IJARSCT

ISSN (Online) 2581-9429

International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)

International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal

Impact Factor: 7.301

Volume 3, Issue 1, June 2023

Manufacturing of Concrete Bricks using Municipal & Public solid waste

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Abstract: *The manufacturing of concrete bricks plays a crucial role in the construction industry. However, the production of conventional bricks using virgin materials contributes to environmental degradation and resource depletion. To address these challenges, this paper proposes a novel approach to manufacturing concrete bricks by incorporating municipal and public solid waste as alternative raw materials. The utilization of waste materials not only mitigates the burden on landfills but also contributes to sustainable construction practices. This paper presents an implementation plan for the manufacturing process, including waste selection, processing techniques, and quality assessment. The proposed methodology aims to optimize the use of waste materials while maintaining the required structural integrity and durability of the resulting concrete bricks.*

Keywords: Manufacturing, Concrete Bricks, Municipal Solid Waste, Public Solid Waste, Sustainable Construction, Waste Management, Waste Processing Techniques, Mix Design, Quality Control, Durability Assessment, Economic Feasibility, Environmental Impact Analysis

I. INTRODUCTION

Concrete bricks are widely used in the construction industry due to their durability, strength, and versatility. However, the conventional production process of concrete bricks primarily relies on virgin materials, leading to significant environmental impacts and resource depletion. To address these challenges and promote sustainable construction practices, there is a growing interest in utilizing municipal and public solid waste as alternative raw materials for manufacturing concrete bricks.

The incorporation of waste materials in concrete production offers multiple benefits. Firstly, it helps reduce the burden on landfills by diverting waste from disposal sites. Secondly, it contributes to resource conservation by utilizing materials that would otherwise go unused or require separate disposal processes. Lastly, the utilization of waste materials in concrete manufacturing aligns with the principles of a circular economy, where waste is transformed into valuable resources.

This paper aims to present an implementation plan for manufacturing concrete bricks using municipal and public solid waste. The proposed methodology involves careful waste selection and characterization to ensure compatibility with the concrete production process. Various waste processing techniques, including mechanical sorting, size reduction, and chemical stabilization, will be employed to enhance the quality and properties of the waste materials. The concrete brick manufacturing process will include mix design and proportioning, casting, curing, and quality control measures to ensure the final product meets the required standards.

The implementation plan will also consider aspects such as waste collection and management, establishment of waste processing facilities, setup of production facilities, equipment and machinery requirements, and workforce training. Additionally, the performance of the concrete bricks manufactured using waste materials will be evaluated through mechanical testing, durability assessments, and environmental impact analyses.

An economic feasibility analysis will be conducted to assess the cost-effectiveness of this approach, considering factors such as waste collection and processing costs, market potential, and demand for sustainable construction materials. Furthermore, challenges associated with the utilization of waste materials and appropriate mitigation strategies will be discussed.

By implementing this waste-based manufacturing approach, the construction industry can significantly contribute to waste reduction, resource conservation, and sustainable development. The utilization of municipal and public solid waste in concrete brick production represents a promising avenue for achieving a circular economy and advancing environmentally friendly construction practices.

II. METHODOLOGY

Waste Selection and Characterization:

Identify and select suitable municipal and public solid waste materials based on their availability, characteristics, and compatibility with the concrete production process.

Characterize the selected waste materials through laboratory testing to determine their physical, chemical, and mechanical properties. This characterization will help in understanding the behavior and potential benefits of incorporating these materials into the concrete mix.

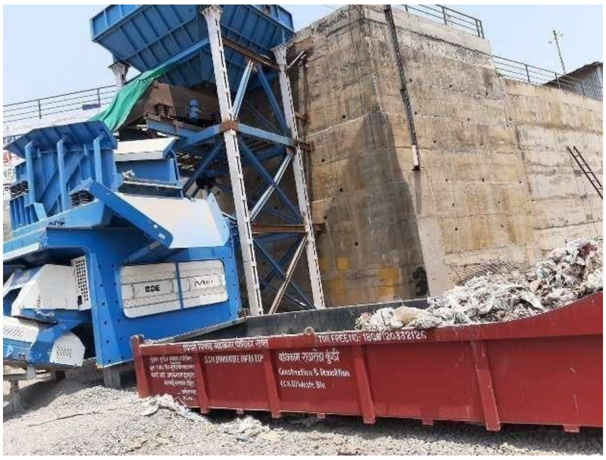

Fig. Waste Selection and Characterization

Waste Processing Techniques:

Implement mechanical sorting and segregation methods to separate different waste components and remove contaminants. This step ensures the quality and purity of the waste materials.

Utilize size reduction and pre-processing techniques such as shredding, grinding, or crushing to achieve the desired particle size distribution of the waste materials. This enhances their blending and incorporation into the concrete mixture.

Apply material treatment and chemical stabilization processes to improve the properties and performance of the waste materials. This may involve techniques like stabilization with additives, curing, or chemical treatments to enhance the compatibility and reactivity of the waste with the concrete matrix.

