A review of the use of industrial waste and sewage sludge for the production of bricks

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ABSTRACT

The most basic building material for construction of houses is the conventional brick. The rapid growth in today's construction industry has obliged the civil engineers in searching for more efficient and durable alternatives far beyond the limitations of the conventional brick production. A number of studies had taken serious steps in manufacturing bricks from several of waste materials. However, the traditional mean of bricks production which has brought hazardous impacts to the context has not yet been changed or replaced by more efficient and sustainable one. This paper aims to compile this state of the art work of manufacturing bricks in the past and the current trend in the bricks industry with respect to the raw materials, ways of manufacturing and the out-comings. Moreover, the hazardous impacts of the conventional brick manufacturing will be wholly covered as well as the attempts of the previous researches in treating the problem properly.

Keywords: Industrial Waste, Sewage sludge, Environment, Brick.

1. INTRODUCTION

The increase in the popularity of using environmentally friendly, low cost and lightweight construction materials in the building industry has brought about the need to investigate how this can be achieved by benefiting the environment as well as maintaining the material requirements affirmed in the standard. Recycling of waste generated from industrial and agricultural activities as building materials appears to be a viable solution not only to such pollution problem but also to the problem of economic design of buildings. Brick belongs to the wide family of construction materials since it is mainly used for the construction of outer and inner walls in buildings. The brick industry is the most indicated technological activity sector to absorb solid waste due to the large quantity of raw material used by the sector as well as by the large volume of final products in construction. Various attempts were made to incorporate various waste material in bricks production such as natural fibers, textile laundry wastewater sludge, foundry sand, granite sawing waste, perlite, processed waste tea, sewage sludge, structural glass waste, PC and TV waste, fly ash, sugar cane bagasse ash, organic residue, steel dust, bottom ash, rice husk ash, silica fume, marble and granite waste, municipal solid incineration fly ash slag (Chee-Ming, 2011 - Raut et al, 2011). This review highlights the effects of various waste materials on the bricks property like physical and mechanical properties as well as thermal insulation.

2. LITERATURE SURVEY

Aeslina Abdul Kadir and Abbas Mohajerani (2011) reviewed the recycling of different wastes into fired clay bricks. A wide range of successfully recycled materials and their effects on the physical and mechanical properties of bricks were presented. Most of the manufactured bricks with different types of waste have shown positive effects on the properties of fired clay bricks.

A. A. Mageed et al (2011) investigated the possibility of using sludge of New Assiut city (Assiut- Egypt) as a partial substitute for shale in brick making. Due to the high content of organic matter in water sludge, incineration of the sludge is necessary to remove all organic compounds contained therein. For brick making mixture of various proportions from 10 % to 50% by weight of sludge ash added to shale were used as raw materials in hand-moulded brick making. The brick samples after drying process and firing at 1000 °C for 6 hrs, were inspected a series of tests including firing shrinkage, weight loss on ignition water, absorption, bulk density, compressive strength, slake durability and efflorescence test. Studies indicate well for the percentage of sludge ash was up to 30%
Alaa A. Shakir and Ali Ahmed Mohammed (2013) presented the state of the art work of manufacturing bricks in the past and the current trend in the bricks industry with respect to the raw materials, ways of manufacturing and the out-comes. Moreover, the hazardous impacts of the conventional brick manufacturing were covered as well as the work of the previous researches in treating the problem properly was also presented. This paper is an attempt to fill the gap of the past studies and suggest more sustainable and sophisticated methods of brick manufacturing in the future.

Alaa. A. Shakir et al (2013) reviewed utilization of industrial & sewage sludge waste and recycling various waste materials in bricks production. The effects of industrial & sewage sludge waste on the bricks properties such as physical, mechanical properties were suggested. This review work on bricks making from waste could provide a potential and sustainable solution for above waste materials.

