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COMPRESSED CEMENT EARTH BLOCK USING BAGASSE ASH: A REVIEW

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ABSTRACT

Ordinary Portland cement is recognized as a major construction material throughout the world .Industrial wastes, such as blast furnace slag, fly ash and silica fume are being used as supplementary cement replacement materials. Currently, there has been an attempt to utilize the large amount of bagasse ash, the residue from an in-line sugar industry and the bagasse-biomass fuel in electric generation industry. When this waste is burned under controlled conditions, it also gives ash having amorphous silica, which has pozzolanic properties. A few studies have been carried out on the ashes obtained directly from the industries to study pozzolanic activity and their suitability as binders, partially replacing cement. Therefore it is possible to use bagasse ash (SCBA) as cement replacement material to improve quality and reduce the cost of construction materials. This paper presents the current status and past studies in the area of SCBA.

KEYWORDS: SCBA, Compressed Earth Block, Molasses.

INTRODUCTION

In developing countries, provision for housing is an important need and whole economy of the country around construction industry. It has become difficult for rural and urban people to afford as the cost of land and construction are very high. Many governments have brought up housing schemes which help facilitating housing ownership for low income groups. It is very essential to find out ways to reduce the construction cost, at least for low income housing. This can be done focusing on locally available material for construction purpose with proper and appropriate technology. Soil is the word with which everyone is familiar with. Since ages soil is being used as a building material and one of the major advantages is its availability. Even today soil has been the primary material for construction of traditional low cost houses all over the world. However, traditional earth construction techniques such as wattle and daub, cob and adobe need continuous maintenance in order to keep them in good condition. There has been considerable development in the usage of soil for building purpose. The most popular methods are rammed earth wall and compressed stabilized earth blocks (CSEB).

Compressed stabilized earth blocks may be defined as compressed blocks made out of soil and binding materials. These blocks have various advantages, such as economical, affordable, non-combustible, low thermal conductivity and low energy input. One of the attractive characteristics of CSEB is the use of innovative materials along with soil. Due to limited means within developing countries, it is necessary to seek ways to reduce construction costs, especially for low-income housing, as well as adopting easy and effective solutions for their repair and maintenance. This can be achieved by using CSEB which can be produced with locally available materials. The application of CSEB is not popular because of many failures recorded in the past. So it is very important to study the short term and long term durability of the CSEB to build up the confidence in using this technology. CSEB is one of the construction material which helps in bringing down the cost of construction. Even though it is in use since 1950s, customers are reluctant to use this material for construction because of the negative experiences with its use. Although failure might be attributed to a number of factors, such as unskilled labour, lack of knowledge about the type of soil to be used and bad equipment; it is important to demonstrate that these blocks are strong and durable, which can promote the usage of CSEB and will benefit

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many low-income groups. In addition, the usage of waste agricultural material for block production will help in solving regional waste disposal problems and hence, promote healthier environments. This study has benefits not only in the residential construction industry, but also in pavement industry. These blocks can be used as an alternative for the pavers used in pedestrian walkways. They can also be used for residential driveways and commercial driveways that see little traffic and no heavy vehicles. The uniform, pleasing appearance of paving blocks means that they are very well-suited for use in disguising imperfections in an outdoor space and they can be used as paths, patios or mixed with other paving types to create a unique feature.

RELATED WORK

G.C. Cordeiro, L.M. Tavares and R.D. Toledo Filho [2016], Selective grinding was identified as a potential technology to reduce the content of quartz in sugar cane bagasse ash (SCBA), so as to assist in developing an improved supplementary cementitious material. The selective grinding strategy comprised of a ball mill and two classifiers, where a quartz-rich waste is discharged as a coarse waste by the first one. The amenability of two distinct SCBA samples to selective grinding was first demonstrated on the basis of measurements of strength of individual particles. The samples were then analyzed with respect to chemical and mineralogical compositions and pozzolanic activity. Results showed that the quartz content decreased significantly as a result of selective grinding and classification, thus increasing the amorphous content and, consequently, the pozzolanic activity for both of the studied SBCA samples. Moreover, good correlations were observed between the amorphous content and SCBA reactivity considering electrical conductivity and pozzolanic activity index tests.

