EXPERIMENTAL STUDY ON FERROCK
A Life Cycle Comparison to Ordinary Portland Cement

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Abstract: Our projects deal with experimental study on FERROCK.Cement production currently constitutes the fourth largest source of carbon emissions. As these emissions continue to rise, the natural world faces the threat of an hazardous environmental pollution. Ferrock, an innovative iron-based binding compound, presents a carbon-negative alternative to cement that utilizes a variety of waste streams to produce a versatile building material. Life Cycle Analysis (LCA) is used from a cradle-to-gate perspective to compare the environmental impacts of Ferrock and Ordinary Portland Cement (OPC), focusing specifically on their contribution to carbon pollution, water use and energy consumption.

Index Terms **- Ferrock, Life Cycle Analysis, Iron-based binder, carbon negative, recycled by-product**

I. INTRODUCTION

Globally, cement production in accounted for approximately 8% of total carbon dioxide (CO2) emissions. The world's infatuation with carbon-intensive materials and processes has grown to be a real pandemic as the accumulation of these emissions contributes to the growing threat of Global Climate Change .Historically, concrete has been an essential factor in the exponential growth of the world's major cities and continues to be the product of choice for further industrial expansion. However, as researchers are exposing more information about the environmental degradation associated with concrete production, contractors have been forced to reevaluate alternative building materials in order to maintain competitive advantage in an evolving green market. Ferrock is an iron-based compound made of 95% recycled materials that have been proven to be less-expensive, stronger and more flexible in its building applications than OPC. Furthermore, this unique material uses compressed carbon dioxide to expedite the curing process and requires no added heat to catalyse its chemical reaction, making ita carbon-negative alternative to OPC. Since Ferrock is still a proprietary blend, much of the literature describing its processes and impacts is written from a preliminary perspective. However, the information that is available highlights several beneficial properties for this material. The first of two white-papers drafted by the product's founder, Dr. David Stone, in conjunction with several engineers from Arizona State University, define the flexural strength and overall durability of the compound compared to OPC. They concluded, "the fracture toughness and critical crack tip opening displacement (CTODC) of the iron-based binders were significantly higher than those of the OPC matrices [8]." Porosity is also another beneficial characteristic of the iron-based material in contrast to OPC, which can be reviewed in
Dr. Stone's second white paper titled, Pore- and Micro-structural Characterization of a Novel Structural Binder based on Iron Carbonation [9]. Additional information regarding the benefits of using recycled materials as substitute ingredients for binding material production are further defined in a short essay by the Environmental Protection Agency titled, Creating a Carbon-Negative Building Material from Recycled Glass, Steel Dust, and Carbon Dioxide . All ingredients necessary for Ferrock production are conventional industrial materials except for iron powder. The main source of literature for fly ash and silica fume, used for this study is a scientific report titled, Sustainability of Construction Materials, specifically chapter because of its focus on clinker material production. Chapter makes a comprehensive review of the technical characteristics of composite cements and other low clinker cement mixtures, as well as its components. It also includes a review of the emissions associated to these materials. Information about the environmental impact of limestone has been obtained from the limestone material fact sheet published by the Natural Stone Council, which covers a review of the products, applications, performance, physical properties, and environmental data about this material. An additional study by Rod Jones, Michael McCarthy and Moray Newlands, was also used for more general information on the environmental impacts of limestone, silica fume and fly ash in terms of GWP, water and energy use. Research literature for Ordinary Portland Cement is much more widely available because of it's longevity amongst the general market. In addition, the components of OPC are also conventional materials that have been thoroughly analyzed, making their statistical data readily available. More information regarding the current literature for Ferrock and OPC can be found by reviewing section.

II.MATERIAL USED:

1. Iron Powder
2. Fly Ash

3. Limestone

4. Silica fume

5. Weak organic acid (oxalic acid)

III.METHODOLOGY:

IV.LITERATURE REVIEW:

1.Title of the journal is A life cycle comparison between ferrock and ordinary Portland cement.

Author's name: Alejandro Lanuza Ashik Thithira AchaiahJohn BelloThomas Donovan

From these journals I have learned that using instead of cement and sand,aggregates are not used in these project they have used some different times of materials are used new materials are silica fume.

