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PARTIAL REPLACEMENT OF CEMENT WITH RICE HUSK ASH & SUGARCANE BAGASSE ASH: REVIEW PAPER

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ABSTRACT

In response to the growing need for sustainable construction and the growing preference for traditional materials, designers and developers are beginning to embrace alternative materials. One important factor in achieving this objective is the exploitation of agricultural leftovers and industrial waste materials. They also made an effort to assess the concrete's durability and efficacy in their trial. The Indian Standard offers a method for determining the proper blend for standard concrete. This method facilitated the development of a design incorporating sugarcane waste ash and rice waste ash rather than other materials.

Keywords: Rice Husk Ash (RHA), Sugarcane Bagasse Ash (ScBA), Cement replacement, concrete, Advanced Techniques.

INTRODUCTION

The sugar industry and farming yield plentiful supplies of rice husk ash and sugarcane bagasse ash. Electricity generation relies on the utilization of waste products and fuel derived from bagasse biomass. Controlled incineration of this waste will result in the presence of a substance known as amorphous silica within the remaining ash. This material has special qualities that can be used well in construction projects. We have studied and researched whether it is possible to use industry waste instead of cement. The goal of this study is to see how well ashes adhere to various material. These can be substituted for cement to make building materials including mortar, concrete pavers, roof tiles, and blocks. By making these modifications, the materials are upgraded to be both cheaper and of higher quality. After extracting the juice from the sugar cane, we can repurpose the leftover parts such as RHA & ScBA. When rice husks are burned, they turn into a substance known as rice husk ash.

Ash can be incorporated into cement as an additional ingredient. To minimize the discharge of methane during organic waste elimination, it is beneficial to opt for SCBA rather than

conventional cement. Rice husk ash and sugarcane bagasse ash have the potential to replace cement in the production of building materials like mortar, concrete pavers, roof tiles, and blocks. These adjustments will lead to higher quality materials at a lower price. By crushing sugar cane to obtain its juice, we can also obtain useful byproducts such as rice husk ash and sugar cane bagasse from the remaining residue. The process of burning rice husks leads to the creation of rice husk ash.

In construction projects all over the world, concrete holds great importance as it is extensively utilized and highly favored. The mix is made up of cement, both large and small rocks, along with water. The increasing demand for construction materials, insufficient supply, and high energy expenses, contribute to the daily price surge of these materials. Concrete is now being created using unused materials from agriculture, manufacturing, and other origins as opposed to cement. Adding these extra materials to cement has a lot of advantages. By saving energy during the cement production process, it not only reduces costs but also enhances the strength of the cement, while also benefiting the environment by minimizing waste. How durable something is directly relating to the properties of the materials used and the ease with which they can be penetrated. Improving something like this will likely make it endure for a longer time. By incorporating a particular substance called a pozzolanic material into concrete, its overall performance and lifespan can be greatly improved. Silica and aluminum are present in a substance referred to as a pozzolanic material or pozzolan. When the weather is cool and there is water nearby, it combines with lime to create substances that are similar to cement.

It was determined by knowledgeable individuals that the remaining parts of rice and sugarcane can be repurposed in creating items. After being used in agriculture and industry, these parts are often disposed of, but they can now be utilized in building construction. The cooling effect of RHA and ScBA concrete is much more significant than that of regular concrete, making them ideal for lowering the temperature of large concrete structures.

RICE HUSK ASH (RHA)

The combustion of rice husks results in the formation of rice husk ash. The success of rice growing in many Asian countries can be linked to excellent conditions such as good soil, abundant water supplies, and a suitable climate with continuous rainfall. In order to prepare rice for consumption and sale, we employ a device referred to as a fabricating handle, which helps remove the outer coating. The incorporation of rice husk into an oven has been discovered

to have advantages in terms of simplifying the cooking process for a range of foods.. Shown in fig 1.

Fig 1 Rise Husk Ash

Characteristics of Rice Husk Ash (RHA)

The response of pozzolans and waste materials, commonly deemed as worthless, to each other is determined by their silica type and carbon content. Creating unique open debris involves using a technology capable of maintaining a low ultimate temperature and a short upkeep time. Consequently, the garbage will contain a small amount of carbon and will be quite large. It is important to consider the impact of temperature and heating duration on silica in Rice Husk Ash, as it significantly affects its physical and chemical characteristics.

