RESEARCH ARTICLE OPEN ACCESS

ECO EFFICIENT CONCRETE BY USING DOLOMITE POWDER AND BIOCHAR AS DUAL SUBSTITUTES

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Abstract: **OPC production is one of the major sources of CO2 emissions,accounting for about7-8%of the total anthropogenic CO2 output. Because of this environmental challenge, supplementing with cementitious materials and by-products from industries has become as promising strategy for sustainableconstruction.Thecurrentstudyfocusesonthedevelopmentofeco-efficientconcreteusing dolomite powder and biochar as dual partial substitutes for cement. Different replacement levels of cement with dolomite powder and biochar were tested through experimental investigations. Workability, compressivestrength of concrete and split tensile strength was evaluated.The results showed that concretes with optimum blends of dolomitepowder(10-20%) constantly and as a variable of biochar (1-3%) possessed satisfactory strength and reduces carbon footprint. Thus, enhancing the performances compared to the conventional concrete mixes.**

Key Words:Dolomite,Biochar,M30 ,Compressive Strength,Split Tensile Strength

I. INTRODUCTION

CONCRETE

Concrete is a very strong and versatile mouldable construction material.It consistsofcement,sand and aggregate (e.g., gravel or crushed rock) mixed with water. The cement and water form a paste or gel which coats the sand and aggregate. When the cement has chemically reacted with the water (hydrated), it hardens and binds the whole mix together. The initial hardening reaction usually occurs withinafewhours.Ittakessomeweeksforconcretetoreachfullhard nessandstrength.Concretecan continue to harden and gain strength over many years. It is a popular material for many construction applications,and it is widely used because of its strength,durability,reflectivity,and versatility.These properties make it a sturdy and long-lasting option for numerous domestic and commercial settings

II. LITERATURE REVIEW:

Author / Year	Focus of Study	Key Findings
I. Gusain (2023)	Dolomite in conventional concrete	Maximum compressive & flexural strength observed around 15% cement replacement with dolomite.
X. Chen et al.(2022)	Dolomite in glass-fiber. reinforced concrete mixes	Dolomite addition improved fluidity, long-term strength, durability, and reduced chloride ion penetration at suitable replacement levels.
Gupta et al.(2021)	Effect of adding biochar in concrete mixes	Porous biochar improved internal curing. Slight reduction in workability due to water absorption

III. MATERIALS&METHODOLOGY

Cement(Opc53Grade),FineAggregate,Coarse Aggregate,Biochar,Dolomite

Tests are conducted as per IS-CODES

A.TEST RESULTS ON MATERIALS

Fineness of cement **[IS 4031 (Part-1)]** = **"6%"**

Consistency of cement **[IS 4031(Part-4)]** = **"30%"**

Initial setting time of cement **[IS 4031 (Part-5)]** = **"32 min",**Sieve Analysis Of Fine Aggregate or Fineness modulus **[IS 2386 (Part-1)]** = **"2.60"**

Specific Gravity of Fine Aggregate **[IS 2386 (Part-3)]** = **"2.61"**

Coefficient of curvature [**IS 2720 (Part 4): 1985]** = **"0.99"**

Coefficient of uniformity [**IS 2720 (Part 4): 1985**] = "**3.187**"

Sieve Analysis of Coarse Aggregate or Fineness modulus **[IS 2386 (Part-1)]** = **"7.15"**

Specific Gravity of Coarse Aggregate **[IS 2386 (Part-3)]** = **"2.77"**

Impact Test of Coarse Aggregate **[IS 2386 (Part-4)]** = **"21.75%"**Aggregate Crushing Test **[IS 2386 (Part 4): 1963]**

\= **"35.08%"** (can used of concrete works)

Elongation index test of Aggregates **[IS 2386 (Part 1): 1963]** = **"29.8%"**

Flakiness test on Aggregates **[IS 2386 (Part 1): 1963]** = **"23.1%**

B.Mix Proportions:

Concrete mix of **M30 grade** is designed as per IS10262:2019.Cement is partially replaced with dolomite and biochar in different percentages and totally there are 10 mixes in this experimentalstudy.

C.Mix Variations

- Control Mix (0% replacement)
- 10%Dolomite(constant)+(1%,2%,3%)Biochar(variable).
- 15%Dolomite(constant)+(1%,2%,3%)Biochar(variable).
- 20%Dolomite(constant)+(1%,2%,3%)Biochar(variable).

➢ WatercementratiofortheM30gradeisconsidered:0.42.

Mixratio istaken asperthemix designis**"1 :1.245 : 2.39"**

IV. FRESH CONCRETE(WORKABILITY TEST RESULTS)

Slump-cone test and compaction factor experiments are concucted .

