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EXPERIMENTAL ANALYSIS OF FERROCK MATERIAL SUBSTITUTE TO CEMENT CONCRETE

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ABSTRACT:

Concrete, after water across the world, the second most broadly utilized material involving 8-10% of all yields of CO2, is predominantly because of cement. This project ultimately aims to determine the potential use of Ferrock as an exceptional replacement for cement in concrete compared with other alternative alternatives. It is a steel-based restraining compound used to form a carbon-negative structure substance utilizing waste material absorbents. The iron residue (an iron business loss) that would end in sites somehow alongside small quantities of limestone, Metakaolin, and fly ash is being used to make this an efficient substance. Our research focuses unexpectedly on their commitment to carbon dioxide contamination, energy use, water use, the ecologic impact of ordinary Portland cement and Ferrock (limestone 8%, Metakaolin 12%, and fly ash 20%, and iron residue 60%). By subtitling concrete with Ferrock in fluctuating proportions of 5%, 10%, 15%, and

20% in solid, we attempt to find the ideal proportion of substitution, which, along with sustainability, would boost wanted outcomes for both (compressive and divided tensile). In all this proportion, the test result shows 10% is more efficient than others Here we use materials such as Metakaolin, limestone, fly-a along with iron dust for proper As per the available literature we know that the best possible proportion of ingredients is iron dust (60%), fly-ash (20%), Metakaolin (12%) and limestone (8%). Analysis (atomic Absorption spectroscopy) shows that fully cured samples contain Between 8 and 11% captured CO2 by weight. Ferrock is therefore' 'Carbon negative" unlike Portland cement, which during manufacture is the major source of CO_2 and other air pollutants.

Key Word-Ferrock Concrete, Concrete, Fly-Ash, Metakolin, Lime Powder

INTRODUCTION:

Concrete is perhaps the most used material for structures on highways, structures, spans, and various foundations. Every year, approximately 1 ton of cement is supplied for every human on the planet. This widespread worldwide use requires an accurate assessment of the natural impact of this material. Today, the effects of the material on ozone-hazardous substances and environmental change have been measured. From this perspective, a long-term inscrutable discrepancy has been generated in the supposedly solid green concept. The solid is responsible for the highest CO2 feelings by various materials frequently based on incompletely supplanting concrete.

Nowadays global warming is one of the major threats to our ecosystem. Amongst the greenhouse gases leading to global warming, carbon dioxide is of the maximum percentage, that is 76%, as shown in Fig. 1. Aiming to reduce the total percentage of carbon dioxide being emitted, an analysis of the sources of it was done and sorted. Working towards a greener environment, civil engineers are contributing by analyzing the carbon emitters and finding ways to solve them.

In this fast-growing world, infrastructure development is given more importance leading to a linear increase in the construction of multi-stories or high-rise buildings, roads, bridges, towers, etc... The most important material used in this construction is cement. Cement is the binding material used to gain strength to sustain the loads applied to it. It is an artificially manufactured product which releases carbon dioxide in the process of its manufacture which contributes to the environment.

LITERATURE REVIEW:

2.1 Literature review

- **Niveditha, Y M Manjunath & H S Prasanna (2021)**

  Structural properties of the best-performing system were considered as the ferrock. The experimental studies on the curing process were conducted and determined by trial-and-error methods based on the number of days of curing by carbon dioxide and the number of days of air curing. It was suggested that carbon curing for 4 days and air curing for 3 days gives the best result.

- **Magudeaswaran. P, Kiran. K2, ShabeerShumsudheen, Srivignesh. N. K (2020)**

  The ferrock is made of 90 % recycled materials so the cost of making this will be lower than cement when manufactured in bulk. The other factor is that one of the major issues faced by humans is carbon dioxide, which is the major reason for the greenhouse effect and other chain problems like global climate change etc. ferrock is a carbon-negative substance and it takes CO2 for its reaction, to attain its strength, past studies say that it will take the CO2 even after attaining the initial strength.

Ashik Thithira Achaiah, John Bello, and Thomas Donovan (2019)

Ferrock has been defined to be extremely enticing, but the ambiguity of its unique properties has the potential to have an even greater influence on the sustainable well-being of the environment and the prosperity of human civilization.

- **D.S. Vijayan a, Dineshkumar b, S. Arvindan a, Thattil Shree Lakshmi Janarthanan (2019)**

  It is found that the strength of Ferrock Concrete is twice that of ordinary conventional Concrete. From the experimental results, the optimum Molarity (i.e., grams/litre) of oxalic acid (catalyst) is found to be 10 moles for the best behaviour in Compression.

- **Alejandro Lanuza, (2017)** et.al.made new findings on "Ferrock: A life cycle comparison to ordinary Portland cement", and studied an alternative iron binder for concrete where he collected raw materials from industrial wastes. The result showed that the binder attains strength within 4 days of curing and it absorbs CO2 for the reaction to achieve its strength. Ivan Menz student of Pittsburgh Swanson School of Engineering published a paper on "Green Cement: Finding an Alternative to Portland Cement" in that he mentioned the future of ferrock and what are its advantages over other replacements. In this, he gives the importance of finding new alternatives instead of ordinary Portland cement
- **N. K. Amudhavalli (2012)** et.al.concluded that Portland cement is the most important ingredient of concrete and is a versatile and relatively high-cost material. Large-scale production of cement is causing environmental problems on the one hand and depletion of natural resources on the other hand. This threat to ecology has led researchers to use industrial by-products as supplementary cementation material in making concrete. This paper represents a detailed experimental study on compressive strength, flexural strength and split tensile strength. The consistency of cement depends upon its fineness.
- **Kavita Singh (2020)**

  Green concrete has reduced environmental impact with a reduction of the concrete industries' CO2 emission by 30%. Green concrete is having good thermal and fire resistance. In this concrete recycling use of waste materials such as ceramic wastes, and aggregates, so increased, so increased the concrete industry's use of waste products by 30%. Hence green concrete consumes less energy and becomes economical.