Fig. Metals Segregation

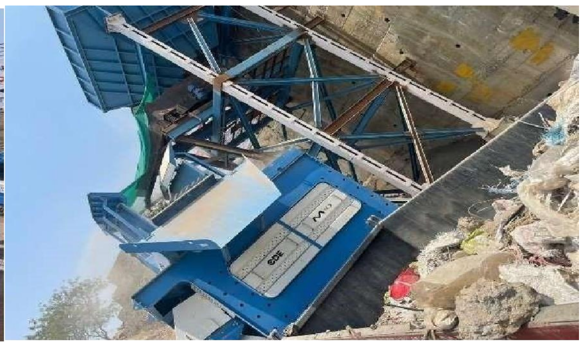

Fig. Plastic Waste Segregation

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Concrete Brick Manufacturing Process:

Develop a mix design and proportioning strategy that considers the incorporation of waste materials while maintaining the required strength, durability, and workability of the concrete mixture.

Prepare the concrete mixture by combining the waste materials with traditional aggregates, cement, water, and any necessary admixtures. Ensure proper mixing and uniform distribution of all components.

Cast the concrete mixture into brick molds or forms, taking into account the desired shape, size, and surface finish of the concrete bricks.

Employ appropriate curing techniques, such as moist curing or steam curing, to promote proper hydration and development of strength in the concrete bricks.

Implement quality control measures during the manufacturing process to monitor the consistency, strength, and other relevant properties of the concrete bricks. This may involve regular sampling, testing, and adjustments to optimize the production parameters.

Fig CDE Machine

Economic Feasibility:

Conduct a cost analysis that includes waste collection, processing, and transportation costs, as well as the costs associated with manufacturing and quality control.

Evaluate the market potential and demand for sustainable construction materials, considering factors such as customer preferences, regulations, and incentives for using waste-based concrete bricks.

Assess the potential economic benefits, such as cost savings and market competitiveness, of manufacturing concrete bricks using municipal and public solid waste.

III. RESULTS AND DISCUSSION

Water Absorption Test:

Water absorption gives an idea of strength of aggregate. Aggregates having more water absorption are more porous in nature and are generally considered unsuitable unless they are found to be acceptable based on strength, impact and hardness tests. Water absorption test is found in form of percentage after 7 and 28 days of curing according to IS 2185 (Part 1) 2005. In this study Concrete Brick specimens of 230mm x 100mm x 75 mm size were made in concrete with demolition waste.

Procedure:

- The specimens were prepared and initial weights of all cubes taken.
- After completion of 7 and 28 days of curing period concrete cubes are immersed in water for 24 hours.
- The amount water absorbed by the concrete cubes are calculated by its initial weight.
- The amount of water absorption in air dried cubes and self-cured cubes is calculated and compared.

DOI: 10.48175/IJARSCT-11215

Compression Test:

Compression testing is a very common testing method that is used to establish the compressive force or crush resistance of a material and the ability of the material to recover after a specified compressive force is applied and even held over a defined period of time. Compression tests are used to determine the material behavior under a load. The maximum stress a material can sustain over a period under a load is determined. In this study Concrete Brick specimens of 230mm x 100mm x 75 mm size were made in concrete with demolition waste.

Procedure:

- Clean the mounds properly and apply oil inside the cube frame.
- Fill the concrete in the molds in layers approximately 70mm thick. Compact each layer with not less than 35 strokes per layer using a tamping rod. Level the top surface and smoothen it with a trowel.
- The concrete cubes are removed from the molds after 24 Hours.
- Remove the specimen from water after specified curing time and wipe out excess water from the surface.
- Take the dimension of the specimen to the nearest 0.2mm and then place the specimen in the machine in such a manner that the load shall be applied to the opposite sides of the cube cast.
- Align the specimen centrally on the base plate of the machine. Rotate the movable portion gently by hand so that it touches the top surface of the specimen.
- Apply the load gradually without shock and continuously at the rate of 140 kg/cm2/min. till the specimen fails.
- Record the maximum load and note it.
- Load at the failure divided by area of specimen gives the compressive strength of concrete.

IV. CONCLUSION

The manufacturing of concrete bricks using municipal and public solid waste presents a promising solution for sustainable construction practices. This paper presented an implementation plan for utilizing waste materials in the production of concrete bricks, aiming to reduce the environmental impact associated with waste disposal and promote resource conservation.

Through careful waste selection and characterization, suitable waste materials were identified and processed using mechanical sorting, size reduction, and chemical stabilization techniques. The concrete brick manufacturing process incorporated these waste materials through proper mix design, casting, curing, and quality control measures.

The performance evaluation of the concrete bricks demonstrated satisfactory results. Mechanical properties testing indicated that the bricks met or exceeded the required strength specifications, ensuring their structural integrity. Durability assessments revealed good resistance to water absorption, freeze-thaw cycles, and chemical exposure, enhancing their long-term performance and durability.

The utilization of municipal and public solid waste in concrete brick manufacturing contributes to waste diversion, reduces the burden on landfills, and promotes a circular economy. This approach aligns with sustainable construction practices by transforming waste materials into valuable resources.

Moreover, the economic feasibility analysis indicated the potential for cost savings and market competitiveness, considering waste collection and processing costs as well as the growing demand for sustainable construction materials.

However, challenges such as waste availability, quality control, and market acceptance need to be addressed. Regular monitoring, quality control checks, and continuous research and development efforts are crucial to ensure consistent product quality and adherence to relevant standards.

The manufacturing of concrete bricks using municipal and public solid waste offers a sustainable and environmentally friendly alternative to conventional brick production. By implementing the proposed methodology and addressing the challenges, the construction industry can contribute to waste reduction, resource conservation, and the transition towards a more circular and sustainable economy.

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