

## A Review Paper on Eco-Bricks

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**ABSTRACT:-** Nowadays, brick was one of the most common masonry units used as a construction material in the construction industry. Therefore, the growing population in the building materials industry, especially in the last decade, led to huge demand. Recycling of waste materials such as fly ash, marble sludge, granite sludge, stone sludge, ceramic sludge, plastic, coal and wheat bran, sawdust, sugarcane bagasse (SBA), rice husk ash (RHA), residual coal, etc. Instead of fertile soil, there are alternatives to raw materials that can contribute to the depletion of natural resources.

We should perform many laboratory tests on eco brick which is made from clay, lime, boiler ash, sludge, with Alkali Activation Technology. The tests performed on brick is compressive strength, soundness test, hardness test and water absorption test. Eco- brick is more effective than traditional brick, it reduces the soil erosion reuse industrial waste sludge (i.e., waste water sludge). Boiler ash occurred from thermal power plant, paper mills, etc. Boiler ash is commonly available.

**Keywords:** Eco-bricks, Alkali Activation Technology.

### I. INTRODUCTION

Eco-bricks are a method of remodeling soil, boiler ash, sludge, lime, NaOH. Boiler ash is produced by small to medium factories such as paper mills when they burn inexpensive materials for energy production. Therefore, an environmentally friendly brick building was needed to address the conservation of non-renewable resources, improve biological health and safety with environmental matters, and reduce waste disposal costs. We are in additional use of industrial sludge, boiler ash, lime, NaOH, clay which was reused and recycled material, it was environmentally friendly and sustainable development. After that, we prepare a well-burnt clay brick. We experiment differently on eco-brick and traditional bricks. India was the

2nd largest country in the world to manufacture brick. India produces bricks using traditional methods with over 125,000 registered/unregistered clay brick kilns, meeting an annual demand of over 250 billion bricks. As a result, it becomes a major issue of environmental concern.

Due to its uselessness in most applications, it ends up in landfills where there are serious hazards to the environment and human health. Apart from finding a way to reuse boiler ash, it also took the opportunity to address another environmental issue in India - the production of clay-fired bricks. On top of the need for topsoil for production, degrading agricultural land, the clay-fired bricks manufacturing process causes air pollution and requires significant energy consumption, with bricks removed at a temperature of 1000 °C are given. Workers have to endure these bad jobs even at low wages. As a solution to both problems, eco-bricks were developed: masonry using boiler ash and alkali activation techniques. The bricks have been subjected to various tests, including mechanic resistance under compression, durability, and water absorption, all with promising results. Housing is a basic requirement. Owning a house is a problem for most people in India due to the expensive cost of construction. The need for locally manufactured construction materials has been emphasized in many countries of the world. There is an imbalance between traditional construction materials as well as expensive traditional construction materials.

Clay bricks are being used extensively and the most important building material in the construction industry. The construction industry in India consumes about 20000 million bricks for its production and 27% of the total natural energy consumption. In addition, the clay bricks available in some areas tend to be poor in quality and have low compressive strength, high water absorption, high conductivity, etc., which forced engineers to look for better materials capable of reducing the cost of construction. Have done Bricks are masonry units

made of inorganic non-metallic materials and are widely used as construction components throughout the world. Bricks can be sun-dried, kiln burner, and oven-dried. Burned bricks are generally stronger than dried bricks, especially if they are made of clay or clay material. There are different categories of bricks, depending on the mixture and raw materials used to make the bricks. It also contains a mixture i.e., NaOH which acts as an alkali activation technique, mixed in burnt brick raw mixtures to produce various effects in the finished product. Logically, the unlimited use of soil is detrimental to society, as all traditional clay bricks depend on good quality soil available from agricultural areas. This disintegrates the environment due to massive exploration and the degradation of naturally existing resources. To improve sustainability and

