EXPERIMENTAL STUDY ON MECHANICAL BEHAVIOUR OF FERROCK –A SUBSTITUTE FOR CEMENT

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Abstract:
Cement is the main component of concrete. It is very important in the construction industry. Despite this product, cement releases carbon dioxide. That's why iron ore is used instead of cement. Ferrock is an iron-based composite that is carbon neutral to cement and can be used to produce a variety of household products from various wastewaters. Ferrock is a binder made from a mixture of iron oxide powder, fly ash, lime powder, metakaolin and oxalic acid. Oxalic acid acts as a catalyst. Iron oxide reacts with carbon dioxide and water to form iron carbonate. It can improve the environment by absorbing atmospheric carbon dioxide for the hardening process. By using iron ore, you can reduce the emission rate of the most harmful greenhouse gases. During treatment, carbon dioxide is used instead of antibiotics. This helps reduce water consumption.

Keywords: Light Weight SCC, Perlite, Metakaolin, Flow properties, Mechanical Strength.

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1. INTRODUCTION:

Ferrock-based mortar has emerged as a viable alternative in the construction industry, where there is an increasing need for environmentally conscious and sustainable methods. This represents a significant movement towards building materials that are ecologically sensitive. With the growing urgency around climate change and the increasing recognition of the negative environmental effects caused by conventional construction materials, there is a critical demand for creative alternatives. This introduction explores the domain of Ferrock, providing insight into its composition, benefits, and the wider context of its use in the building sector. Ferrock, frequently acclaimed as a groundbreaking substance, is a variety of mortar that stands out due to its environmentally friendly composition and sustainable properties.

2. LITERATURE REVIEW:

Development of Carbon Negative Concrete By Using Ferrock, IJSRSET (2018). V Rajesh M Patel, Hardik J Solanki. In this paper,

They partially replaced cement with Ferrock in gradually varying proportions from 20%-30%. Cubes and Cylinders were cast and tested for Compression, Tension and Flexure. The test results showed that 25.43% replacement gave optimal performance in compression, 17.51% in tension and 25.11% in flexure.

FERROCK: A life cycle comparison to ordinary portland cement, ISE 576 - Industrial Ecology (April 24, 2017). Alejandro Lanuza Garcia, Ashik Thithira Achaiah, John Bello, Thomas Donovan This is the only available published journal for proportioning of Ferrock. In this paper, Life Cycle Analysis (LCA) is used from 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.

This process LCA includes an in-depth environmental assessment of Ferrock production, from the point of its raw materials extraction, to its curing and hardening phase, and all processing steps in between. The results have been compared to a previous life-cycle analysis of OPC. This analysis finds that Ferrock has both the potential to replace OPC, and contribute significantly to the promotion of an environmentally sustainable future.

Evaluation of ferrock: A greener substitute to cement – Elsevier D.S. Vijayan, Dinesh kumar, S.Arvindan, Thattil Shree lakshmi Janarthanan

Their study compares the environmental impacts of ordinary Portland cement and Ferrock (iron dust 60%, fly ash 20%, Metakoalin 12% and limestone 8%) focussing specially on their contribution to carbon pollution, water use and energy consumption. By substituting cement with Ferrock in varying proportions as 4%, 8%, and 12% in concrete they are trying to find the optimum ratio of replacement which would give desired results in both strength (compressive, split tensile & flexural tested) along with sustainability.

Plasticity Characteristics of Ferrock Reinforced Expansive Soils – IJAST H. S. Prasanna, Rucha Nerlikar, Shubhashree S. R., Sowndarya K.M., Gazala Manzoor

In their studies, the degree of expansion of expansive soils were analyzed. Unique and very useful correlations were established between the percent fines and plasticity characteristics.