Rakshith P. C. Gowda and Claudia E. Zapata [2016], Concern and interest about the environment and ecologic systems have promoted the usage of earth as a construction material. Technology advancement has resulted in the evolution of old adobe and cob into compressed stabilized earth blocks (CSEBs). Compressed stabilized earth blocks are prepared by compressing the soil-stabilizer mixture at a particular stress. In order to accomplish the required strength, cement has been used in a regular basis as stabilizing agent, at proportions that are still harmful to the environment. CSEB blocks have various advantages related to cost reduction, energy efficiency and environmental friendly and therefore, it is of interest to find means to reduce the amount of cement used in their construction without affecting its dry strength and durability. In this study, natural fibers were used along with lower proportions of cement than those commonly used in practice and varying fine content in the soil to assess its effect on the dry strength and durability of the blocks. Blocks were compacted with 10MPa stress and prepared by using 7%, 5% and 3% cement along with varying fiber content ranging from 0.25% to 2%. The effect of fine content, cement and fibers on strength and durability of the natural fiber-reinforced blocks was studied. Sand/clay fractions of a native soil from the Phoenix area were used to fabricate the blocks. Preliminary results indicate that the compressive strength reaches a maximum value for blocks with 30% fine content; blocks with 5% cement withstand the durability test; an increase in fiber content decreases the strength of the material; and finally, the soil-cement loss was minimal for blocks with 50% fine content.

Syed M.S. Kazmi , Safeer Abbas , Muhammad A. Saleem , Muhammad J. Munir [2016], Burnt clay brick is one of the major and widely used building units in masonry construction around the globe. The manufacturing of burnt clay bricks using waste materials can minimize the environmental overburden caused by waste deposition on open landfills and would also improve the brick performance at low production cost leading to more sustainable construction. This study aims to evaluate the effect of the waste addition produced from two major crops: sugarcane and rice in clay bricks manufacturing. In this study, sugarcane bagasse ash (SBA) and rice husk ash (RHA) were collected locally from a sugar mill and bull's trench kiln, respectively. Brick specimens were manufactured at an industrial brick kiln plant using various dosages (5%, 10% and 15% by clay weight) of SBA and RHA. Mechanical and durability properties of these bricks were studied. It was observed that clay bricks incorporating SBA and RHA exhibited lower compressive strength compared to that of clay bricks without SBA and RHA. However, compressive strength of bricks with 5% of SBA and RHA satisfied the Pakistan Building Code requirements (i.e. >5 MPa). Scanning electron microscopy (SEM) analysis confirms the porous microstructure of the brick specimens incorporating SBA and RHA, which resulted into lesser unit weight leading to lighter and economical structures. Furthermore, resistance against efflorescence was improved in all the tested bricks incorporating SBA and RHA. Based on this study, it can be concluded that the brick specimens incorporating lower dosage of SBA and RHA (i.e. 5% by clay weight) will not only relieve the environmental burden but also result into a more sustainable and economical construction.

T.Subramani and M.Prabhakaran [2015], Slag is very effective in the design and development of high strength concrete. The main parameter investigated in this study is M35 grade concrete with partial replacement of coarse aggregate by furnace slag by 50% to 60% and by 70%.This paper presents the result of an

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experimental investigation caring out to find the sustainability of furnace slag in concrete and compressive strength, split tensile strength, flexural strength is attained at the age of 7days and 28 days. Durability study on acid attack was also studied and percentage of weight loss is compared with normal concrete. Test result indicates that use of furnace slag in concrete has improved the performance of concrete in strength as well as durability aspect. Slag, the by-product of steel and iron producing processes, has been used in civil engineering for more than 100 years. Furnace Slag, which is also addressed as Steel Slag in this paper, has no pozzolanic activity. The cost optimization is finding out by comparing one m³ of conventional concrete and slag concrete resulting high strength of slag with coarse aggregate replacement. In this project, a study was made to obtain low cost building materials using industrial wastes (welding and furnace slags). The objective of the study is to use these wastes in low-cost construction with adequate compressive strength. The knowledge on the strength and permeability of concrete containing furnace slag could be beneficial in the utilization of these waste materials in concrete work.

