Performance Evaluations of Ferrock Integrated Concrete

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***Abstract*—In our country environmental pollution is a major issue especially in the construction sector, cement produce more carbon-di-oxide (CO2) which lead to sever environmental impacts to overcome this we introduce FERROCK this is a green alternative and sustainable construction material which used as a substitute for conventional cement concrete. Ferrock concrete is prepared by combination of (steel dust flyash metakaolin oxalic acid and lime powder). The main advantage of ferrock concrete is, this absorbs CO2 in the time of curing process so this consider as a carbon negative construction material and also, this is good salt and corrosion resistance material so this becomes heavy environmental performance material. We can use ferrock concrete in a areas like (sustainable construction, slabs , pavements, and also eco-friendly projects)So in future ferrock concrete has a potential to develop a high performance construction materials and become a green alternative one**

***Index Terms*—Ferrock, sustainable concrete**

I. INTRODUCTION

Concrete is a most widely used construction material but in a process of cement production it releases more carbon-di-oxide (CO2) to atmosphere which leads to environmental impacts and global warming. To dimish ths we focused on eco-friendly and green alternative materials. Ferrock concrete is a green innovation alter to conventional concrete. Ferrock is made of mainly (steel dust flyash metakoline oxalic acid and lime powder)The main property of ferrock is this absorbs CO2 during curing process due to this it's form iron carbonate compounds and make concrete more strength and durability so ferrock is considered as a carbon negative material and also this had more compressive strength compare to conventional concrete and gives a better crack and salt resistance so we can used in a Marine also. We can use ferrock concrete in an area like (sustainable construction, slabs, pavements, and also eco-friendly projects) So in future ferrock concrete has a potential to develope a high-performance construction material and become a green alternative one

1.1 Objectives

- To evaluate Ferrock influence concrete strength and durability over conventional concrete
- To analysis split tensil and compressive strength behaviour over 7,14,28 days of curing
- To observe internal bonding and structure of ferrock integrate concrete
- To examine CO2 reduction in ferrock concrete as a environmental benefit
- To check Ferrock concretes behave with aggressive environment

1.2 Scope

- To analysis strength behaviour of ferrock concrete with different percentage of ferrock mix
- To assess mechanical properties through compressive, tensile and flexural strength tests
- This study applicable for only small-scale specimen level it not applicable for full scale structural elements
- Result may help for future research and sustainable construction materials development
- Comparison of ferrock concrete with conventional concrete only under laboratory test

1.3 Advantages

- Give more compressive strength compare to convene conventional concrete
- Absorbs CO2 and reduce heat in cement
- Long-term strength and eco-friendly construction material

1.4 Disadvantage

- Raw materials not easily available in all areas
- High cost compares to conventional
- May Need special curing condition

II. FERROCK

Ferrock is green alternative construction material, mainly it's made of steel industry waste and silica-based materials. It behaves like a cement in concrete but main difference is it absorbs CO2 gas from cement and act as a green material. Normal cement hards from water reaction (hydration) but ferrock cement hards from CO2 reaction (carbonation process) it forms strong iron carbonate compounds so due to this strength improves.

Fig 2.1 Ferrock

The accepted reaction steps for this process are

$Fe + 2CO2 + H2O \longrightarrow Fe^{2+} + 2HCO^{-}3 + H2$

$Fe^{2+} + 2HCO^{-}3 \longrightarrow FeCO3 + CO2 + H2O$

The net reaction then is

$Fe + CO2 + H2O \longrightarrow FeCO3 + H2$

2.1. Material Used

- Cement
- Aggregate
- Iron dust
- Fly ash
- Metakaolin
- Lime powder
- Oxalic Acid

2.2 Cement

Cement may be described as a material with adhesive and cohesive properties that make it capable of bonding mineral fragments ('aggregates') into a compact whole. In this process, it imparts strength and durability to the hardened mass called concrete. The cement used in the making of concrete are called hydraulic cements.

2.3Aggregate

Since aggregate occupies about three-quarters of the volume of concrete, it contributes significantly to the structural performance of concrete, especially strength, durability and volume stability. Aggregate is formed from natural source by the process of weathering and abrasion, or by artificially crushing a larger parent (rock) mass. Other types of aggregate may be used for plain concrete members (Code C1.5.3.1), however, as far be possible, preference shall be given to natural aggregates. Aggregates is generally categorised into fine aggregate (particle size between 0.075 mm and 4.75 mm) and coarse aggregate (particle size larger than 4.75 mm)

2.4 Iron Dust

Iron dust is a waste product from industry is used as a green material for partial replacement of a construction site. It is used to diminish CO2 in concrete

2.5 Fly Ash

Fly ash is a waste residue from coal power generation. They are used as a cementious materials in construction fly ash used to reduce CO2 in concrete. It enhances strength and durability in concrete

2.6 Metakaolin

Metakaolin is a high rich aluminium mineral admixture that reacts with lime and steel dust to enhance strength and durability in concrete and improve performance in cement

2.7 Oxalic Acid

It is a cement alternative, oxalic acid acts as a catalyst, react with the metal particles and improve CO2 reaction and also increase ferrock strength