2. Title of the journal is A life-cycle assessment of Portland cement manufacturing comparing the traditional process with alternative technologies.

Author's name: Huntzinger, D. N., & Eatmon,

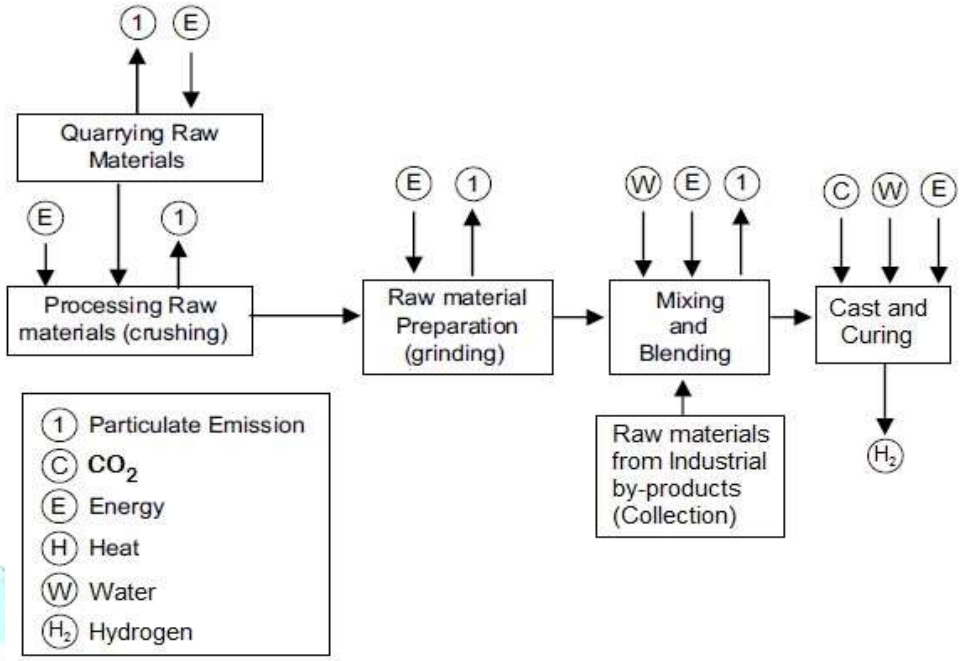
Silica fume is used in these project so only I have consider this material will gives us strength to our ferrock project

3. Title of the journal is Comparison between Concrete with Iron Powder

Author's name: Shehdeh Ghannam

The iron powder act as bonding material in these project the strength will get some extra comparing to other ordinary Portland cement.

V.PROJECT PROCESS IN FLOW CHART:



VI.SUMMARY OF RAW MATERIALS REQUIRED FOR FERROCK MANUFACTURING:

MATERIAL	PERCENT (BY WEIGHT)	SPECIFICATION
Iron Powder	60%	Waste metallic iron powder with a median particles
Fly Ash	20%	Class F fly ash
Limestone	10%	Limestone powder median particle size of 0.7 μm
Silica fume	8%	powder form material
Weak organic acid	2%	Oxalic acid has been used

VII.PROPERTIES OF FERROCK:

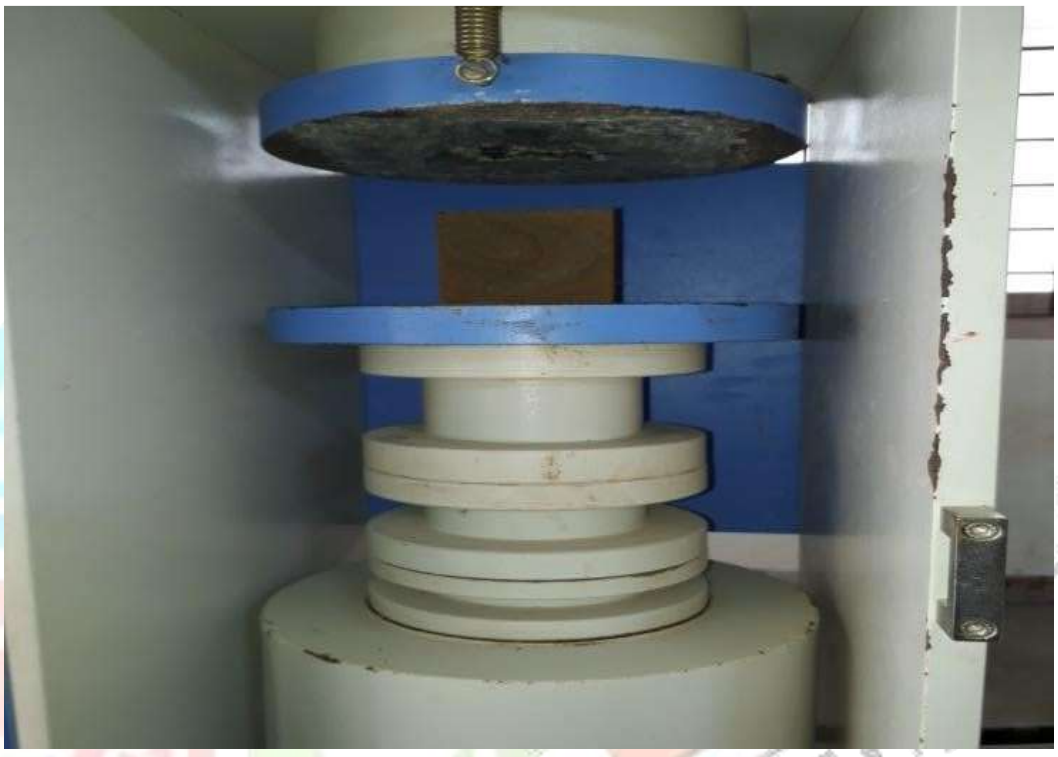
- Stone's materials called ferrock for iron
- Compressive strength test shows the pure past to be stronger than comparable samples of Portland cement
- Analysis shows that fully cured samples contain between 8% and 11% captured CO_2 by weight ferrock is therefore "carbon negative" unlike Portland cement, which during manufacture is major source of CO_2.

VIII.TEST DONE FOR FERROCK: COMPRESSION TEST:

PROCEDURE FOR COMPRESSION TEST:

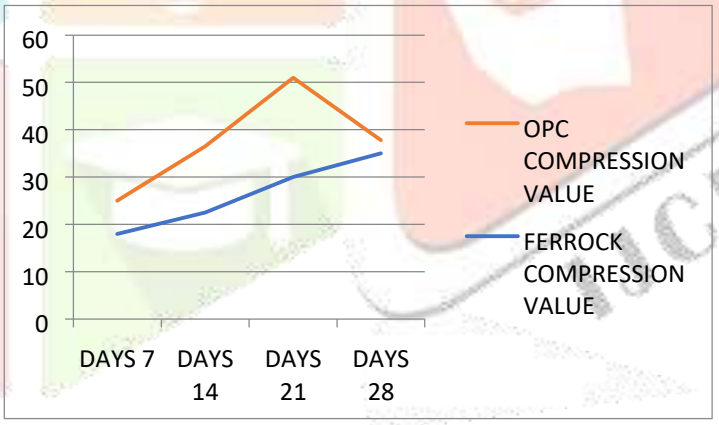
1. Remove the specimens from water before 30 minutes of testing.
2. Remove any loose sand or other material from the surface of the specimens and let them dry.
3. Clean the bearing surface of the compression testing machine.

4. Now place the cube in the testing machine in such a manner that the load is applied o the opposite sides of the cubes.
5. Align the axis of the specimen with the center of thrust of spherically seated platen.
6. Apply the load increasingly at a rate of 140 kg/cm² per minute until the cube collapse.
7. Note down the maximum load applied to the specimen and any other unusual activities at the time of failure.



BEFORE COMPRESSION TEST

AFTER COMPRESSION TEST



GRAPH B/W OPC AND FERROCK

RESULT:

S.NO	NO OF DAYS	FERROCK COMPRESSION TEST VALUE
1	7	18
2	14	22.5

3	21	30
4	28	35

FERROCK:

X.CONCLUSION:

The compression test says that the FERROCK concrete stronger than OPC, Use of these material leads to sustainable development in construction industry, To save the environmental, FERROCK is the better partial substance as replacement of cement in concrete.

XII.REFERENCES

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