Mangesh V. Madurwar, Sachin A. Mandavgane and Rahul V. Ralegaonkar [2014], Application of bio-fuel by-product sugarcane bagasse ash (SBA) as a principal raw material for the manufacturing of bricks was studied. The bricks were developed using the quarry dust (QD) as a replacement to natural river sand and lime (L) as a binder. SBA as a principal raw material was characterized using X-ray fluorescence (XRF), thermo-gravimetric analysis (TGA), X-ray diffraction and scanning electron microscopy (SEM). XRF confirms SBA as a cementitious material. TGA confirms thermal stability till 650□C, whereas SEM monograph shows individual ash with a rough surface and numerous fine pores. Elemental analysis of quarry dust and lime was also carried out using XRF and classic wet test. The physical properties of quarry dust and lime were determined using the laboratory test methods. SBA–QD–L combination bricks were designed and developed in different mix proportions. Physico-mechanical properties of the developed bricks were studied according to recommended standards. The results of the SBA–QD–L bricks were compared with physico-mechanical properties of commercially available burnt clay-and-flyash bricks. It was observed that SBA–QD–L bricks are lighter in weight, energy efficient and meet compressive strength requirements of IS 1077:1992. The bricks also serve the purpose of solid waste management and innovative sustainable construction material. The bricks can be used in local construction especially for non-load-bearing walls.

Richard Onchiri, Kiprotich James, Bernadette Sabuni, Claude Busieney [2014], The provision of housing is a challenge around the world, especially in developing countries. The spiraling growth of population, low Gross National Product and the general lack of purchasing power are factors that contribute to the progressive deterioration of the housing situation in developing economies. This condition in many developing countries necessitates finding appropriate low-cost cost building materials. Building materials such as fired clay bricks, lime and Portland cement require enormous energy input, hence prove to be expensive. The sugar manufacturing industries produce a lot of sugarcane bagasse which is disposed off in an open land (landfill). This ash has pozzolanic properties which can be made use in the construction industry. Pozzolanic materials can be used as a partial cement replacement in the production of low-cost earth building blocks. Ideally, building materials for low-cost housing must be produced from locally available raw materials. The utilization of waste materials in soil stabilization provides a satisfactory solution to some of the environmental concerns and problems associated with waste management. Agro wastes such as rice husk ash, wheat straw ash, nut shell and sugarcane bagasse ash are used as pozzolanic materials for the development of blended stabilizers. This paper presents the use of sugarcane bagasse ash as a partial replacement for cement to stabilize self-interlocking compressed earth blocks (SSIEBs) using various bagasse ash contents. Sugar manufacturing companies are increasing in Kenya in line with Vision 2030, the amount of bagasse produced is expected to increase annually. When dried, sugarcane bagasse acts like fuel since it is composed of natural fibers that can be easily combusted. The resulting pozzolanic ash combined with little OPC can be used to stabilize self interlocking earth blocks. The stabilized earth blocks can be used without burning thereby reducing the amount of embedded energy and saving on fuel which has become scarce.

Sergio Neves Monteiro, Carlos Maurício Fontes Vieira [2014], The main focus was a division into three producing methods: firing, cementing and geopolymerization. Both firing and cementing methods were indicated to consume significant amount of energy and release large quantities of greenhouse gases. Based on these drawbacks and taking into account the need to protect clay resources, it was concluded that geopolymerization seems to be the trend to follow. Most of the reviewedworks on the firingmethod, published since 1987,were related towastes incorporated into clay ceramics. In the present work, starting from previous review articles, additional information was added to extend the knowledge,not covered byZhang, on the

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incorporationofwastes into clay ceramics. The particular case of Brazil, inwhich large and easy to mine clay deposits support an extensive network of ceramic industries, is surveyed. Fuel containingwastes contribute to save infiring energy,while fluxingwastes improve the ceramic properties. At least for the next decades, clay ceramic incorporation seems to be the most realistic solution for recycling industrial wastes in countries, such as Brazil, with vast clay resources.

Giridhar.V [2013], This paper emphasizes the effect of Sugar and Jaggery on strength properties of concrete. The experimentation has been carried out for evaluating the strength properties of concrete using Sugar and Jaggery as admixtures into the concrete composition. Based on the literature, the main function for usage of Sugar and Jaggery is to extend the initial setting time of concrete. Usually these type of admixtures used in the special cases like large piers and long piles. Three different percentages of admixtures (Sugar and Jaggery) are chosen in the experimentation as 0, 0.05 and 0.1% by weight of cement. Finally it was concluded that workability and compressive strength of concrete enhanced when admixtures like Sugar and Jaggery added into the concrete composition.

