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Experimental Investigation on Production and Strength of Ferrock Block

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Abstract: *This invention relates to the development of sustainable Ferrock construction blocks using industrial waste materials. Ferrock blocks are designed as an eco-friendly alternative to conventional concrete blocks with improved strength and durability. In this study, iron powder (steel waste) is used as the main material along with fly ash, limestone powder, and metakaolin to enhance binding and strength properties. Sodium hydroxide and acetic acid are used as chemical activators to initiate the reaction and support carbonation curing. The blocks are produced by mixing the materials in suitable proportions and casting them into moulds. Compressive strength and water absorption tests are conducted to evaluate the mechanical and durability performance of the Ferrock blocks. The results indicate that Ferrock blocks exhibit good compressive strength and low water absorption due to the formation of a dense iron carbonate matrix. Thus, Ferrock blocks can be considered a sustainable and durable building material suitable for construction applications while reducing industrial waste and environmental pollution.*

Keywords: Ferrock blocks, Iron powder, Fly ash, Sustainable construction, Carbonation curing

I. INTRODUCTION

FERROCK BLOCKS IN CONSTRUCTION

Ferrock is a new type of sustainable construction material developed as an alternative to conventional concrete. It is mainly made using industrial waste materials such as iron powder (steel waste), fly ash, limestone powder, and metakaolin. Unlike normal concrete, Ferrock gains strength through chemical reactions and carbonation curing, where carbon dioxide helps form strong iron carbonate compounds.

In construction, Ferrock blocks can be used for masonry walls, paving blocks, boundary walls, and low-cost building applications. These blocks are strong, dense, and durable, making them suitable for structures that require good load resistance and long service life. Ferrock blocks also show low water absorption, which improves their resistance to weathering and moisture damage.

The use of Ferrock blocks promotes eco-friendly construction by recycling waste materials and reducing the usage of cement, thereby lowering carbon emissions. Ferrock is considered a carbon-negative material because it can absorb CO_2 during curing, helping to reduce environmental pollution. Thus, Ferrock blocks provide a practical solution for sustainable and modern construction practices.

II. OBJECTIVE

1. To develop strong and durable Ferrock blocks for construction applications.
2. To utilize industrial waste materials such as iron powder (steel waste), fly ash, limestone powder, and metakaolin in block production.
3. To reduce environmental pollution by converting waste materials into useful construction products.
4.To evaluate the compressive strength and water absorption properties of Ferrock blocks.
5. To promote sustainable and eco-friendly construction by producing a low-carbon alternative to conventional concrete blocks.

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III. SCOPE

- The project focuses on designing and developing Ferrock blocks using industrial waste materials such iron powder (steel waste), fly ash, limestone powder, and metakaolin.
- It includes testing the compressive strength and water absorption properties to evaluate the performance of Ferrock blocks.
- The study covers the use of alkaline activators like sodium hydroxide and acetic acid to improve binding and carbonation reaction.
- The scope involves comparing Ferrock blocks with conventional concrete blocks in terms of strength, durability, and sustainability.
- It also examines the suitability of Ferrock blocks for construction applications such as masonry walls, pavements, boundary walls, and low-cost housing.
- The project considers the environmental benefits of Ferrock blocks by reducing industrial waste disposal and lowering carbon emissions through eco-friendly construction.

IV. NEED FOR FERROCK BLOCKS

- To develop strong and durable construction blocks using industrial waste materials.
- To reduce environmental pollution by utilizing steel waste (iron powder) and fly ash effectively.
- To minimize the use of cement and reduce carbon dioxide emissions in construction.
- To produce blocks with low water absorption and improved durability for long-term use.
- To provide a sustainable and cost-effective alternative to conventional concrete blocks for construction applications.

V. IMPORTANCE OF FERROCK BLOCKS:

1. High Compressive Strength
2. Improved Durability
3. Low Water Absorption
4. Eco-Friendly Construction Material
5. Utilization of Industrial Waste Materials
6. Reduction in Cement Usage and CO_2 Emission
7. Carbonation Curing Advantage (CO_2 Absorption)
8. Good Resistance to Weathering and Moisture
9. Cost-Effective Alternative to Conventional Blocks
10. Suitable for Sustainable and Low-Cost Construction Applications

VI. MATERIALS

6.1 DESCRIPTION OF STEEL WASTE

Iron powder is an industrial waste material obtained from steel industries in the form of steel dust, filings, or slag powder. It contains high iron content which is the main component responsible for Ferrock formation. During curing, iron reacts with carbon dioxide and forms iron carbonate compounds, which increase the strength and durability of the blocks. Using iron powder also helps in reducing industrial waste disposal and promotes sustainable construction.