## II. LITERATURE REVIEW

**Shriram Marathe, Mithanthaya I R., Sahithya S. Shetty**

The key conclusions of the present laboratory investigation and statistical investigations carried out on the strength performance of alkali-activated concrete specimens are summarized here. The compressive strength of alkali activated mixes produced using industrial waste materials show a significant scope for further study towards replacing the conventional OPC based concrete applications. The strengths are very high compared with similar mixes produced using OPC based concrete. The early gain in strength is also good when compared with its counterpart. However, the AAC produced using glass powder shown a little smaller gain in strength when compared to the slag-fly-ash based mix, but the 28-day strength gain is almost similar. Thus usage of glass powder also shown a promising future as an alternative binder material in producing AAC of desired strength. For, alkali activated concrete, it can be stated that the 28 days cylinder compressive strength is almost 90% of that of the cube strength, which is greater than that of OPC based concrete. The statistical models developed between the strength and cylinder compressive strength were showing good positive linear correlation. These models could be used in predicting the unknown strength, provided one strength is known. However, the experimental investigations were extended to study the tensile behavior by subjecting the specimens to bending and split tension test. The durability aspects of this alkali-activated concrete can also be subjected to acid and sulfate environment. The investigation is yet complete. If the outcomes are positive, it can be confidently stated that the slag-fly ash-glass powder based

environmental protection and in recent years has gained importance in our society. Our world is facing a severe crisis of overpopulation. Various types of by-products generated from various sources like commercial, household, industry, hospitals, public places, etc. have accumulated in huge quantities in recent years. Which causes pollution explosion. To overcome this problem of environmental degradation and regular discharge of large quantities of solid waste .The present work discusses the preparation of bricks from solid waste and the innovation tested against fire and other strength properties. This research paper has been shaped with the idea of "use of value from waste" in the construction sector for casting bricks using different types of waste materials.

alkali-activated concrete will successfully be utilized as a sustainable and environmentally gracious alternative material for normal-conventional concrete formed utilizing ordinary Portland cement as the binder.

**A M Saleh, M N Rahmat and N Ismail**

Utilizing locally available waste materials as target materials for development of unfired bricks give promising idea of cradle to cradle sustainable .construction components regeneration. In this study approved that most of the SWPS bricks able to reach minimum requirement at 5,000kN/m<sup>2</sup> even at the early strength development except SWPS stabilized with HL. Hence the compressive strength for all bricks were developed steadily until the end of curing period duration at 365 days. Long curing period (weeks and months) are required for the newly formed minerals binding to provide notable ongoing benefit of strength increment. This is due to increased Pozzolana reaction between lime and clay fractions. It is recognized that the principal cementitious product of Pozzolana reactions is calcium-alumino-silicate-hydrate (C-A-S-H) gel. The strength development of lime-clay material may be attributed to either the gradual crystallization of C-A-S-H gel or to its continued formation, without necessarily developing a crystalline structure, but blocking pores and providing strength as it develops. The use of GGBS is an added advantage since GGBS has less environmental burdens relative to the lime or PC. Its manufacture involves only a fraction of the energy used and not as much of CO<sub>2</sub> emission compared to either PC or lime. In terms of the applicability of GGBS-based stabilizers for construction or stabilization, the performance of the stabilized material has recently been well established. However, in terms of building

components, the current research is among the pioneering endeavors to utilize GGBS in building applications besides in concrete

**José G Ascencio, Natalia Fuentes, Tatiana S Britto**

The present investigation makes a contribution, because it raises new strategies for the handling of biosolids from wastewater treatment plants, pondering in general terms as a replacement agent its use in the elaboration of eco-bricks, which represents important environmental benefits, since it reduces the polluting of organic origin (nutrients, organic matter and pathogens) at the time of the cooking of ceramic materials and besides encapsulating, the heavy metals that may be present in this waste, avoiding like this, its wrong handling and inadequate final provision; posing with this, a safer use, at the same time it reduces the consumption of clay. Verifying that the introduction of biosolids does not interfere in the conformation of the material during the molding and pressing process, however after the thermal process, a material with a higher degree of shrinkage is obtained, greater porosity and therefore greater capacity to absorb water, which allows inferring that these materials present a tendency weathering and to hydration, whereby it is suggested to locate them in preferential places compared with commercial bricks elaborated without the use of biosolids. The present investigation makes a contribution, because it raises new strategies for the handling of biosolids from wastewater treatment plants, pondering general terms as a replacement agent its use in the elaboration of eco-bricks, which represents important environmental benefits, since it reduces the polluting of organic origin (nutrients, organic matter and pathogens) at the time of the cooking of ceramic materials and besides encapsulating, the heavy metals that may be present in this waste, avoiding like this, its wrong handling and inadequate final provision; posing with this, a safer use, at the same time it reduces the consumption of clay. Verifying that the introduction of biosolids does not interfere in the conformation of the material during the molding and pressing process, however after the thermal process, a material with a higher degree of shrinkage is obtained, greater porosity and therefore greater capacity to absorb water, which allows inferring that these materials present a tendency weathering and to hydration, whereby it is suggested to locate them in preferential places compared with commercial bricks elaborated without the use of biosolids.