SUGARCANE BAGASSE ASH (ScBA)

ScBA, which stands for Sugarcane Bagasse Ash, refers to the residue left behind when sugarcane is pressed for its juice. The distinctive characteristics of this item render it valuable for diverse applications. The cultivation of sugarcane holds great significance for individuals residing in hot and humid places, as it plays a vital role in their sustenance and maintenance of good health. Producing a large quantity of sugar simultaneously heavily relies on the significance of this particular item. Bagasse, a byproduct of the sugarcane juice extraction process, refers to the remaining material. Bagasse is the term used to describe the leftover fibrous material of sugarcane after the juice has been taken out. The remnants of sugar cane, when burned, produce a type of residue known as bagasse ash. The ScBA is facing issues due to improper disposal methods for their garbage. They are incorrectly placing items and accumulating a large amount of waste. Barroso claims that the production of one ton of sugarcane results in the creation of 280 kg of bagasse waste. Handling means how you use, take care of, or manage something. The act of disposing something off implies the act of getting rid of it through proper disposal methods such as throwing it in the trash or recycling it accordingly. A specific job is done using a special computer program called an application.

Taking advantage of waste materials in concrete creation is of utmost significance in maintaining the well-being of the environment. The cultivation of sugarcane is a significant source of income in South Asia. Recognizing the worth of sugar production and refraining from underestimating it are of utmost importance. (Shown in Fig 2)

Fig 2 The Bagasse of ScBA

CHARACTERISTICS OF ScBA

The height of the sugar cane plant is considerable, and it consists of two distinct layers: an exterior layer and an interior layer. The outer part is constructed with lengthy and slim threads, whereas the interior is composed of shorter threads. There are two types of fiber found in the bagasse. The cells in sugarcane have something called cellulose. Sugarcane consists of cellulose, which accounts for about one-third of its weight. Approximately 40-50% of cellulose and 25-35% of hemicellulose make up the residual sugarcane parts. The other part consists of wax and lignin. Hemicellulose, unlike cellulose, lacks a definite structure and contains carbohydrates such as xylose and glucose. The three components of this thing improve its functionality when combined with other objects. The final phase is stronger than the other two. The strong portion is positioned separately from the other two segments. The presence of hydroxyl groups enables the interaction of molecules, whether internally within a molecule or externally between different molecules.

LITERATURE REVIEW OF RICE HUSK ASH (RHA)

We predict that incorporating ash obtained from rice husks into the concrete will result in a stronger mixture. In an examination, scientists are attempting an alternative technique of combining rice husk ash with concrete, veering away from the usual incorporation of cement.

It has effectively satisfied diverse needs in the context of concrete structures, such as ensuring robustness. There are several aspects that impact the behaviour of rice husk ash concrete. In order to ensure consistent outcomes for our experiments, we will maintain the constancy of these variables.

This project revolves around the utilization of the byproducts caused by incorrect incineration, specifically consisting of rice husk ashes and waste paper sludge. The purpose is to make use of these materials instead of the usual ones, such as concrete, for building objectives. We also wanted to find out if this would change how strong the concrete is. The concrete was tested to see how strong it is when it is compressed and split into pieces. We can control how strong concrete becomes by using the IS mix design method. Additionally, we were interested in determining the potential impact on the concrete's strength. The investigation considered replacement levels across four categories: 5%, 10%, 15%, and 20%. In this research, we examined how long it takes for something to be cured. In our experimentation, we examined time periods ranging between 7- and 28-days multiple times. **[Rasik Fayaz (August 2018)].**

We conducted experiments at four different levels (5%, 10%, 15%, and 20%) to assess the effectiveness of the replacement method. The characteristics of concrete were analysed by scientists once it was combined with cement. We tested how strong and useful concrete is on purpose. The method of choice in India for determining the suitable way to mix regular concrete is the Indian Standard procedure. This technique served as a source of inspiration for the formulation of a mixture design aimed at replacing RHA. **[N Kaarthik Krishna (2016)].** Different amounts of RHA were used instead of OPC, from none at all to 25%. The control group did not have another option given to them. Our objective was to evaluate the adhesive properties of recently poured concrete through the implementation of the Compact Factor test. In addition to measuring strength, our test included evaluating the endurance of concrete cubes when submerged in water. We tested them after 7, 14, and 28 days. It was noticed that the Compacting factor decreased when less OPC and more RHA were used. Using RHA instead of OPC makes the hardened concrete weaker. **[OBILADE, I.O. (September 2014)].** The research examines the impact of replacing some of the conventional cement with rice husk ash on various types of concrete. We used different amounts of RHA instead of OPC, starting from none and going up to 40%. The researchers mainly studied how strong, absorbent, and long-lasting concrete is. This study shows that using RHA instead of OPC, up to 20%, can be a good way to partially replace cement. It stays strong and lasts a long time, showing great strength