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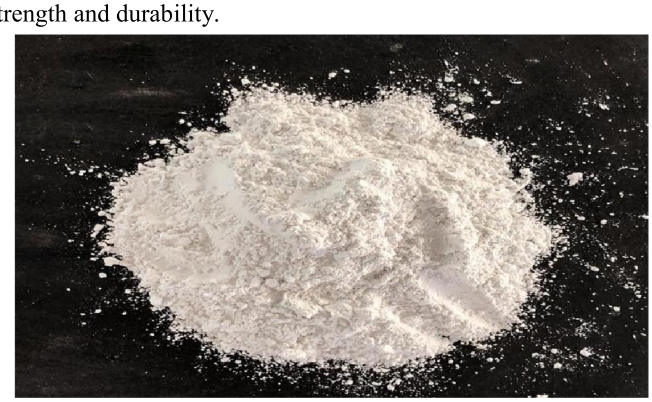
6.2 DESCRIPTION OF FLY ASH

Fly ash is a fine powder collected from thermal power plants during coal combustion. It is rich in silica and alumina, which makes it a good pozzolanic material. In Ferrock blocks, fly ash acts as a binder material and helps improve workability and strength. It also fills voids in the mix, reducing porosity and improving durability. The use of fly ash reduces the need for cement and supports eco-friendly construction.

6.3 DESCRIPTION OF LIMESTONE POWDER

Limestone powder is obtained by crushing and grinding limestone rocks into fine powder form. It mainly consists of calcium carbonate. In Ferrock blocks, limestone powder acts as a filler material that improves density and compactness. It fills micro-voids between particles and provides smooth surface finish. It also supports the formation of carbonate compounds, improving strength and durability.



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6.4 DESCRIPTION OF METAKAOLIN

Metakaolin is a highly reactive pozzolanic material produced by heating kaolin clay at high temperature. It contains silica and alumina and is used to enhance binding properties. In Ferrock blocks, metakaolin improves early strength, reduces porosity, and increases resistance to chemical attack. It strengthens the internal structure and improves long-term durability.

6.5 DESCRIPTION OF SODIUM HYDROXIDE

Sodium hydroxide is a strong alkaline chemical used as an activator in Ferrock block preparation. It initiates the chemical reaction between fly ash, metakaolin, and other materials by dissolving silica and alumina. This results in the formation of strong binding gel. NaOH improves strength development and helps in producing dense and durable Ferrock blocks.

6.6 DESCRIPTION OF ACETIC ACID

Acetic acid is a weak organic acid used to support carbonation and chemical reactions in Ferrock blocks. It improves bonding between iron powder and binder materials and enhances the formation of iron carbonate compounds. This increases the strength and stability of Ferrock blocks. Acetic acid also contributes to improved curing and durability.

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VII. MIXPROPORTIONS

Block 1=5.9 : 3.5 : 2.3 : 2.3 : 0.6 : 0.1
Block 2=5.3 : 4.1 : 2.3 : 2.3 : 0.6 : 0.1
Block 3=5.9 : 3.2 : 2.6 : 2.3 : 0.6 : 0.1
Block 4=5.9 : 3.2 : 2.3 : 2.6 : 0.6 : 0.1

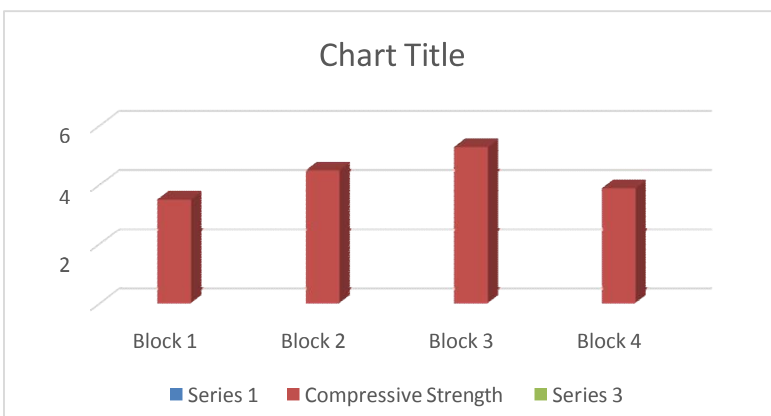
Unit	Iron Powder	Fly Ash	Limestone Powder	Metakaolin	Sodium Hydroxide	Acetic Acid
By weight(kg)	5.9	3.5	2.3	2.3	0.6	0.1
By volume(m^3)	0.00197	0.00150	0.00085	0.00092	0.00040	0.00010

VIII. RESULTS

Compressive Strength Test

Compressive strength is the ability of a Ferrock block to withstand crushing load under compression. In this test, the Ferrock block is placed in a Compression Testing Machine (CTM) and load is applied gradually until the block fails. The maximum load taken by the block indicates its strength. Ferrock blocks generally show good compressive strength due to the formation of iron carbonate compounds, which makes the blocks dense and durable for construction applications.