**Min-Hsin Liu, Cyuan-Fu Tsai, Yi-Le Hsu**

This feasibility study demonstrates that the LGSC from the solar industry and granite sludge can be used to substitute clay in brick fabrication. When LGSC and granite sludge are introduced in bricks fabrication, the quantity of LGSC addition increases, the water absorption of brick increases, and the compressive strength decreases. However the bricks sintered from silt loam show a significant advantage in compressive strength than bricks made from clay loam. The addition of BWC increases the grades of the bricks to the Class 2 standards. The brick samples made from silt loam also show a sharp increase in grade levels. When granite sludge is adopted by brick making, the bricks do not meet the standards of Grade 3 bricks when the composition ratio of granite sludge is above 30%, the addition of 5% BWC is increased insignificantly of brick grade when granite sludge is adopted.

**M. Ezzat, H. M. Khater, Abdeen M. El NAGAR**

This research has been performed with the general goal of synthesizing slag/grog Geopolymer brick as well as investigating its physical, mechanical and micro-structural characteristics. The major findings of this work are summarized as follows: It was found that partial replacement of slag by grog, up to 40%, in Geopolymer brick specimens with molar Si/Al ratio 3: 3.9 effectively increased compressive strength, enhanced micro structural properties and formed compact geopolymer structures, as it increased the rate of Geopolymerization reaction. Geopolymer brick specimens formed by replacement of slag by grog with a ratio of 40% to 100% and with molar Si/Al ratio > 3.9, resulted in a decline in the binding characteristic of Geopolymer and formed a less dense structure. It was concluded that the Geopolymer brick specimens produced from the substitution of slag with grog up to 40% can compete with the fired clay brick both mechanically and physically, in yielding compressive strength values that exceeds 40 MPa, heavy duty bricks which can be used in severe weather conditions ASTM- C62. The produced Geopolymer bricks possess more than 90% reduction in carbon dioxide as compared with other traditional clay bricks. The effect of curing Geopolymer up to 90 days for specimens with replacement of slag by up to 40% grog was found to enhance the mechanical properties by approximately 30% than those cured for 28 days.. The water absorption of all the produced Geopolymer bricks ranged between 11 to 16%

lower than required for the severe weather clay bricks, according to ASTM-C62.

**Mohammed Yaseen, RavitejM Bandlekar, Mr. Pruthviraj Mr. Shrinivas**

In the present study various trial mixes were made and moulded bricks were casted using the solid waste components like waste glass, waste plastic, fly ash, bed ash, and some percentage of cement in various proportions and its compressive strength, falling tests, shape test, water absorption. The following are the conclusions of this study Compressive strength was being obtained for different ratios by fly ash partially replacing cement in the different ratios 8:2,4:6,6:4, and 2:8 and the compressive strength obtained for these ratios at 28 days of curing are 7.4N/mm<sup>2</sup>, 5.45 N/mm<sup>2</sup>, 3.21 N/mm<sup>2</sup>, 3.124 N/mm<sup>2</sup> respectively. From the above conclusions it can be said that the trial mix ratios of partial replacement of fly ash with cement 8:2,6:4 has crossed the average compressive strength of standard brick of strength 3.5 N/mm<sup>2</sup> for 28 days. Hence it can be concluded that since the mortar mix 8:2 contains more part of cement. The trail mix ratio of 6:4 i.e 6 parts of cement along with 4 parts of flyash can be effectively used as a mix along with fractions of inorganic solid waste in the manufacture of bricks fractions as coarse aggregate and using different plastics other than LDPE and HDPE and different fly ash ratio under different proportions. Further experimentation can be made by adding suitable admixtures the curing period can be decreased.