A new plasticity chart was developed for the classification purpose. It is observed that by reinforcing the montmorollinitic soils with Ferrock the intensity of free swell ratio, Liquid limit can be reduced reasonably and thereby increasing the plastic limit and shrinkage limit which greatly influences the engineering behavior of soil. This innovative project is eco-friendly and provides an economical solution in overall development of infrastructural facilities by using industrial waste materials which otherwise reach landfill

EXPERIMENTAL STUDY ON FERROCK A Life Cycle Comparison to Ordinary Portland Cement - 2018 IJCRT | Volume 6, Issue 1 February 2018 Karuppasamy, Kethepalli Dinesh Kumar, Kotla Janardhan reddy

Their studies deal with experimental study on FERROCK. 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. They concluded that use of these material leads to sustainable development in construction industry, To save the environmental degradation, FERROCK is the better partial substance as replacement of cement in concrete.

3. METHODOLOGY:

- Literature Survey
- Collection of Materials
- Blending of Ferrock
- Mix Proportion
- Casting
- Curing
- Test & Result

4. EXPERIMENTAL PROGRAMME:

4.1 Material properties:

4.1.1. Cement

- OPC (Ordinary Portland Cement) of grade 43 was used based on IS : 12269 (2013) as cementitious material.

4.1.2. Fine Aggregate

- The Fine aggregates utilized were passing through 4.75mm size sieve.
- The Specific gravity of fine aggregates is 2.6 and the Fineness modulus is 2.94

Figure 1: River Sand

4.1.3. Water

- Potable faucet water was utilized for mixing and curing.

4.1.4. Iron Oxide Powder

- Iron powder is a powder form of iron. It's sizes about 0.02mm – 0.04mm.

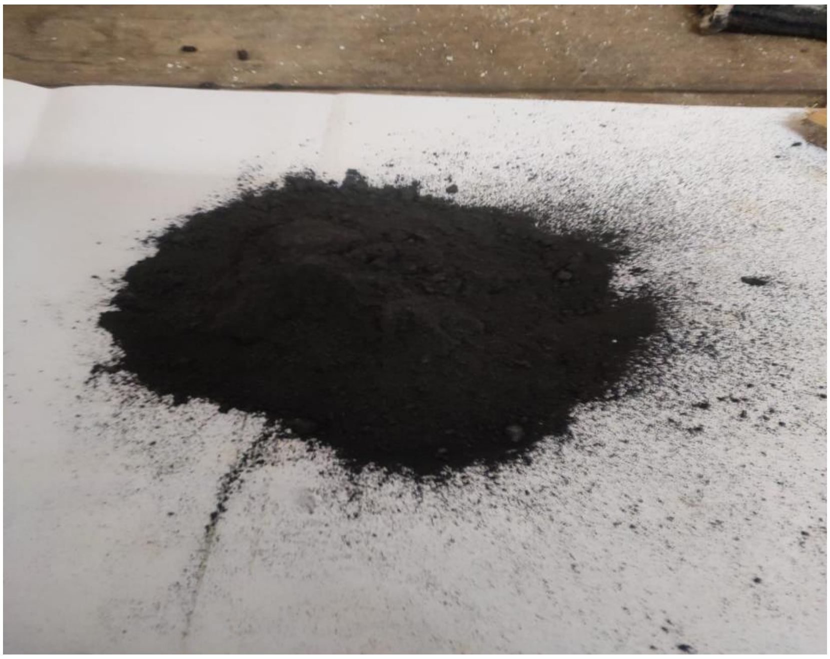


Figure 2: Iron powder

4.1.5. Metakaolin

- Metakaolin is the anhydrous calcined form of clay mineral kaolinite, Traditionally used is the manufacture of porcelain.
- As metakaolin is named for increasing the strength and permeability/durability characteristics of concrete designed for a very low w/b ratio of 0.3.