Sandeep Yadav et al (2014) presented the status of recycling of the waste products like STP Sludge and Fly ash in bricks. The sewage treatment process generates a sludge that must be dis-posed-off in an environmentally sound manner. The sludge generated in most of the treatment systems around the world is dis-charged into the nearest watercourse. Among all disposal options, the use of sludge in producing constructional elements is considered to be the most economic and environmentally sound option. This paper reviews the recycle of sewage treatment plant sludge and Fly ash for fired clay bricks. He indicated that Bricks so formed have adequate crushing strength, hardness and water ab-sorption properties.

Mary Lissy P N and Dr. M S Sreeja (2014) investigated bricks manufactured from dried sludge collected from the textile wastewater treatment plant. Results of tests indicated that the sludge proportion and the firing temperature were the two key factors determining the brick quality. Results 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 6.66% sludge added to the bricks, the strength measured at temperatures 500°C met the requirements of the National Standards. This study showed that the pulverized sludge could be used as a brick material in reducing the firing temperature for the production of energy-efficient bricks. The bonding strength can be further enhanced by controlling operating conditions.

Aeslina Binti Abdul Kadir (2014) reviewed on the utilization of different types of sludge wastes into fired clay bricks. Previous investigations have demonstrated positive effects on the physical and mechanical properties as well as less impact towards the environment. Thus, the utilizations of sludge waste could produce a good quality of brick and could be one of the alternative disposal methods for the sludge wastes.

B. Shoba (2015) reported the use of sludge as new and non-conventional construction materials as an alternative means of sludge disposal. Sludge percentage is varied from zero to thirty percentages by weight. Parameters such as compressive strength and water absorption are studied as per BIS (Bureau of Indian Standards) procedure. Water treatment plant sludge up to 15 % can be added to get the higher compressive strength of 8.30N/mm².

Vivek Chaudhary and K.S. Gumaste (2015) reviewed the study of various research works that had been done, in order to find the suitable type of sludge for brick manufacturing in western Maharashtra region. This study emphasis on producing bricks manufactured from clay blended with sludge, having properties as per IS code.

S.S. Razvi et al (2016) presented the work in the manufacturing of bricks with sewage sludge additions ranging from 20, 25, 30 and 40% by dry weight respectively and compare produce brick with regular brick. Bricks with a sludge content of up to 40 % were capable of meeting the relevant technical standards. However, if bricks with more than 30 % sludge addition are not recommended for use because they are brittle in nature and easily broken even when handled gently as well as color is not as per the requirement. Also from this investigation, we can solve disposal problem completely and also construct and economical structure with easy designing.

R.Nithiya et al (2016) present the strength of the bricks by using different recyclable materials like coconut fiber, granite waste, and egg shell powder.

Bharat Nagar and V. P. Bhargava (2016) evaluated the effect of dry sludge on concrete performance, its physical and mechanical properties were studied. In this research, an attempt is taken to bring into play the sludge waste in various proportions so that the final product property of concrete mixture is same as the control mix. Waste sludge material was replace with fine and coarse aggregate in various percentages such as 50%, 45%, 40%, 35%, 30%, 25%, 20%, 15%, 10%, 5%, 4% and 3%. Reference concrete mix is also made for comparative reasons.

Shrutakirti A. Mahajan and Dr. M. Husain (2016) utilized the sludge (dry) in making of construction materials, which is produced from TATA MOTARS, PUNE. Even to analyze the sludge have been studied. For inducing strength materials like fly ash, lime, sand, cement, CaCl2, have been used. Sludge bricks show better compressive strength when compared with normal fly bricks or building bricks.

Manish Kumar Sahu et al (2016) present the status of manufacturing of bricks in past and present status and also the about harmful effect of these practices. In this paper, author explained about various techniques to enhance the quality of bricks and also to reduce the hazardous effect on the environment.