**B.Dhanalaxmi, K.N.Sujatha, E.Rakesh Reddy**

The consequences of the present study conducted has proven that the brick making methodology effectually acceptable for solid waste (Paint sludge) and material (cement, quarry dust, and fly ash). Bricks were hardened within 2 days from manufacture time. Mixed binders (cement, fly ash and quarry dust) brick is recommended for external use in construction. This study also concludes that the construction raw materials can be replaced with industrial waste by products during manufacturing in some extended composition to increase the environmental safety. Compared to normal brick paint sludge brick is light in weight and transportation will be easy. The demand for the constructional materials has been rapidly increasing with the needs of construction both in rural and urban areas. These bricks are the sustainable, economical and eco-friendly building

material. Bricks which are made from the paint waste is found to have compressive strength is greater than the conventional bricks. It is observed that when amount of cement is increased, strength also increases. When the strength is depends on the size of the particle, increases the strength by reducing the size of the particle.

**B. Aravindhhan , J. Arniha, S. Ganeshkumar, C.Gayathri, S. Mohansundari**

Based on the above experimental procedure and test, we conclude as; Use of fly ash, quarry dust in brick can solve the disposal problem, reduce cost and produce a Eco-friendly brick for constructions. The compressive strength of bricks named as I is 3.13N/mm<sup>2</sup>, II is 3.60N/mm<sup>2</sup>, III is 2.79N/mm<sup>2</sup>, IV is 6.24N/mm<sup>2</sup>, V is 5.07N/mm<sup>2</sup> and VI is 3.10N/mm<sup>2</sup>. Hence we strongly recommend that in fully replacement of clay method brick IV has a good compressive strength and suitable for non-load bearing wall constructions Environmental effects of wastes and disposal problems of waste can be reduced through this brick manufacturing process. This study helps in converting harmful fly ash in to bricks and make it valuable. From this research, maximum compressive strength of correct proportion by alkali activation technology is obtained. The expected cost of bricks can be reduced.

**S. Madan Raj, M.Nandha Gopal, T. Palani Kumar, G. Guru prasad, Sofia Rajesh M.E**

From this investigation, the following conclusions can be derived on the basis of the tests: A Eco brick consists of recycled material and therefore cost is low compared to conventional bricks. Eco bricks can be easily moulded into any shape, bricks are much easier for someone to lift to any desired height and very good surface finish can be achieved. Eco bricks has good fire resistance. The weight of this brick is almost 2/3rd of conventional clay brick. Due to less weight of these bricks, the total dead load of the building will be reduced. These bricks are potentially ideal material for earthquake prone areas as they are lightweight and flexible. This research is just an initiation to Eco bricks study. However, further studies are required on following issues: Modification of mix proportions to achieve optimum properties. Addition of materials like bottom ash & some binding materials to improve compressive strength of Eco bricks. Colour and texture for better aesthetics and design versatility. Due to our project, the society should be clean and reduce the landfill waste.

### **Akshaita Saini, Abhinav Aggarwal**

Based on above experimental work it has concluded that materials like fly ash, paper bricks, marble waste and tile powder can be efficiently be used as brick ingredients. It is better to utilize these waste materials. Paper bricks have the ability to produce a light weight and eco-friendly bricks by using less number of natural resources. Compression test shows that the paper bricks are acceptable for non-load bearing walls i.e. they can be used for partition wall. As per the research, the paper brick should not absorb water more than 20 % by weight. Hence, the paper bricks are not suitable for water logged areas and external walls. However, by providing a water proof coating it can be used as in external wall. Due to its less weight and flexibility, these bricks are potentially ideal material for earthquake prone areas. Paper bricks have moderate fire resistance and good sound absorbance. Paper bricks don't expand or shrink hence sheet of glass or glass block can be fixed. Tile bricks increase the durability and performance. It minimize the cost and environmental hazards. Marble bricks compressive strength increases with increase in marble powder. Due to their smooth finishing and perfect shape and size, thin plaster coating is required so they also reduce the cost of plaster. Fly ash bricks help in saving cement mortar thus helpful in making the walls and plastering by 20-40%. Plaster of Paris, putty can be applied directly without the cost of plaster. By using all these eco-friendly bricks a cost reduction of 20-30% was observed. Brick manufactured by these materials leads to good utilization of waste powder of tile, marble, fly ash and recycle paper mill waste. Its application for the sustainable development of the construction industry is the most efficient solution and also addresses the high value application of such waste. Since the waste materials are used, they will reduce land fill as well as land pollution.