when being compressed. **[C. Marthong (August2012)]**. The percentage of substitute materials used ranged from 5% to 20%. Cubes with both standard and unique samples were used in the analysis. We did different tests on these examples. The results of the test showed that lightweight concrete worked well and was in line with what was expected. Adding more ash made the material weaker. Although the strength was deemed adequate, it was still suitable for producing lightweight concrete. According to the passage, by substituting a small portion of the ingredients in concrete, the overall weight of the concrete will decrease. **[D. A. Opeyemi, O. O. Makinde (September 2012)].** This study investigated if it is feasible to use rice husk ash instead of certain materials in concrete. The concrete cubes being tested at present are designated as the Control and Specimen. Between 5 and 20 percent of the specimen cubes' composition was replaced with different materials. This happened when using a mixture of (1:2:4) 1 part cement, 2 parts sand, and 4 parts gravel. Scientists performed various experiments and discovered that by replacing other substances with rice husk ash, the concrete became more robust. Nevertheless, it was noted that optimal outcomes were achieved when the quantity of rice husk ash added remained below the 10% threshold. **[Mohammad Iqbal Malik (February 2015)].** We wanted to understand the characteristics of concrete that has Rice husk ash in it by studying and doing experiments. The study looked at how incorporating rice husk ash into concrete could affect its behavior. They tried out two different levels of replacements: none and 20%. When 20% of the concrete mix was changed to rice husk ash, the concrete became stronger, like having a higher ability to withstand compression, compared to when no rice husk ash was used. We tested the strength of a material by squashing it. They tested two different levels of replacements: one with no replacements at all, and another with twenty percent replacements. The best strength was achieved when 20% of rice husk ash was included, in comparison to not including any at all. The power was checked 14, 21, and 28 days later. **[Arvind Kumar, (July 2016)].** We were curious to experiment with our local Rice Husk Ash in place of expensive Ordinary Portland cement to see if it would perform effectively in concrete. The objective was to discover how to increase the strength of houses using a smaller amount of concrete material. This study offers a potential solution to the challenge of managing leftover agricultural waste. We discovered that RHA equals 1. 55 times denser than water means that the substance is much heavier or more compact than water. The heaviness of RHA concrete was found to be 2. The numbers 043, 1912, and 1932 represent the weight of something in kilograms per cubic meter. These numbers were obtained when 10%, 20%, and

25% of the material was replaced. RHA concrete was easy to handle because it had a high slump value of more than 100mm. **[Maurice E. Ephraim, (May 2012)].** This research delved into the effects of replacing Ordinary Portland Cement with Rice Husk Ash on the performance of concrete. The material known as Rice Husk Ash, remaining from farming activities, has potential applications in extensive concrete ventures. Tests have proven that it is strong when pressed together, with a strength of 33-38 in a certain measurement. Specifically, when it is used to replace 10-25% of the mixture, the strength is 4N per square millimetre. This mixture usually contains materials in equal amounts. According to this research, the utilization of RHA Concrete rather than traditional concrete in buildings has the potential to increase its durability. This investigation aims to analyze how the use of RHA, as opposed to OPC, influences the properties and resilience of concrete.

[Naraindas Bheel, (October, 2018)]. This study looks at what happens when we use rice husk ash instead of cement in hollow sand concrete blocks. A machine makes a big block that is 225 x 225 x 450 millimeters by shaking it. We can conclude from the results that adding RHA makes the block less dense. When more RHA is added, the blocks become less dense. The block does not become stronger when it is squeezed. The findings indicate how the properties of the blocks are influenced by changes in temperature and moisture levels **[G. L. Oyekan and O. M. Kamiyo (13 January, 2011)].** The primary aim of this study was to examine whether fly ash and rice husk ash could be used as alternative materials in place of certain concrete substances. The study also looked at what chemicals are in the ash and how they affect how strong compressed concrete. Through the use of charts, tables, and pictures, we examined various chemical compounds present in both fly ash and rice husk ash. In some situations, these substances in the final product were reduced a lot or not mentioned at all **[Sam Joel (July, 2020)].**

LITERATURE REVIEW OF SUGARCANE BAGASSE ASH (ScBA)

Scientists did some research on a substance called Bagasse ash for this document. They examined how it was made up and what it looked like. They also used it to change the amount of cement used in concrete. They tried using no cement, 5% cement, 15% cement, and 25% cement, based on the weight. We tested new concrete to see how easy it is to make it more solid and to see how it will move. We also examined old concrete to determine its strength and ability to withstand being pulled or bent. The results show that when more bagasse ash was used instead of other materials, the concrete became stronger. **[R. Srinivasan, K. Sathiya (2010)]**.

