Review Article

USE OF PADDY STRAW IN CONCRETE- A BRIEF REVIEW

Abstract: Rice is a crop that is grown worldwide and is mostly produced in Asian countries such as China, India, Indonesia, Vietnam, and others. For every ton of harvested rice, around 1.5 tons of paddy straw is produced. Paddy straw is available in substantial amounts during the rice harvesting seasons, depending on the region. In place of burning, governments and communities can promote composting, use paddy straw as animal feed, or invest in technology that turn waste straw into goods that are valuable. Buildings with improved energy efficiency, reduced agricultural waste, and alternative building materials can all benefit from the use of paddy straw in construction. However, proper processing and treatment are required to assure structural integrity, fire resistance, and longevity in construction applications. A thorough analysis was carried out to see how paddy straw might be used to address different environmental issues. It addresses a number of issues, including market potential, sustainability, cost-effectiveness, and technological viability. In this type of research, the durability, workability, and compressive strength of the concrete mix are typically evaluated by replacing a portion of the cement with ash derived from paddy straws. Research topics often include the optimal ash concentration, effects on hydration kinetics, and long-term performance of concrete.

Keywords: *Paddy straw, Concrete, strength, Rice and potential*

1.1 INTRODUCTION

One of the most extensively grown crops in the world, rice is mostly produced in China, India, Indonesia, Vietnam, and other Asian nations. Around 1.5 tons of paddy straw are usually produced for every ton of harvested rice. Depending on the locale, paddy straw is accessible in significant quantities throughout the rice harvesting seasons. Rice is harvested twice a year in many places, which causes cyclical spikes in the supply of paddy straw. Traditionally, paddy straw was considered a waste material and often burned, causing air pollution and environmental degradation. However, with the advent of sustainable practices, this agricultural residue has now been repurposed into eco-friendly packaging.pr some other such field where it may be reused [8-11].

1.2 Environmental Impacts of Paddy Straw Waste

1. Air Pollution: In certain areas, it is customary to burn paddy straw in open fields, a practice that contributes significantly to air pollution. Particulate matter (PM2.5 and PM10), sulfur dioxide (SO_2), carbon monoxide (CO), nitrogen oxides (NO_x), and volatile organic compounds (VOCs) are some of these contaminants. This leads to the development of smog and poor air quality, which in turn causes health concerns such as respiratory ailments.

2. Greenhouse Gas Emissions: The burning of paddy straw releases carbon dioxide (CO_2), methane (CH_4), and other greenhouse gases (GHGs) into the atmosphere. These emissions contribute to global warming and climate change [15-17].

3. Soil Degradation: Removing paddy straw from fields may cause decreased fertility and soil erosion. In addition to adding organic matter and serving as a protective layer, the straw helps the soil retain nutrients and moisture. The quality of the soil may deteriorate if it is withdrawn and not sufficiently restored, which would reduce agricultural production [18-20].

4. Water Pollution: Paddy straw can leak chemicals and nutrients into the water when it is dumped in fields or bodies of water, which can cause eutrophication and water pollution. Aquatic ecosystems can be disrupted and algal blooms caused by excessive nitrogen levels.

5. Waste Management Issues: The disposal of paddy straw might present problems for waste management. Waste can accumulate as a result of improper treatment and disposal, which can cause odors, fires, and ugly conditions.

6 Loss of Resources: Used correctly, paddy straw can be a useful resource. It can be transformed into bioenergy by a number of methods, including the creation of biogas, charcoal, or biofuel; however, poor management results in the loss of this valuable resource.

Governments and communities can encourage alternatives to burning, such as encouraging composting, using paddy straw as animal feed, or investing in technologies for converting straw waste into useful products. Additionally, raising awareness among farmers about the benefits of sustainable practices can play a vital role in mitigating these issues [12-14]. Adopting sustainable agricultural practices and implementing proper waste management techniques are crucial in addressing these problems.

1.3 Sustainable Uses of Paddy Straw:-

I. Bioenergy Production: The utilization of paddy straw in anaerobic digestion, which yields biogas, or in the synthesis of bioethanol can be employed to create bioenergy.
II. Mushroom Cultivation: It serves as a substrate for mushroom cultivation, providing an additional income source for farmers.
III. Construction Materials: Incorporating paddy straw into building materials, such interlocking tiles, is one potential application that could improve sustainability in the building sector.