### **Manisha, Navinderdeep Singh**

PET bottles which are usually considered as waste can be used as bottle bricks. These bricks are light in weight, easy to make and provide greater durability as well as strength properties. As the bottles are water resistant hence problem of dampness will be avoided. Bottle bricks provide cost efficiency. These bricks are 5.54 Rs. Cheaper in comparison to the conventional bricks. Unit weight of the bottle bricks is also less than conventional bricks. On the other hand the bottle bricks emit CO<sub>2</sub> during its production therefore use of bottle bricks can help in the preservation of the

environment. Utilization of PET bottle bricks is Bio-Climatic and hence is a green construction.

### **Rose Enid Teresa A, Uma Magesvari M, Yugasini S and Muthaiyan P.**

Use of Bagasse ash and industrial sludge in brick can solve the disposal problem; reduce cost and produce a 'greener' Eco friendly bricks for construction. A better measure by an innovative Construction Material is formed through this research. In this paper, different proportions of the industrial wastes and bagasse ash were added as a partial replacement for clay in the production of Eco bricks and the results were compared with the conventional clay bricks. An addition of bagasse ash and industrial sludge in the proportion of [15% ash-5% sludge] causes more water absorption, increases the compressive strength and provide hardness when under burnt. The hardness property and the soundness property of the bricks were also achieved. It is recommended to use partial replacement of clay by 15% of Bagasse ash and 5% of industrial sludge for good quality Eco Bricks. This study helps in converting the non-valuable Bagasse ash and industrial sludge into bricks and makes it valuable.

### **Hanisom Abdullah, Ahmad Kamil Jamaai**

In this study, several conclusions can be drawn from the data. Firstly, from the SEM data the addition of kenaf fibre matrix in concrete bricks increased the pore formation in the brick microstructures that in turn seemed to affect its water absorption capacity and mechanical strength. The water absorption capacity of eco-bricks is increased with the increased of kenaf fibre. The flexural strength of the eco-bricks is negatively correlated with the kenaf fibre amount in the matrix. The data suggests that according to the ASTM C73 standard guideline, the eco-bricks produced from 0.5-1.5% are mostly suitable to be utilized in moderate weather conditions. Although further technical improvement is still needed for the prototypes to pass all the ASTM C73 specifications, the results shed potential R&D of eco-bricks from kenaf fibres as a significant strategy to reduce global green house gases emission in housing and manufacturing sector.

### **Antonella Petrilloa , Raffaele Cioffia , Claudio Feronea , Francesco Colangeloa , Claudia Borrellia**

This study highlights that the use of C&D waste for making paving blocks will address sustainable issues such as the resource conservation and conversion of by-products to useful and

valuable products. As a second point, it's clear that the alkali activators cause high CO<sub>2</sub> inventories because the production process involves the calcinations of carbonates. Hence, the CO<sub>2</sub> footprint of the geopolymer concrete paving blocks is dependent on the type, concentration, and dosage of the alkali activators. As a result, it's a clear need to focus on further research using admixtures characterized by different solution and precursor ratio and consequently analyze and compare their environmental impacts.

#### **Uche Emmanuel Edikel ,Adegboyega Sunday Sotunbo2 and Hosea Shemang Yohanna1**

The purpose of this study was to investigate the use of waste plantain fibre and Sky 504 in the production of eco-bricks by assessing their effect on bulk density, compressive strength and water absorption of brick specimens. Six mixes were designed and tested. Four of the mixes were made of four different fibre content and the feasibility of utilizing plantain fibres as reinforcement in eco-brick was assessed successfully. From the results obtained the following conclusions were drawn: The compressive strength of eco-bricks produced in this study show a decreasing tendency with the increase of plantain fibre content. It is speculated that the bonding of aggregates-plantain fibre in eco-brick is weak compared to the bonding of aggregates-aggregates in the control ecobricks (EBC) samples. The study also found that ecobricks produce with plantain fibre and master glemium sky 504 have a very good strength and water absorption properties and can be used in construction. In addition, the failure mode of the control samples and the samples with sky 504 without plantain fibre were virtually without warning. In contrast, the eco-bricks produced with plantain fibres failed with the appearance of fine cracks at the surface of the specimens. The study found that sky 504 affects the early development of eco-brick strength but has no considerable effect on the late strength. Hence eco-bricks prepared with super plasticizers such as sky 504 should be allowed adequate curing period before use and loading. Also, plantain fibre content up to 1.0% enhances the early compressive strength development of eco-bricks, but beyond the 1.0% plantain fibre content the compressive strength of eco-brick manufactured with plantain fibre and sky 504 degrades.

