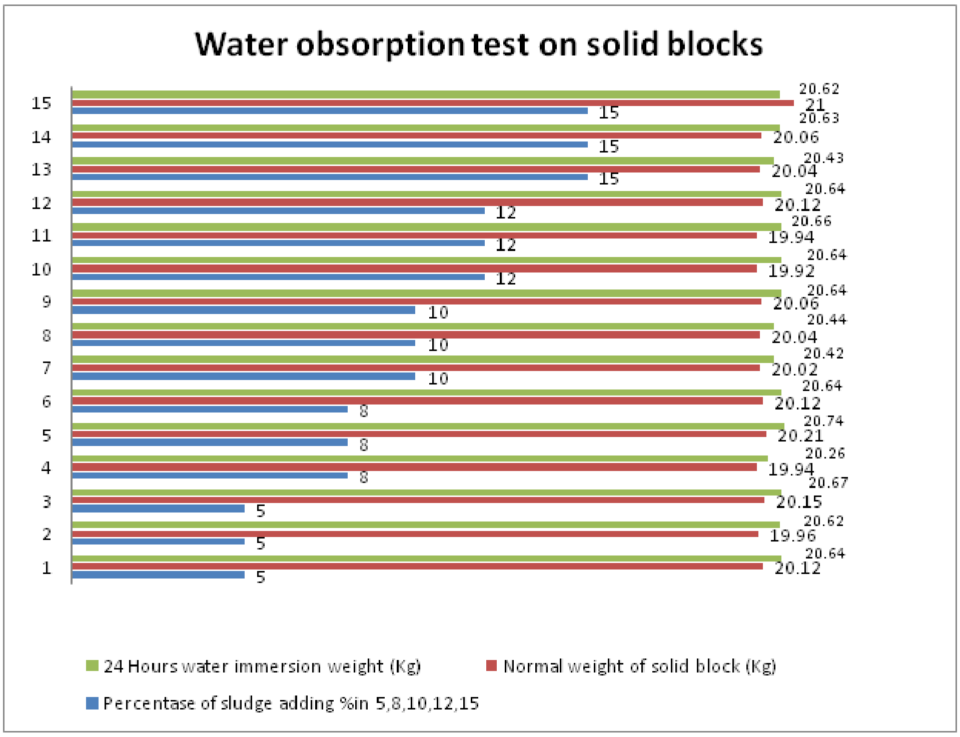

Figure 4: Water absorption results for 7 ,14 and 28 days

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