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ADDITION OF BACTERIAL SUBTILIS AND DOLOMITE POWDER TO CONCRETE

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ABSTRACT
An essential part of construction, concrete frequently suffers from issues with degradation brought on by microbes, carbonation, and chloride intrusion. This study explores how adding dolomite and Bacillus subtilis bacteria to concrete might improve their combined impacts in terms of durability. Rich in calcium and magnesium carbonates, dolomite is used as an additional cementitious ingredient and may provide advantages including better workability, decreased permeability, and enhanced resistance to acid attack. to evaluate split tensile and compressive strength.

Keywords:
Dolomite, Workability, Bacillus Subtilis, Compressive Strength and Split Tensile Strength.

1. INTRODUCTION

This study aims to investigate the combined effects of dolomite and Bacillus subtilis on the durability of concrete. By synergistically harnessing the benefits of a mineral additive and a bio-based agent, this research seeks to develop concrete formulations with enhanced resistance to various degradation mechanisms. Understanding the interaction between dolomite and Bacillus subtilis within the concrete matrix is crucial for optimizing their effectiveness and promoting sustainable infrastructure solutions.

Dolomite, a naturally occurring mineral composed of calcium magnesium carbonate, has garnered attention as a potential additive in concrete production due to its beneficial properties. Concrete, the most widely used construction material globally, undergoes various forms of deterioration over time, including chemical attack, abrasion, and environmental exposure. Incorporating dolomite into concrete formulations offers an opportunity to improve its performance and durability while reducing environmental impact.

By introducing Bacillus subtilis into concrete mixes or applying it to the surface of existing structures, researchers aim to exploit its biomineralization capabilities to repair cracks and voids within the material. Upon activation by moisture and nutrients present in the concrete matrix, Bacillus subtilis cells produce urease enzymes that hydrolyze urea into ammonia and carbonate ions. Subsequently, the carbonate ions react with calcium ions released from calcium hydroxide (a byproduct of cement hydration) to form calcium carbonate precipitates, effectively sealing cracks and improving the material's mechanical properties.

2. OBJECTIVES

(a) Concrete treated with Bacillus subtilis is more durable.
(b) The capacity of dolomite to strengthen resistance against chemical assaults and decrease permeability.
(c) To calculate the split tensile strength and compressive strength.

3. MATERIALS

1. Cement:- Cement plays a crucial role in construction by providing cohesion and strength to building materials. When mixed with water, it undergoes a chemical reaction known as hydration, during which it forms a gel-like substance that binds the aggregates together. This process, called cement hydration, leads to the formation of a solid mass with structural integrity and durability.

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2. Fine aggregate:- Fine aggregate is derived from natural sources such as riverbeds, quarries, or sand pits, or it can be manufactured by crushing rocks or gravel. It plays a crucial role in concrete by filling the voids between coarse aggregate particles and cement paste, thereby improving the workability, cohesion, and strength of the mixture.
3. Coarse aggregate:- coarse aggregate is commonly derived from natural sources such as crushed stone, gravel, or sand and gravel deposits, or it can be manufactured from recycled materials like crushed concrete or recycled asphalt. It is characterized by its larger particle size compared to fine aggregate, providing structural stability and strength to concrete mixes.
4.Dolomite:- Because of its chemical makeup, dolomite reacts to create more calcium carbonate crystals when it comes into contact with calcium hydroxide, which is a result of cement hydration. By filling the capillary gaps and holes in the concrete matrix, these crystals improve durability by lowering permeability.
5.Bacteria Subtilis:- When given an appropriate calcium supply and carbon dioxide, Bacillus subtilis bacteria can cause biomineralization, namely the precipitation of calcium carbonate (CaCO3). These bacteria are not active when added to concrete mixtures; they wait to be stimulated by the moisture and nutrients in the concrete matrix.

6.Water:- Water has a significant impact on the workability, strength, durability, and other characteristics of the hardened material in concrete mixes. For the creation of durable and high-quality concrete buildings, proper mix design, curing procedures, and management of the water-cement ratio are crucial.

4. TEST RESULTS

(a) Compressive Strength: The most significant load or force that a material can bear under compression (pressing or squeezing) before failing or breaking is known as its compressive strength. To determine for 28,56 and 90 days.