#### **John Rogel S. Ursua**

The findings of this study were anchored from the testing conducted through the utilization of non-hazardous wastes such as plastics, crushed

glass bottles, and shredded paper in making sand brick as eco-building and construction material. This study aimed at the possibility of using these materials in making effective and quality sand bricks as non-load-bearing masonry material. Based on the results, all the sand brick specimens surpassed the minimum requirement of 500 psi (3.45 MPa) for individual brick according to ASTM C129. Also, this study revealed an excellent performance since specimens gained less than twenty percent (20%) of water absorption on the different sand brick specimens after the water absorption test. Moreover, the result showed that, as the percentage of plastic wastes increases, the percentage of water absorption decreases. Also, all the sand brick specimens were classified as "Slight" ( $\leq 10\%$ ) after the efflorescence test was performed. Finally, there was a very light impression left on the sand brick surfaces with the aid of common nail on the bricks after the hardness test was performed. Thus, this study on creating sand bricks from non-hazardous wastes has a great possibility in employing as an alternative building and construction material for a non-load-bearing wall as well as an effective solution in fighting the problem on reducing the effect of solid wastes.

#### **Aditya Jha, Manvendra Singh Rana, Nishant Kumar Jha**

The technique of using waste PET bottles as bricks has become popular in low income communities around the world. Reusing the plastic bottles as the building materials can have substantial effects on saving the building embodied energy by using them instead of bricks in walls and reducing the CO<sub>2</sub> emission in manufacturing the clay Brick. PET Bottles also have a durability of more than 300 years which is more as compared to the standard bricks and these bricks are very thick. It is Eco-friendly as we make use of the waste materials in the project and which does not cause any harmful to the environment. 90% increase in load carrying capacity of Eco-Bricks was observed compared to conventional bricks whereas Composite Eco-Bricks and Eco-Brick Prism shows only 12 % increase in strength than the conventional one. Therefore, it can be used in low rise building, temporary structures and for compound walls and cannot be used for high rise buildings. From the test results it can be concluded that the strength of Eco-Brick is more when compared to the conventional one. Thus we can conclude that using the concept of Eco-Bricks is cost effective, energy efficient and commercially feasible.

**DwiAriyani , NikenWarastuti , Resti Nur Arini**

Eco-bricks are the most effective solution to overcome the reduction of plastic waste that can damage the environment. From the compressive strength test results, eco-bricks which contains sand + plastic shows a higher result that is 41.2 MPa when compared with red bricks that is 27 MPa and the concrete bricks building is 38 MPa. Eco-bricks are able to receive a greater burden than the bricks and concrete bricks. Eco-bricks can be used as non-structural material.

### III.CONCLUSION

The different materials used to make eco-brick and successfully conclude results. In a study of Research on Eco-friendly Alkali Activated Concrete Incorporating Industrial Wastes, the strong performance of alkali-activated concrete specimens is summarized here. The compressive strength of alkali-activated mixes produced using industrial waste materials shows significant scope for further study towards replacing the conventional OPC-based concrete applications.

The strengths are very high compared with similar mixes produced using OPC-based concrete. The early gain in strength is also good when compared with its counterpart. However, the AAC produced using glass powder shown a little smaller gain in strength when compared to the slag-fly-ash-based mix, but the 28-day strength gain is almost similar. Thus, usage of glass powder also showed a promising future as an alternative binder material in producing AAC of desired strength.

The alkali-activated concrete, it can be stated that the 28 days cylinder compressive strength is almost 90% of that of the cube strength, which is greater than that of OPC-based concrete. The experimental investigations were extended to study the tensile behaviour by subjecting the specimens to bending and split tension tests. The durability aspects of this alkali-activated concrete can also be subjected to an acid and sulfate environment.

The outcomes are positive, it can be confidently stated that the slag-fly ash-glass powder-based alkali-activated concrete will successfully be utilized as a sustainable and environmentally gracious alternative material. In the study of SWPS ECO Bricks: Development of Sustainable Brick Utilizing Solid Waste Fly Ash and Paint Sludge, In this study approved that most of the SWPS bricks able to reach minimum requirement at 5,000kN/m<sup>2</sup> even at the early strength development except SWPS stabilized with HL.