Mayur Tanpure, Pratik P. Shinde (2017) disposal of sewage waste is the major problem in urban cities as it causes many harmful effects on the environment. Sludge is the main product of sewage waste. Conventional brick is mostly prepared by using clay. The chemical composition of sludge is nearly similar to the clay. Hence sludge can be used as a replacement for clay, the soil in the manufacturing of bricks.
Vineet Garg et al (2017) study and testing which includes the use of dry sludge collected from the waste water treatment plant in the manufacturing of fired clay bricks. During the whole process, the sludge is replaced with the clay soil used in the bricks. The replacement is done by the weighing batching method. We replace the sludge by 0%, 5%, 10% and 15%. Manufacturing of the bricks using the WTP sludge is the alternate way the dispose of the sludge and to prevent the natural clay soil. Various tests are done on the dry sludge bricks and then the results were compared with the conventional bricks.

Revathi V et al (2017) incorporated the municipal sewage treatment plant sludge (STP) and the sugarcane press mud/filter cake along with fly ash and lime to get the better binding and compressive strength. The bricks are made without burning so the CO2 emission is controlled. The press mud is a material which is obtained from the clarification of sugar. The disposal of these wastes into the environment causes the land pollution so the attempt made will be a better solution for this problem. The municipal sewage sludge and sugarcane press mud/filter cake are added at different percentages such as 10, 15, 20 and 25. The test was conducted and the optimum percentage is obtained.

K. T. Phalak et al (2017) represents the most suitability of replacement of sewage treatment dry sludge in brick with ordinary soil. The compressive strength, water absorption, weight and other aspects were studied.

Tarun Jain and Prof. Archana Tiwari (2017) investigated mechanical properties of lightweight bricks and compare its functions with conventional bricks. EPS Geofoam is a light substance that has been utilized in construction applications since last few decades. EPS has good thermal insulation properties with stiffness and compression strength comparable to medium clay. In, this experimental investigation effort is made to develop light weight brick by combining EPS beads with cement fly-ash and sand.

3. CONCLUSION

A survey of journal articles published between 2010 and 2017 yields studies that vary in scope and level of analysis where critically studied. Based on the extensive literature review, the research that were carried out over the last thirty years have revealed that many successful attempts to incorporate different types of waste into the production of fired clay bricks including sludge, fly ash, polystyrene, kraft pulp residue, processed waste tea, sawdust, grass, paper and others. The manufactured bricks with different types of waste have shown positive effects on the properties of fired clay bricks such as improved porosity, thermal conductivity, water absorption properties, and reduction of density and energy used during firing. Thus, utilization of solid wastes has been encouraged as one of the most cost-effective alternative materials that could be used in fired clay brick manufacturing.

It was also shown that the past studies recycled various sorts of waste in bricks making. Different tests were conducted on the bricks manufactured from waste. Bricks property like physical, mechanicals has been positively influenced by the additional of waste material. Moreover, utilization of waste in bricks manufacturing may contribute to the conservation of natural resources, environmental protection and saving in the land for construction. Furthermore, there will be energy conservation which is in otherwise, will be spent in extracting, handling and reclaiming the virgin resources as clay or shale in bricks production.

Besides, the pollutant gasses as carbon monoxide (CO), carbon dioxide (CO2), ammonia (NH3) and in some cases chlorine and fluorine which are unsafe gases which are usually emitted through bricks firing and will be considerably reduced in non-fired bricks, hence sustainability will be achieved.

Below are the main points which can be considered as a conclusion and directions for future works in order to fall the gap which exists in the work carried out this far.

1) Prevent the natural resource consumption as clay, shale, and sand in the brick production. Most of the researchers investigated the possibility of developing clay bricks from waste. Although, their efforts were valuable and worthy they didn’t save the virgin resources from the evitable depletion since they are still extracted and utilized in the production processes. Therefore, more efforts should be directed toward different types of industrial waste. For instance, Billet scale, Quarry dust, Fly ash, Bottom ash to be utilized as the main constituents in the bricks.

2) Seek for an alternative fuel and promote the usage of renewable energy for the brick plants that still fellow the conventional mean of brick manufacturing, since there was no research in this area, so more studies regarding the alternative fuel should be conducted.

3) The firing of bricks should be prohibited from the manufacturing process and the bricks industry in the future should be held in an ecological basic since few studies were conducted in developing bricks in an eco-environmental method. Therefore, more studies showed be held in this area.

4. REFERENCES