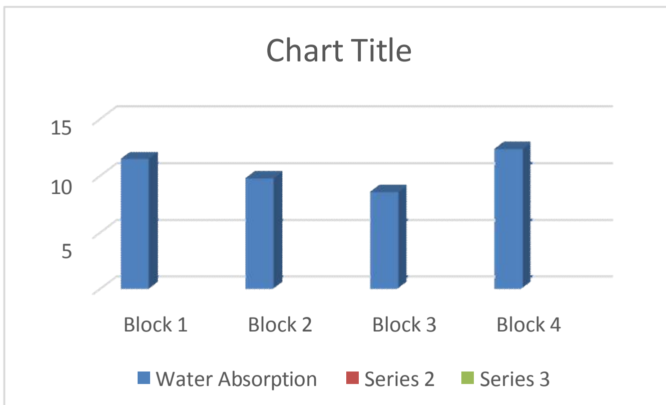
BLOCK NO	COMPRESSIVE STRENGTH
Block 1	3.50MPa
Block 2	4.50MPa
Block 3	5.30MPa
Block 4	3.90MPa



Water Absorption Test

Water absorption test is conducted to determine the amount of water absorbed by Ferrock blocks when immersed in water. In this test, the block is first dried and its dry weight is measured. Then it is immersed in water for 24 hours, removed, and the wet weight is taken. The difference between dry and wet weight indicates the water absorbed by the block. Low water absorption shows that the Ferrock block is dense, less porous, and has better durability and resistance to moisture and weathering.

BLOCK NO	WATER ABSORPTION
Block 1	11.5%
Block 2	9.8%
Block 3	8.6%
Block 4	12.4%



IX.CONCLUSION

The experimental study on Ferrock blocks confirms that strong and durable blocks can be produced successfully using industrial waste materials such as iron powder (steel waste), fly ash, limestone powder, and metakaolin along with sodium hydroxide and acetic acid as chemical activators. The compressive strength results indicate that Ferrock blocks have good load-bearing capacity due to the formation of iron carbonate compounds and a dense microstructure. The water absorption results show low permeability, which improves resistance to moisture and increases durability.

This project also highlights the environmental benefits of Ferrock blocks by reducing the use of cement and utilizing waste materials, thereby lowering carbon emissions and supporting sustainable construction. Overall, Ferrock blocks are found to be a promising alternative to conventional concrete blocks and can be effectively used in eco-friendly construction applications.

REFERENCES

[1]. Allan, M., & Crawford, R. (2015). Development of Ferrock as a Carbon-Sequestering Construction Material. Journal of Sustainable Building Materials.

[2]. Gonzalez, L., & Martinez, P. (2017). Mechanical Performance of Iron-Rich Waste Based Cementitious Materials.

[3]. Construction and Building Materials Journal.

[4]. Reddy, S., & Kumar, V. (2018). Utilization of Steel Dust in Eco-Friendly Construction Blocks. International Journal of Green Engineering.

[5]. Davidovits, J. (2016). Geopolymer Chemistry and Applications in Sustainable Construction. Journal of Materials Science and Engineering.

[6]. Brown, T., & Singh, A. (2019). Carbon Dioxide Absorption in Iron-Based Cementitious Systems (Ferrock). Journal of Cleaner Production.

[7]. Patel, R., & Sharma, M. (2020). Strength and Durability of Geopolymer and Waste-Based Masonry Units. International Journal of Structural Engineering Research.

[8]. Wilson, J., & Lee, H. (2018). Industrial Waste Utilization in Low Carbon Construction Materials. Waste Management in Construction Journal.

[9]. Fernando, T., & Silva, R. (2021). Microstructural Analysis of Ferrock-Based Building Materials. Construction and Building Materials.

[10]. Kumar, N., & Mishra, A. (2019). Performance Evaluation of Eco-Friendly Blocks Using Fly Ash and Steel Waste. Green Materials and Sustainability Journal.

[11]. Zhang, H., Li, Q., & Wong, K. (2020). Sustainable Masonry Units Incorporating Recycled Industrial Waste. Journal of Sustainable Construction Engineering.