FIG.1.SLUMP CONE ,FIG.2.COMPACTION FACTOR

S. No	Mix	SLUMP (mm)	CF	TYPE OF SLUMP
1	Mix – 0 (Control mix)	100	0.949	Trueslump
2	Mix–1 (D-10%& B-1%)	100	0.94	Trueslump
3	Mix–2 (D-10%& B-2%)	90	0.92	Trueslump
4	Mix–3 (D-10%& B-3%)	85	0.91	Trueslump
5	Mix–4 (D-15%& B-1%)	95	0.89	Trueslump
6	Mix–5 (D-15%& B-2%)	80	0.92	Trueslump
7	Mix–6 (D-15%& B-3%)	80	0.88	Trueslump
8	Mix–7 (D-20%& B-1%)	95	0.90	Trueslump
9	Mix–8 (D-20%& B-2%)	100	0.90	Trueslump
10	Mix–9 (D-20%& B-3%)	95	0.87	Trueslump

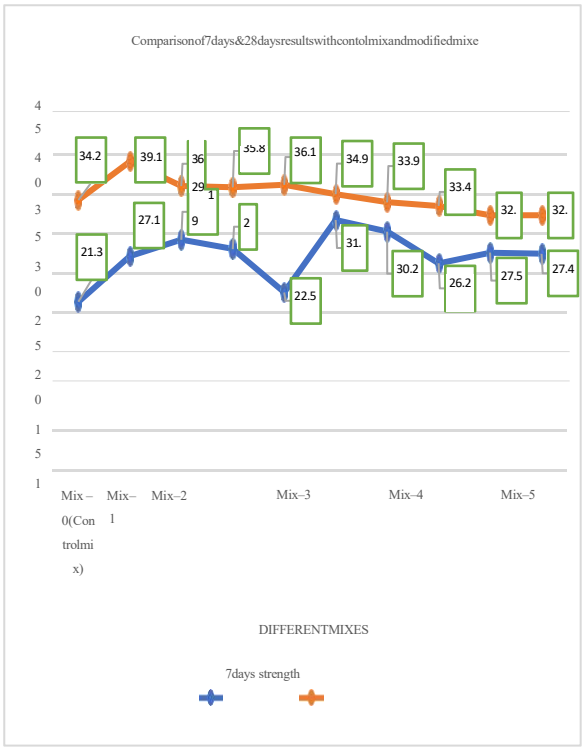
FIG 3.CASTING OF SPECIMENS

V. TESTS ON HARDENED PROPERTIES

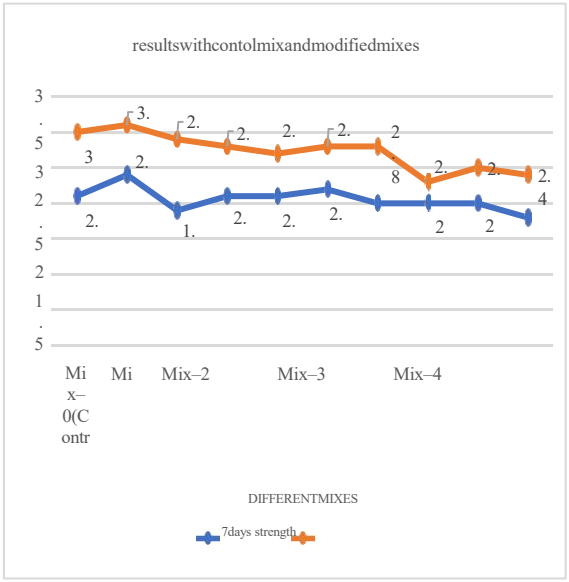
1.COMPRESSIVE STRENGTH 2.SPLIT TENSILE STRENGTH

FIG.4.COMPRESSIVE STRENGTH TEST

Compressive Strength Test Results& Split tensile results(G-1&2)



GRAPH.1.COMPRESSIVE STREGTH RESULTS



GRAPH.2.SPLIT TENSILE STREGTH RESULT

Discussion: The optimum split tensile strength is achieved at Mix–1(D-10%&B-1%)with a maximum28-day strength of 3.1 N/mm², while it also shows the highest 7-day strength of 2.4 N/mm², indicating that lower replacement levels provide the best overall performance; the strength increases from Mix–0 to Mix–1 and then generally decreases from Mix–2 to Mix–9.

VI. CONCLUSIONS

- The present study demonstrates that partial replacement of cement with dolomite powder and biochar has a significant influence on the mechanical properties of M30 grade concrete.
- The compressive strength results indicate that the incorporation of dolomite powder and biochar enhances the early-age strength of concrete when compared to the conventional control mix.
- Among all the mixes,15% dolomite &2% biochar exhibited the highest7-day compressivestrength, indicating improved early hydration and particle packing effect.
- At 28 days of curing, 10% dolomite & 1% biochar achieved the maximum compressive strength, suggesting that lower percentages of replacement contribute to better long-term strength development.
- It is observed that moderate replacement levels of 10–15% dolomite and 1–2% biochar yield optimum strength characteristics, while higher replacement levels adversely affect the performance.
- The reduction in strength at higher replacement levels of 20% dolomite may be attributed to the

dilution effect and reduced cementitious content in the mix.

- The split tensile strength results follow a similar trend as compressive strength, confirming the positive contribution of dolomite powder and biochar at optimum levels.
- The maximum split tensile strength was recorded for 10% dolomite & 1% biochar at both 7 days and 28 days, indicating improved bonding and crack resistance.
- The dolomite powder provides early strength whereas biochar provides maximum strength at 28 days.

However,excessive incorporation of biochar leads to a reduction in strength due to increased porosity and reduced workability.

The study establishes that an optimum combination of10–15%dolomitepowderand1–2%biochar can be effectively used to produce eco-efficient concrete with improved mechanical properties.

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