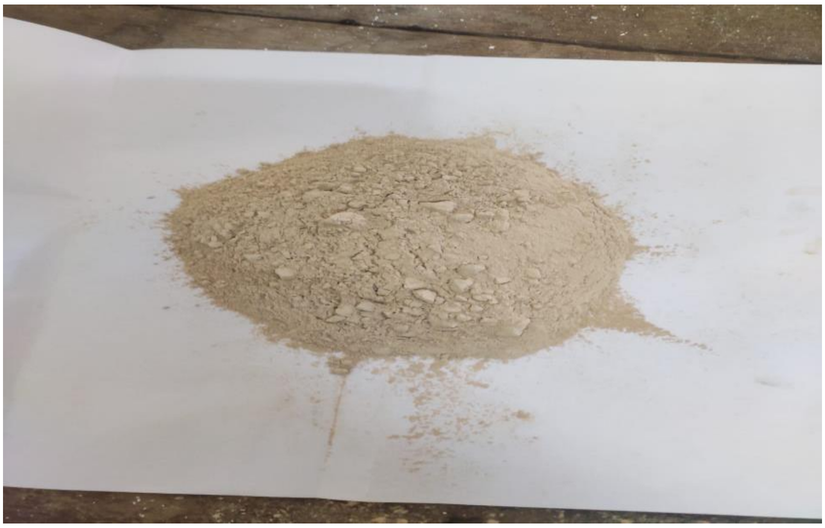


Figure 3: Metakaolin

4.1.6. Fly ash

- Apart from Volcano's, fly ash comes primarily from coal-fired, electricity-generating power plants. These power plants grind coal to powder fineness before it is burned. Fly ash – the mineral residue produced by burning coal – is captured from the power plant's exhaust gases and collected for use.
- And it leads to promote workability of concrete with lowering the water-cement ratio.

Figure 4: Flyash

4.1.7. Lime Powder

- Lime contains clay, magnesium carbonate, Silica & metallic acids. Which tends to increase the workability and degree of plasticity of concrete.

Figure 5: Lime Powder

4.1.8. Oxalic acid

- Oxalic acid (catalyst) promotes the precipitation and mineralization of iron.

Figure 6: Oxalic Acid

4.2.MIX PROPORTIONS:

Mix Proportions were arrived using "FERROCK: A life cycle comparison to ordinary Portland cement, ISE 576 - Industrial Ecology (April 24 – 2017)

Table 1: Mix Proportions of Ferrock

Material	Proportion (% by weight)
Iron powder	60%
Fly ash	20%
Limestone	10%
Metakaolin	8%
Oxalic acid	2%

Table 2: Mix Proportions of Ferrock mortar

Ferrock	Fine aggregate	Water-solids ratio
1	3	0.56

Table 3: Mix Proportions of Conventional

Materials	Proportions (% by weight)
cement	1 part
sand	3 part
W/C	0.5

5. CASTING

The Cubes were casted for determining the Compressive strength ferrock. The moulds of size 70.60 mm x 70.60 mm x 70.60 mm were used. The specimens were cleaned and applied with oil before casting. After the casting is done the casted blocks are removed from the moulds after 24 hours from the time of mixing and immersed in curing tank.

Figure 7: Casted ferrock cubes

Figure 8: ferrock cubes after curing

6. MECHANICAL PROPERTIES

6.1 Compressive Strength test

The Ferrock blocks were tested for Compression at 7 & 28 days respectively. The mechanical properties were tested as per IS: 516 (1970). The results were tabulated in table 3 below for various mixes.

Fig 9. Ferrock cube under compression loading

Table 4: Compressive strength of Ferrock

Mix	Compressive strength	
	7 Days	28 Days
S - 1	31.25	56.78
S - 2	30.87	58.24
S - 3	31.92	54.78
S - 4	30.75	54.12

Table 5: Compressive strength of conventional Mortar (OPC 43)

Mix	Compressive strength	
	7 Days	28 Days
S - 1	20	49.28
S - 2	22.5	47.35
S - 3	26	48.24
S - 4	28.29	44

Fig 10. Pictorial Representation of Compression Strength values for Ferrock mortar