This paper aims to encourage the use of industrial SCBAs for safety and protection. To achieve this, we need to make the SCBAs smaller before using them. By implementing this alteration, the filler and pozzolanic effects will be improved, and the impact of the amorphous SiO2 content on the increase in compressive strength will be reduced **[Sirirat Janjaturaphan and Supaporn Wansom (2010)]**. In addition, a significant build-up of Sugar Cane Bagasse Ash, a byproduct of the sugar industry, is present. These materials must be environmentally friendly and sustainable. India holds the second position in sugarcane production globally. They also generate a lot of Sugar Cane Bagasse Ash, a byproduct of the sugar business. Concrete can be assembled using this ash as an adhesive. By adopting a different material, we may do this and enhance waste management while saving cement in the manufacturing of concrete. The goal of this strategy is to produce less harmful gasses throughout the cement-making process.

[Pragalbha Khare (2018)]. The use of untreated bagasse ash in place of specific fine components in concrete is the subject of this study. A portion of the fine aggregate was substituted with bagasse ash. We tried a few other amounts, such as 10%, 20%, 30%, and 40%. Using techniques such as the compaction factor and slump cone tests, we conducted testing on wet concrete. We conducted a detailed examination of exceptionally strong concrete, measuring its strength, water absorption capacity, and likelihood of splitting using several techniques. Bagasse ash has been shown by researchers to be a good fine aggregate alternative. **[Prashant O Modania, M R Vyawahareb (2013)]**. The information contained in this document encompasses studies carried out in the last 20 years, focusing on the application of Sugarcane Bagasse Ash (SCBA) as a replacement for cement in the production of strong concrete constructions. First, we will discuss the basic details about how SCBA is created. We will also talk about how the heat of burning affects the structure of the SCBA. Next, we will look at the physical and chemical qualities of SCBA. Finally, we will describe how SCBA works. Our first focus is to elaborate on how the utilization of SCBA modifies the characteristics of the material at its inception. Subsequently, we examine the properties of the material after it has undergone the hardening process. This text is about how quickly strength is gained and how strong the material is. It also discusses how bendable the material is and how chloride ions can go through it. In conclusion, it describes how it reacts in a difficult environment. **[Muhammad Jahanzaib Khalil, (2020)]**. Small business loan usage in community development corporations was the focus of the study. The study focused on the key areas of interest, major publication sources, commonly employed vocabulary, preferred articles

and authors, and the leading contributors by country in this particular field of research. We also examine how the Small Business Administration (SBA) influences the qualities of fresh and durable cement blends and their capacity to endure damage. They discovered that the industry that makes materials used in construction and building had the most articles published, with a total of 36. Bahurudeen A wrote the most articles and published 14 of them. India had the highest number of publications in this field, with a total of 110. **[Waqas Ahmad, (2021)]**. By using SCBA instead of cement in amounts ranging from 10% to 20% of the total weight, you can meet the PAI requirement mentioned in ASTM-595(1985). The study found that SCBA is lightweight, and changing 10% of its makeup causes a big increase in PAI. Put in simpler words, it is recommended to use 10% or 20% less of SCBA with strengths of 22. 3N/mm2 and 201N/mm2 in reinforced concrete can be described as the strength or pressure exerted on the material **[T. S. ABDULKADIR, (2014)]**. Instead of using cement and small rocks, we used leftover sugarcane material and waste from making marble for this experiment. The scientists mixed bagasse ash to create concrete paver blocks. They checked how strong the paver blocks were in resisting pressure, force, wear and tear, and soaking up water. Using leftover pieces of marble instead of the usual small rocks improved how well a material can resist being worn away and slightly increased its ability to handle pressure when compressed. The research discovered that using bagasse ash in concrete makes it stronger and longer-lasting than regular concrete. When we incorporated bagasse ash into the concrete mixture, replacing up to 20% of it, we observed this improvement. **[T. Murugesan, R. Vidjeapriya, A. Bahurudeen (2020)]**.