1.4 Role of Paddy Straw in Construction

I. Interlocking Tiles: It is possible to process and add paddy straw to the mixture to create interlocking tiles. In addition to giving agricultural waste a sustainable new purpose, this can enhance the tiles' insulating and lightweight qualities.
II. Insulation Panels: It can be utilized to create environmentally friendly building insulation panels that have both thermal and acoustic advantages.

2.1 LITERATURE REVIEW

Using paddy straw in construction can help with sustainability initiatives by lowering agricultural waste, offering substitute building materials, and enhancing building energy efficiency. However, in building applications, durability, fire resistance, and structural integrity must be ensured through appropriate processing and treatment.

A detailed review was conducted to see possible uses of paddy straw to mitigate the various environmental concerns and it covers various aspects including sustainability, technical feasibility, cost-effectiveness, and market potential..

According to a study by Gupta et al. (2022), growers have harvested a significant amount of paddy, leaving behind stubble, or leftover rice straw, which is putting a significant strain on farmers to handle. Burning stubble has become popular due to its convenience, however this has a negative impact on the environment. Utilization solutions for rice straw should be chosen in order to lessen this issue. Thus, the methods for using rice straw in fiber or ash form to create building materials have been compiled in this review article. The production process, raw material variability, and different mechanical and physical qualities of the intended construction materials are also taken into consideration in the manuscript. Additionally, the financial implications of using rice straw and rice straw ash are encoded. The research in this area will be accelerated by this review, which can also be useful for startups involved in the development of different products utilizing straw locally. This might lessen the importance of burning straw in the field and its consequences on the environment.

Garas et al. (1994) talked about boling or burning the straw that's left in the fields after rice is harvested. Even after being phased out in the Egyptian law of Environment number, buting remains the primary method of disposing of the majority of rice straw residue because there aren't enough baling equipment available to support most farmers. Because of this, the majority of farmers burn their straw in open fields, which causes major air pollution and health issues for people. This study investigates the recycling of rice straw in order to create lightweight, sustainable cementitious straw bricks. An analysis and experiment were conducted to determine the mechanical characteristics and long-term viability of the Incks that were manufactured. A number of rice-snow proportions were investigated in order to determine the optimal mix proportions under compression strength in accordance with Egyptian building codes. The results showed that the maximum compressive stress values for the cementitious rice straw heicks increased when the chopped straw content was reduced to 20 kg/1000 bricks while maintaining the same amount of cement and nearly the same amount of fine aggregate. Additionally, the country's sustainability measures improved while using more cement to sabsorb the aggregates.

Munshi and sharma (2019) evaluated a study on Utilization of Rice Straw Ash as A Mineral Admixture in Construction Work. This study discusses the actual application of rice straw ash (RSA) in building projects. In this experiment, a modest house was constructed with rice straw ash utilized as a cement substitute in half of the structure. In order to investigate the strength variation of the walls constructed with and without RSA, both destructive and non-destructive tests were conducted. To investigate the different characteristics of RSA, energy dispersive spectroscopy analysis and scanning electron microscopy were carried out. The testing findings demonstrate that, when it comes to the building's concrete and mortar components, the strengths of OPC and RSA walls are comparable.

Oliko et al. (2020) investigated the characteristics of concrete in which egg shell lash and rice straw ash were used in place of some of the cement. The physical and chemical characteristics of the resulting ash and the other materials included to the concrete mixes were ascertained after the rice straws and eggshells were burned, sieved, and ground. The control mix was a class 35 concrete mix that had a water/cement ratio of 0.5 and was created using the British Research Establishment method, without using rice straw ash to partially substitute cement. After concrete was allowed to cure for 7, 14, 28, 56, and 90 days, its compressive and splitting tensile strengths were assessed. Rice straw ash was used to replace 5% to 30% of the cement in the concrete. It was also established how long-lasting, resistant to acid attack, and other wet and hardened properties of concrete with rice straw ash partially replacing cement were. Concrete that had rice straw ash added to it in percentages of 5% and 10% increase in compressive strength over the control mix. The 28, 56, and 90-day compressive strengths of concrete mixes increased with the addition of eggshell ash at 15% and 20% in place of cement that was partially replaced with rice straw ash. We may deduce that by substituting some of the cement in concrete with rice straw and eggshell ash, the resulting material will have qualities that are comparable to those of the control.