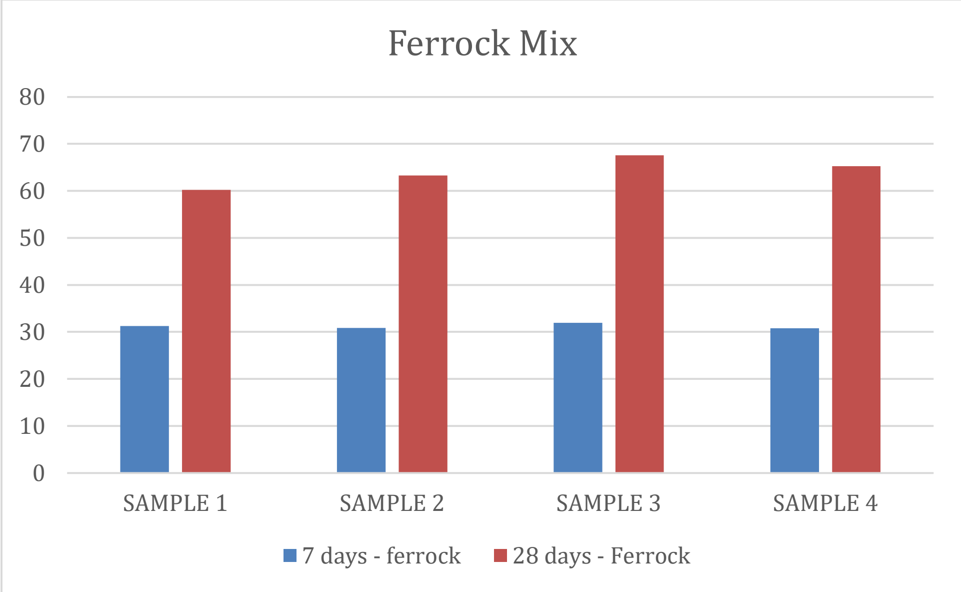
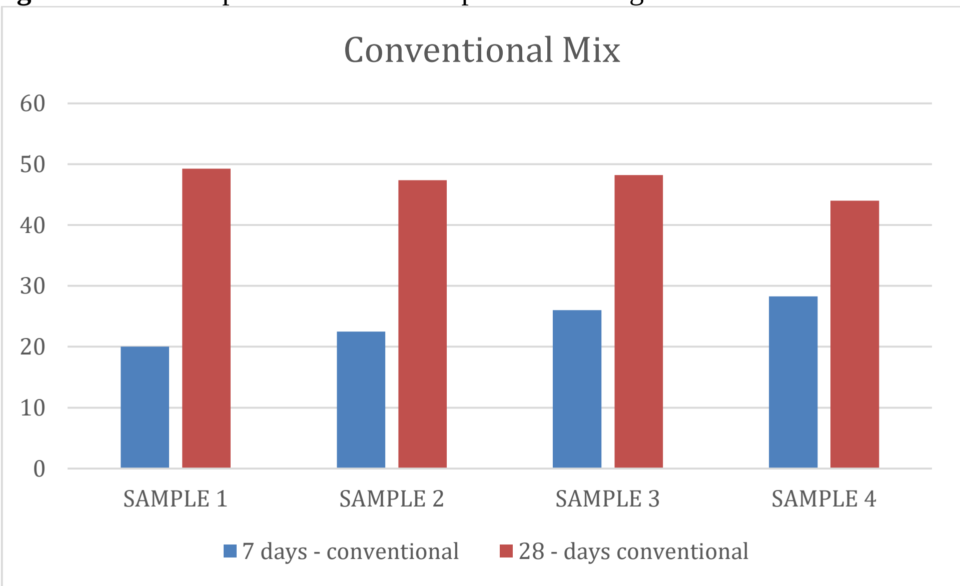


Fig 11. Pictorial Representation of Compression Strength values for Cement mortar



7. CONCLUSIONS:

From the results we can conclude that the compression strength strength of Ferrock is more above as that of normal conventional mortar.

8. REFERENCES:

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