MATERIALS UTILIZED

RICE HUSK ASH (RHA)

Rice farming flourishes in Asian countries as a result of the fertile soil, abundant water resources, and favorable weather patterns characterized by regular rainfall. In order to prepare rice for consumption and sale, we employ a device referred to as a fabricating handle, which helps remove the outer coating. The incorporation of rice husk into an oven has been discovered to have advantages in terms of simplifying the cooking process for a range of foods. Instead of using concrete, an alternative option is to utilize the surplus of rice husks as a substitute or incorporate them as an additional component. In some countries, rice husks are utilized for producing biogas, whereas in other countries, the husks are discarded through the process of burning them. The goal of this study is to discover innovative applications for RHA, a material

that is currently considered to be a byproduct. The typical approach locals use to handle it involves igniting it in the atmosphere to eliminate it. Shown in fig 3.

Fig 3 Rise Husk Ash

SUGARCANE BAGASSE ASH (ScBA)

ScBA, which stands for Sugarcane Bagasse Ash, refers to the residue left behind when sugarcane is pressed for its juice. The distinctive characteristics of this item render it valuable for diverse applications. The cultivation of sugarcane holds great significance for individuals residing in hot and humid places, as it plays a vital role in their sustenance and maintenance of good health. Producing a large quantity of sugar simultaneously heavily relies on the significance of this particular item. Bagasse, a byproduct of the sugarcane juice extraction process, refers to the remaining material. The act of burning leftover sugar cane yields a specific ash known as bagasse ash. The ScBA is encountering problems due to their improper disposal practices, as they are mistakenly throwing trash in unsuitable areas and accumulating large amounts of garbage. According to Barroso, the production of one ton of sugarcane results in 280 kilograms of bagasse waste being produced as well. The disposal of bagasse, the remaining material from sugarcane processing, can affect both the environment and financial resources. An increasing number of individuals globally are searching for improved approaches to address the problem of waste management. Handling means how you use, take care of, or manage something. The act of disposing something off implies the act of getting rid of it through proper disposal methods such as throwing it in the trash or recycling it accordingly. A

specific job is done using a special computer program called an application. Taking advantage of waste materials in concrete creation is of utmost significance in maintaining the well-being of the environment. The cultivation of sugarcane is a significant source of income in South Asia. Recognizing the worth of sugar production and refraining from underestimating it are of utmost importance. (Shown in Fig 4)

Fig 4 Sugarcane Bagasse Ash

CEMENT

When you mix cement with water, it creates a substance that can strongly bond and harden different things. Cement is a substance used to stick things together in construction. It can be used to join rocks, bricks, and blocks. This type of cement mainly contains lime, clay, and magnesium as its main ingredients. It is commonly used in civil engineering for construction purposes. To manufacture it, you must heat up limestone and clay or other suitable components. The most popular type of cement, also called OPC, is Portland cement. There are three varieties to choose from: 33, 43, and 53. In construction projects, cement, which is a kind of chemical substance, possesses a distinctive capability to adhere and connect various objects together. This is because it becomes hard and solid when it dries. Shown in fig 5.

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Fig 5 Cement

AGGREGATES

In order to produce mortar or concrete, a mixture is made by blending aggregates with substances like cement, lime, or mud. These binding substances are strong and won't react with other materials. Most of the concrete, about 70-75% of it, is made up of aggregates. Gravel is used for the bigger pieces and pit sand for the smaller pieces. Aggregate classification can generally be divided into two main groups: fine and coarse. Usually, these groups make up about 60 to 75 percent of all the concrete. When rocks are not strong or long-lasting, they tend to break in a neat way, in two different ways. The principal material in concrete that forms the big rocks is gravel. (Shown in Fig 6)

Fig 6 Aggregates

WATER

The research was conducted using water sourced from a stream that never experienced any blockages. The water retained its clarity and purity due to the noticeable absence of dirt or any

other discernible impurities. The acidity level must be maintained above a minimum threshold of 6.

PROBABLE CONCLUSIONS

1. The strength of concrete increases when RHA and ScBA are added and the mixture is dried for 28 days.
2. This can result in the concrete being both easier to handle and more durable. According to experiments, it remains present for an extended period.
3. One method for significantly cutting the expense of cement is by utilizing no-cost waste materials such as (RHA) and (ScBA).

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