Lianyang Zhang [2013], Bricks are a widely used construction and building material around the world. Conventional bricks are produced from clay with high temperature kiln firing or from ordinary Portland cement (OPC) concrete, and thus contain high embodied energy and have large carbon footprint. In many areas of the world, there is already a shortage of natural source material for production of the conventional bricks. For environmental protection and sustainable development, extensive research has been conducted on production of bricks from waste materials. This paper presents a state-of-the-art review of research on utilization of waste materials to produce bricks. A wide variety of waste materials have been studied to produce bricks with different methods. The research can be divided into three general categories based on the methods for producing bricks from waste materials: firing, cementing and geopolymerization. Although much research has been conducted, the commercial production of bricks from waste materials is still very limited. The possible reasons are related to the methods for producing bricks from waste materials, the potential contamination from the waste materials used, the absence of relevant standards, and the slow acceptance of waste materials-based bricks by industry and public. For wide production and application of bricks from waste materials, further research and development is needed, not only on the technical, economic and environmental aspects but also on standardization, government policy and public education related to waste recycling and sustainable development.

Sofia A. Lima, Humberto Varum [2012], The cultivation of sugarcane and production of its derivatives are closely linked to Brazil's history and development. The factory managers face the problem of discarding the sugarcane bagasse ash (SBA), as these ashes are the final waste resulting from the industrial processes, with no possibility to reduce it. The objective of this study is to analyze the effect of adding SBA to compressed earth blocks (CEBs). Two sets of blocks were prepared with 6% and 12% of cement in addition to the earth and with the addition of SBA at ratios of 0%, 2%, 4% and 8% each. Compressive strength and absorption tests were performed on the blocks. Additionally, masonry prisms were produced with the set of blocks that showed the best preliminary test results. The results showed that the SBA can be incorporated into the CEBs and masonry without damage to the mechanical properties.

S.R. Karade [2010] A large quantity of lignocellulosic wastes is generated worldwide from various sources such as agriculture, construction, wood and furniture industries leading to environmental concerns. Use of these wastes in making cement-bonded construction materials can reduce the magnitude of the problems. However, in this effort there are various restraints like compatibility of these wastes with cement, their toxicity, and limited composite strength. This paper reviews the results of recent research into the use of these wastes in making cement-bonded composites used as building materials. The approaches like pre-treatments, use of chemical admixtures and modified manufacturing process, adopted to overcome the aforementioned drawbacks are described. The benefits and limitations of the use of such materials in building are also discussed.

Mangesh V Madurwar, Sachin A Mandavgane, and Rahul V Ralegaonkar , Sugarcane bagasse ash (SBA), which is otherwise landfilled, was utilized to develop construction material that serves a purpose of disposal of solid waste management and energy efficient alternate construction material. SBA was characterized using particle size distribution, scanning electron microscopy (SEM), X-ray fluorescence (XRF), X-ray diffraction (XRD), and thermo-gravimetric analysis (TGA). SEM monographs show the rough surface with plenty of fine pores. XRF, XRD, and physicochemical properties of the SBA prove its suitability as a pozzolanic or cementitious material. TGA confirms thermal stability till 650°C. On the suitability of principal raw material,

SBA–quarry dust (QD)–lime (L) bricks were developed with a constant composition of lime (20% by weight) and tested for physicomechanical (weight, dry density, water absorption, efflorescence, and compressive strength), functional (thermal conductivity, k), durability (chloride, sulphate, and carbonation), and environmental [toxicity characteristics leaching protocol (TCLP)] properties as per recommendations. The developed (SBA-QD-L) bricks were further analyzed for technical feasibility with commercially available and accepted masonry products like clay and fly ash bricks. The experimental results showed that the SBA-QD-L combination brick is lighter in weight, durable, nonhazardous, energy efficient, has lower k value, and meets the necessary physicomechanical properties of the standards.

CONCLUSION

The study until now was performed on stabilizing compressed earth block and predicting the strength of compressed cement earth block prepared with bagasse. Many researchers tried the different percentage of SBA to achieve the strength and its effect on the strength. they where replacing the sand used in the compressed block but further study gives a new perspective by replacing cement with some percentage and also adding molasses as an part of compressed earth block

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