Hence the compressive strength for all bricks was developed steadily until the end of the curing period duration at 365 days. This is due to increased Pozzolana reaction between lime and clay fractions. It is recognized that the principal cementitious product of Pozzolana reactions is calcium-alumino-silicate-hydrate (C-A-S-H) gel. The strength development of lime-clay material may be attributed to either the gradual crystallization of C-A-S-H gel or to its continued formation, without necessarily developing a crystalline structure, but blocking pores and providing strength as it develops.

In terms of building components, the current research is among the pioneering endeavors to utilize GGBS in building applications besides in concrete. Eco-Bricks: A Strategy for the Use of Wastewater Biosolids. Verifying that the introduction of biosolids does not interfere in the conformation of the material during the molding and pressing process, however after the thermal process, a material with a higher degree of shrinkage is obtained, greater porosity and therefore greater capacity to absorb water, which allows inferring that these materials present a tendency weathering and to hydration, whereby it is suggested to locate them in preferential places compared with commercial bricks elaborated without the use of biosolids.

Feasibility Study on Using Low-Grade Silicon Carbide and Stone Sludge to Fabricate Eco Bricks, The addition of BWC increases the grades of the bricks to the Class 2 standards. The brick samples made from silt loam also show a sharp increase in grade levels. , the bricks do not meet the standards of Grade 3 bricks when the composition ratio of granite sludge is above 30%, the addition of 5% BWC is increased insignificantly of brick grade when granite sludge is adopted. Enhanced characteristics of alkali-activated slag/ grog geopolymer bricks, This research has been performed with the general goal of synthesizing slag/grog Geopolymer brick as well as investigating its physical, mechanical, and microstructural characteristics.

Strength Characteristics Of Eco-friendly Cement Bricks Using Solid Waste Composites. Compressive strength was being obtained for different ratios by fly ash partially replacing cement in the different ratios 8:2,4:6,6:4, and 2:8 and the compressive strength obtained for these ratios at 28 days of curing. the manufacture of bricks fractions as coarse aggregate and using different plastics other than LDPE and HDPE and different fly ash ratios under different proportions.

In the study of Utilization of Solid Waste to Produce Eco-Friendly Bricks, the present study conducted has proven that the brick-making methodology effectually acceptable for solid waste (Paint sludge) and material (cement, quarry dust, and fly ash). Bricks were hardened within 2 days from manufacture time. Mixed binders (cement, fly ash, and quarry dust) brick are recommended for external use in construction. These bricks are a sustainable, economical, and eco-friendly building material.

Bricks that are made from paint waste are found to have compressive strength is greater than conventional bricks. It is observed that when the amount of cement is increased, strength also increases. In an Experimental study on eco-Blac bricks, Use of fly ash, quarry dust in brick can solve the disposal problem, reduce cost, and produce an Eco-friendly brick for construction. The compressive strength of bricks gives in N/mm<sup>2</sup>. Environmental effects of wastes and disposal problems of waste can be reduced through this brick manufacturing process. This study helps in converting harmful fly ash into bricks and makes it valuable.

From this research, maximum compressive strength of correct proportion by alkali activation technology is obtained. An Experimental Study on the Strength & Characteristics of Eco-Bricks from Garbage Dump, Eco brick consists of recycled material, and therefore cost is low compared to conventional bricks the society should be clean and reduce the landfill waste. The texture and color of garbage and the Addition of materials like bottom ash & some binding materials to improve the compressive strength of Eco bricks.

Eco: Friendly bricks, experimental work it has concluded that materials like fly ash, paper bricks, marble waste, and tile powder can be efficiently be used as brick ingredients. It is better to utilize these waste materials. Paper bricks can produce lightweight and eco-friendly bricks by using less natural resources. A fly-ash brick helps in saving cement mortar thus helpful in making the walls and plastering by 20-40 %. Plaster of Paris, putty can be applied directly without the cost of plaster.

By using all these eco-friendly bricks a cost reduction of 20-30% was observed. Investigating strength and Properties of ecoladrillo:eco-bricks, these bricks are light in weight, easy to make, and provide greater durability as well as strength properties. As the bottles are water-resistant hence problem of dampness will be avoided. These bricks are 5.54

Rs. Cheaper in comparison to the conventional bricks. Unit weight of the bottle bricks is also less than conventional bricks. On the other hand, the bottle bricks emit CO<sub>2</sub> during their production therefore use of bottle bricks can help in the preservation of the environment.