Table 1: Compressive Strength Results of Bacillus Subtilis.

Sl.no	Bacillus subtilis	Compressive Strength Results,(N/mm^2)		
		28 days	56 days	90 days
1	0%	39.37	42.89	46.05
2	10^4 Cells/ml	45.29	49.36	53.01
3	10^5 Cells/ml	46.85	51.06	55.21
4	10^6 Cells/ml	41.89	45.68	49.17

Table 2: Compressive Strength Results of Partial Replacement of Cement with Dolomite Powder.

Sl.no	% of Dolomite Powder	Compressive Strength Results,(N/mm^2)		
		28 days	56 days	90 days
1	0%	39.37	42.89	46.05
2	5%	40.92	43.95	47.62
3	10%	42.98	46.81	50.28
4	15%	45.29	49.36	53.01
5	20%	42.81	45.31	50.05

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Table 3: Combined Replacements of Compressive Strength Results of Bacillus Subtilis and Dolomite powder.

Sl.no	% of BS+ DOL	Compressive Strength Results,(N/mm^2)		
		28 days	56 days	90 days
1	0%	39.37	42.89	46.05
2	10^5 Cells/ml BS+15%Dol	49.91	54.42	58.83

Split Tensile Strength: Concrete's split tensile strength is a crucial characteristic as it shows how resistant the material is to tensile stresses and breaking. It is especially important in situations when concrete is anticipated to experience tensile stresses. To determine for 28,56 and 90 days.

Table 4 : Split Tensile Strength Results of Bacillus Subtilis

Sl.no	Bacillus subtilis	Split tensile Strength Results(N/mm^2)		
		28 days	56 days	90 days
1	0%	3.93	4.28	4.59
2	10^4 Cells/ml	4.43	4.82	5.16
3	10^5 Cells/ml	4.76	5.22	5.61
4	10^6 Cells/ml	4.14	4.59	4.85

Table 5: Split Tensile Strength Results of Partial Replacement of Cement With Dolomite Powder

Sl.no	% of Dolomite Powder	Split tensile Strength Results(N/mm^2)		
		28 days	56 days	90 days
1	0%	3.93	4.28	4.59
2	5%	4.04	4.39	4.42
3	10%	4.23	4.62	5.01
4	15%	4.63	5.03	5.46
5	20%	4.18	4.51	4.59

Table 6: Combined Replacements of Split Tensile Strength Results of Bacillus Subtilis and Dolomite powder

Sl.no	% of BS+ DOL	Split tensile Strength Results(N/mm^2)		
		28 days	56 days	90 days
1	0%	3.93	4.28	4.59
2	10^5 Cells/ml BS+15%Dol	4.93	5.37	5.83

5. CONCLUSIONS

1. Dolomite and Bacillus subtilis bacteria in concrete have the potential to increase building resilience, sustainability, and durability.
2. The Normal Concrete of Compressive Strength results for 28,56 and 90 days is 39.37,42.89 and 46.05 N/mm^2.
3. The Normal Concrete of Split tensile Strength results for 28,56 and 90 days is 3.93 , 4.28 and 4.59 N/mm^2.

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4. By 10^5 Cells/ml of bacteria subtilis added in concrete the Compressive Strength results for 28,56 and 90 days is 46.85 , 51.06 and 55.21 N/mm^2.
5. By 10^5 Cells/ml of bacteria subtilis added in concrete the Split tensile Strength results for 28,56 and 90 days is 4.76 , 5.22 and 5.61 N/mm^2.
6. By 15% of dolomite as partial replacement with cement the Compressive Strength results for 28,56 and 90 days is 45.29 , 49.36 and 53.01 N/mm^2.
7. By 15% of dolomite as partial replacement with cement the Split tensile Strength results for 28,56 and 90 days is 4.63 , 5.03 and 5.46 N/mm^2.
8. By the combination of 10^5 Cells/ml BS+15%Dol the Compressive Strength results for 28,56 and 90 days is 49.91 , 54.42 and 58.83 N/mm^2.
9. By the combination of 10^5 Cells/ml BS+15%Dol the Split tensile Strength results for 28,56 and 90 days is 4.93 , 5.37and 5.79 N/mm^2.

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