Table -2.1 percentage of materials added in ferrock

Materials	Percentage (By Weight)
Iron Powder	60%
Flyash	20%
Limestone Powder	10%
Metakaoline	8%
Oxalic Acid	2%

III. MIX DESIGN

3.1 Mix Ratio

Table -3.1 Mix Ratio

	Cement	Fine Aggregate	Coarse Aggregate	Water/Cement Ratio
Ratio	553.85kg/m3	705.92kg/m3	720.3kg/m3	0.4
	1	1.27	1.31	

IV. CASTING OF SPECIMENS

4.1 Conventional Concrete

M25 conventional concrete is prepared by cement sand and aggregate.mix ratio usually 1:1:2(cement sand aggregate) cube size 150mm x 150mm x 150mm and its curring process is for 7 and 14 and 28 days and then test will done (compressive strength test and tensile strength test)

Fig 4.1 conventional concrete cube

4.2 Ferrock Concrete

Ferrock concrete cube is mixture of ferrock materials such as (Steel dust, flyash, metakoline, oxalic acid and lime Salt) caste in a 150mm x 150mm x 150mm mould size and it's cured in a water for 7 14 and 28 days and in a CO2 curing process for its strength and hardening after curing it's taken for a compressive and tensile strength test

Fig 4.2 Ferrock concrete cubes

V. TESTING OF SPECIMENS

5.1 Compressive strength of Cubes

Table 5.1 Conventional cube

Testing Intervel	Cube 1	Cube 2	Cube 3	Average
7 Days	200 KN	210 KN	190 KN	200 KN
14 Days	356 KN	330 KN	315 KN	334 KN
28 Days	597 KN	580 KN	617 KN	598 KN

Table 5.2 Ferrock cube

Testing Intervel	Cube 1	Cube 2	Cube 3	Average
7 Days	240 KN	215 KN	232 KN	229 KN
14 Days	424 KN	418 KN	398 KN	414 KN
28 Days	638 KN	642 KN	648 KN	643 KN

5.2 Tensile strength of Cylinders

Table 5.3 Conventional Cylinder

Concrete cylinder	7 days	28 days
1	3.56	7.60
2	3.10	6.56
3	3.60	7.10
Average value	3.42	7.10

Table 5.4 Ferrock Cylinder

Concrete cylinder	7 days	28 days
1	2.26	3.82
2	2.12	3.23
3	2.30	3.56
Average value	2.22	3.54

VI. COMPARISION OF CHARTS

6.1 Compressive strength of Cubes

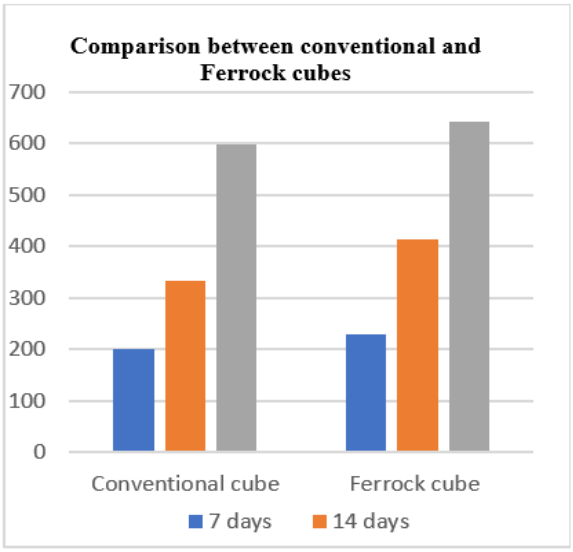

Fig 6.1 Compressive strength test

6.2 Tensile strength of Cylinders

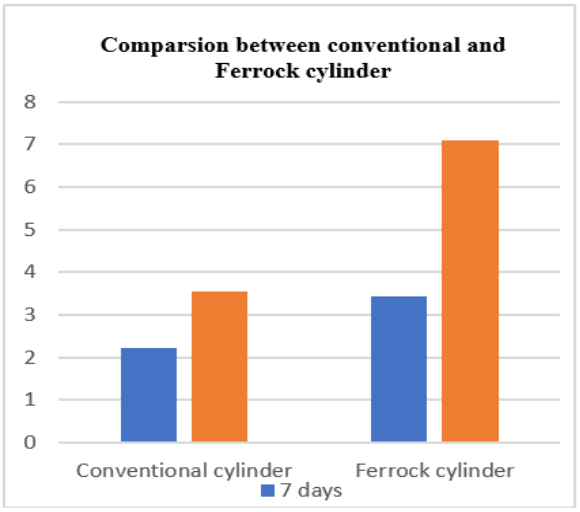

Fig 6.2 Split tensile test

VII. CONCLUSIONS

Here we studied about ferrock concrete a mixture of (steel dust, flyash metakoline oxalic acid and lime powder) which is good in absorbing CO2 producing from cement concrete and act as a green alternative for cement. This performance is compared with conventional cube and cylinder. The main advantage of ferrock concrete is it's absorbing CO2, harden and strengthen the concrete during carbonation process. Test results we observed that ferrock concrete is good in compression strength, durability and crack resistance compared to conventional concrete. So, this ferrock concrete will improve the long-term structural performance

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