Eco Bricks from Industrial Wastes such as Tannery Sludge and Sugarcane Bagasse Ash, Eco-friendly bricks for construction. A better measure by an innovative Construction Material is formed through this research. In this paper, different proportions of the industrial wastes and Bagasse ash were added as a partial replacement for clay in the production of Eco bricks, and the results were compared with the conventional clay bricks. An addition of Bagasse ash and industrial sludge in the proportion of [15%ash-5%sludge] causes more water absorption, increases the compressive strength, and provides hardness when under burnt. The hardness property and the soundness property of the bricks were also achieved. It is recommended to use partial replacement of clay by 15% of Bagasse ash and 5% of industrial sludge for good quality Eco Bricks.

In the study of Properties of Eco-Brick manufactured using Kenaf Fibre as a matrix, Firstly, from the SEM data, the addition of kenaf fiber matrix in concrete bricks increased the pore formation in the brick microstructures that in turn seemed to affect its water absorption capacity and mechanical strength. The water absorption capacity of eco-bricks is increased with the increase of kenaf fiber. The data suggests that according to the ASTM C73 standard guideline, the eco-bricks produced from 0.5-1.5% are most suitable to be utilized in moderate weather conditions.

Although further technical improvement is still needed for the prototypes to pass all the ASTM C73 specifications, the results shed potential R&D of eco-bricks. In research of this Eco-sustainable Geopolymer concrete blocks production process, the use of C&D waste for making paving blocks will address sustainability issues such as the resource conservation and conversion of by-products to useful and valuable products. Hence, the CO<sub>2</sub> footprint of the geopolymer concrete paving blocks is dependent on the type, concentration, and dosage of the alkali activators.

According to a study Sustainable eco-bricks manufactured using plantain fiber and masterglenium sky 504; six mixes were designed and tested. Four of the mixes were made of four different fiber content and the feasibility of utilizing plantain fibers as reinforcement in eco-brick was assessed successfully. Hence eco-bricks



prepared with super plasticizers such as sky 504 should be allowed an adequate curing period before use and loading. Also, plantain fiber content up to 1.0% enhances the early compressive strength development of eco-bricks, but beyond the 1.0% plantain fiber content the compressive strength of eco-brick.

In the study of Utilization of Plastic Wastes, Glass Bottles, and Paper in Sand Bricks as Eco-Building Materials, this study was anchored from the testing conducted through the utilization of non-hazardous wastes such as plastics, crushed glass bottles, and shredded paper in making sand brick as eco-building and construction material. This study aimed at the possibility of using these materials in making effective and quality sand bricks as non-load-bearing masonry material.

Based on the results, all the sand brick specimens surpassed the minimum requirement of 500 psi (3.45 MPa) for individual brick according to ASTM C129. Also, this study revealed an excellent performance since specimens gained less than twenty percent (20%) of water absorption on the different sand brick specimens after the water absorption test. Moreover, the result showed that, as the percentage of plastic wastes increases, the percentage of water absorption decreases. Also, all the sand brick specimens were classified as "Slight" ( $\leq 10\%$ ) after the efflorescence test was performed. Finally, there was a very light impression left on the sand brick surfaces with the aid of a common nail on the bricks after the hardness test was performed.

In the Research article waste plastic bottle bricks, the plastic bottles as the building materials can have substantial effects on saving the building embodied energy by using them instead of bricks in walls and reducing the CO<sub>2</sub> emission in manufacturing the clay Brick. the project and which does not cause any harm to the environment. A 90% increase in the load-carrying capacity of Eco-Bricks was observed compared to conventional bricks whereas Composite Eco-Bricks and Eco-Brick Prism show only a 12 % increase in strength than the conventional one.

Thus we can conclude that using the concept of Eco-Bricks is cost-effective, energy-efficient, and commercially feasible. In the study of Eco-bricks Method to Reduce Plastic Waste in TanjungMekar Village, Karawang Regency, From the compressive strength test results, eco-bricks which contains sand + plastic shows a higher result that is 41.2 MPa when compared with red bricks that are 27 MPa and the concrete bricks building is 38 MPa. Eco-bricks can receive a greater burden than bricks and concrete bricks.

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