Mahdy et al (2023) evaluated Performance of Rice Straw Fibers on Hardened Concrete Properties under Effect of Impact Load and Gamma Radiation. In today's world, concrete is a necessary artificial building material. However, when exposed to dynamic stresses, concrete structures have a limited service life due to their brittle nature. Because of the dangerous radiation and dynamic impacts, nuclear emissions and explosions pose a threat to both human life and the safety of structures. Agriculture has shown to produce a significant amount of waste that needs to be disposed of, so one problem for modern research is how to employ these byproducts in various industries. Concrete in particular is used in building, which is one of the most significant areas for the disposal of such debris. In this study, rice straw fiber, a byproduct of agriculture, was chosen as a potential eco-friendly substitute for artificial fibers in concrete manufacturing. It offers improved static and dynamic performance as well as gamma shielding properties. In this study, various concrete combinations were suggested in order to assess the above described attributes. The planned concrete combinations had four different volume fractions of rice straw fibers (RSF): zero, 0.25%, 0.5%, and 0.75%. These were standard concrete mixtures. Compressive strength, splitting tensile strength, and flexural strength were the targeted static attributes. The impact resistance of RSF-reinforced concrete was also examined in this study using the drop weight impact test. Lastly, the linear attenuation test was used to evaluate the concrete's ability to shield radiation. The findings indicate that while adding agricultural by-products of RSF to concrete production improved the tensile and flexural properties significantly (up to 17.1% and 25.8%, respectively), the compressive strength was only marginally increased (up to 7.0%). Furthermore, the inclusion of RSF allowed concrete to reach a higher impact resistance of up to 48.6%. Moreover, it improved concrete's gamma shielding performance by as much as 7.9%. The findings of this study open the door to the use of RSF-reinforced concrete in a variety of unconventional applications.

Pachla et al (2021) studied Sustainable application of rice husk and rice straw in cellular concrete composites. This study aims to assess the durability, mechanical, acoustic, and thermal qualities of the cellular concrete that will be utilized, as well as the impact of adding rice husk and rice straw as sealing materials. This research describes a sustainable use option for rice culture waste. By adding rice straw, this study aims to enhance the thermoacoustic performance of cellular concrete made solely of rice husk. Adding straw resulted in a 15% decrease in compressive strength and an increase in three-point bending strength. When rice straw was added, sound absorption rose and sound insulation values remained statistically identical. The heat conductivity and straw length had a clear relationship, according to the thermal analysis. The S-

15%-3 formulation, which included 15% rice straw at 3 cm, was generally the best. In order to assess durability, specimens were subjected to wetting-and-drying cycles; this resulted in an increase in compressive strength, which rose with longer curing times. In addition, the three-point bending strength decreased as a result of the cycles, although the thermal conductivity did not change.

Wang and Han (2018) suggested that Environmental protection has become increasingly vital in all businesses due to the advancements in technology and economics. One type of environmentally friendly material utilized in the construction sector is straw fiber. On the one hand, it can lessen crop burning's negative environmental effects. However, it can reduce constructing costs in accordance with national building requirements. By modifying the appropriate mix percentage design, fiber reinforced concrete can meet the requirement for heat insulation while maintaining its high strength.

1. CONCLUSIONS

The analysis was performed on results of various parameters related to strength by various researchers since long times.. From the study, it is concluded that:

1. There is a vast scope of using Paddy straw in various combinations in concrete thereby replacing its ingredients.
2. To increase the percentage of paddy straw in concrete, some binding material can be added.
3. This kind of research usually entails substituting some cement with ash from paddy straws and assessing the concrete mix's durability, workability, and compressive strength. The ideal ash concentration, impacts on hydration kinetics, and long-term performance of concrete are frequently the subjects of research.

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