2.2 Research Gap

Among the papers we reviewed, very few papers have mentioned ferrock ingredients being replaced with cement paper research is starting very early in the period last paper referred to ferrock is published in 2021.

Objectives

- To study the effect of Ferrock on the Environment.
- To study the effectiveness of concrete by the partial replacement of the cement with ferrock ingredients {iron dust, fly ash, Metakaolin and limestone}.
- To determine the compressive strength mix design of grade M25.
- To determine the test result for the compressive strength and tensile strength of the final product.
- To determine the optimum percentage of ingredients in cement so that we can achieve maximum strength.

NEED OF STUDY:

- As we know cement industries emit 8% of global carbon dioxide emissions then we must find alternatives.
- It is important to find an alternative to reduce it to the same extent.
- To have eco-friendly concrete that emits less CO_2 in the environment.

OUTCOMES FROM THE STUDY:

- The Compressive strength for the cube of a controlled mix for 7, 14, and 21 days are 14.93 N/MM^2, 20.69 N/MM^2, and 26.80 N/MM^2 Respectively.
- The Compressive Strength for 47.5 Ferrock concrete for 28 days is all lower than normal concrete.
- The Splitting tensile test on the cylinder for the controlled mix for 7, 14, and 28 days are 2.34 N/MM^2, 2.71 N/MM^2 and 3.05 N/MM^2 Respectively.
- The Splitting tensile test for 47.5% ferrock concrete for 28 days is almost equal to normal concrete.

Conclusions

Investigation on the Ferrock ingredients or material as an alternative for the cement concrete was carried out in the present work to improve the strength of the materials when used as Solid blocks. A destructive test was carried out for compressive strength and a splitting tensile test for 7, 14 and 28 days. The compressive strength of the ferrock concrete comes out to be lower than the normal concrete That is 25.24N/mm2, 22.56 N/mm2 and 24.85 N/mm2 respectively and the tensile strength test turns out to be almost equal to normal concrete 24N/mm2,2.55 N/mm2 and 3.05 N/mm2 respectively. As we come to know that their assumption of directly adding Ferro rock material to cement concrete is not as we expected we learn different aspects of concrete material further we can do a proper investigation on each aspect of it as we research further after the results need some more ingredients and mix method to reach the assumed strength that is to be five times stronger than normal concrete.

REFERENCES:

1. Codes for designing concrete mixes - IS 456; 10262; SP 23.
2. Code of Practices for Plain & reinforced concrete etc. IS 456 – 2000.
3. The compressive strength test for cement mortar cubes IS 2250.
4. Methods of sampling are 2430.
5. International Journal of Advanced Research in Basic Engineering Sciences and Technology (IJARBEST)
6. Altwair, N. M., & Kabir, S. (2010, June). Green concrete structures by replacing cement with pozzolanic materials to reduce greenhouse gas emissions for a sustainable environment. At the 6th International Engineering and Construction Conference, Cairo, Egypt
7. Andrew, R. M. (2018). Global CO 2 emissions from cement production. Earth System Science Data, 10(1), 195 Barcelo, L., Kline, J., Walenta, G., & Gartner, E. (2014). Cement and carbon emissions. Materials and Structures, 47(6), 1055-1065 Niveditha M et al., International Journal of Sustainable Construction Engineering and Technology Vol. 11 No. 4 (2021) p. 90-9
8. Alejandro Lanuza Garcia1 , Ashik Thithira Achaiah2 , John Bello3 , and Thomas Donovan4 1 M.S. Civil Engineer, M.S. candidate Green Technologies, Fulbright Scholar Viterbi School of Engineering, University

of Southern California, CA. email: lanuzaga@usc.edu

9. Das, S., Hendrix, A., Stone, D., & Neithalath, N. (2015). Flexural fracture response of a novel iron carbonate matrix– Glass fibre composite and its comparison to Portland cement-based composites. Construction and Building Materials, 93, 360-370
10. Das, S., Souliman, B., Stone, D., & Neithalath, N. (2014). Synthesis and properties of a novel structural binder utilizing the chemistry of iron carbonation. ACS applied materials & interfaces, 6(11), 8295-830Vardhan Ashutosh PandharpurkarB.Arch. Student, Faculty of Design, Manipal University, Jaipur, India http://journals.resaim.com/
11. D.S. Vijayan a,⇑, Dineshkumar b, S. Arvindan a, Thattil Shreelakshmi Janarthanan From the experimental results, the optimum molarity (i.e., grams/litre) of oxalic acid (catalyst) is found to be 10 moles for the best behaviour in compressionhttps://www.sciencedirect.com
12. Niveditha, Y M Manjunath & H S Prasanna international journal of sustainable construction engineering and technologyhttps://penerbit.uthm.edu.my
13. Magudeaswaran. P, Kiran. K2, ShabeerShumsudheen, Srivignesh journals.resaim.com