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An Experimental Investigation on Properties of Concrete by Partial Replacement of Cement with Sulfur

Dr. K. Chandramouli[1], J. Sree Naga Chaitanya[2], G. Hymavathi[3], A. Medhasri Mrunalini[4], M. Ravi Teja[5]

Professor & HOD, Department of Civil Engineering[1],

Assistant Professor, Department of Civil Engineering[2,3&4]

UG Students, Department of Civil Engineering[5]

NRI Institute of Technology, Visadala (V), Medikonduru (M), Guntur, Andhra Pradesh, India

Abstract: *Knowing how long Mars has been around A new planet has been designated as a "sulfur-rich planet." simulation-based building material The development of Martian soil and molten sulfur. in addition to the availability of raw materials for Creating sulfur concrete, while maintaining its strength achieves levels comparable to traditional cementations materials concrete, low temperature, quick curing resistance to acid and salt in the environment,100% recyclability is a desirable feature. The developed Martian Concrete's properties Different sulfur percentages are tested in this study. The best mixing proportions were investigated. To determine strength development, strength variability, and failure mechanisms, three-point bending, unconfined compression, and splitting tests were used 7days 28 days. The results are compared to sulfur concrete made with ordinary sand. The particle size distribution is found to have a significant impact on the final strength of the mixture. Furthermore, because Martian soil is metal-rich, high-temperature mixing produces sulphates and, possibly, polysulfates, which contribute to the high strength. Due to the difference in gravity between Mars and Earth, the optimal mix developed as Martian Concrete has an unconfined compressive strength of above 50 MPa, which corresponds to a roughly 150 MPa concrete on Mars.*

Keywords: Sulfur Concrete, Martian Soil.

I. INTRODUCTION

Astronauts over long periods of time using locally if possible. resources available to construct livable homes be a highly effective means of creating habitats on the planet The surface of the moon or Mars Conducting a series of preparatory studies on analogous soils here on Earth is critical before attempting this in-situ in order to build secure habitats suitable for human life. It is discovered that concrete can be used as a building material using analogue soils for the Moon and Mars as beginning materials. An crucial subject that major governmental space organizations and lunar industry partners are debating is whether concrete is the best solution for locally produced building material. Aside from using lava tubes, melting holes inside the ice caps in polar craters, and simply filling a crater, sintering regolith is one of the most common approaches. Although sintering regolith (heating it to 1000-1150 ^{o}C) results in stronger flexural or tensile strength than concrete, it provides less radiation protection than standard, water-containing concrete. Furthermore, heating lunar dust can be unsafe when humans are present, is often more difficult to mould accurately, is most successful in dry settings, and is not very cost effective in wet conditions. The ductility and durability of ancient concrete was an engineering feat that still holds true today. Just look at structures like the Pantheon and Colosseum in Rome that are still standing. Concrete has helped shape and advance human civilizations for thousands of years. Since ancient Roman times, advances in concrete have shifted to serve more modern needs, like permeable concrete that allows thousands of liters of water to flow right through its surface to prevent pooling and puddles.

II. OBJECTIVES

The objectives of this study are as follows

1. To optimize the usage of cement with sulfur in concrete.
2. To evaluate the compressive and spilt tensile strength of concrete.

III. MATERIALS

The properties of cement are presented in Table 1.

Table 1: Physical properties of cement

S. No.	Property	Cement (53 grade)
1	Specific gravity	3.14
2	Fineness	9.75%

3.1 Sulfur

Sulfur concrete is not a new invention; it was created in the. It's made up of elemental sulfur and aggregate (sand, gravel, or crushed stone) heated to temperatures above 115°C, which is sulfur's melting point. The material achieves high strength and chemical resistance after cooling. Furthermore, sulfur concrete is thermoplastic, making it recyclable after reheating. However, its low melting temperature is a disadvantage because a fire could cause a building made of it to melt down.

IV. EXPERIMENTAL INVESTIGATIONS

4.1 Compressive Strength Results

The compressive strength conducted in compression testing machine for the cast and cured specimens and the results are furnished in table 2.

Table 2: Compressive strength of concrete with sulfur as partial replacement of cement in concrete

Sl. No	sulfur	7 days	28 days
1	0%	33.29	47.58
2	10%	37.56	53.85
3	20%	39.17	56.82
4	30%	42.56	60.95
5	40%	39.78	58.64

4.2 Split Tensile Strength Results

The split tensile strength conducted in compression testing machine for the cast and cured specimens and the results are furnished in table 3.

Table 3: Split tensile strength of concrete with sulfur

Sl. No	Sulfur	7 days	28 days
1	0%	3.28	4.70
2	10%	3.73	5.36
3	20%	3.85	5.56
4	30%	4.24	6.08
5	40%	3.88	5.73

V. CONCLUSION

- The compressive strength of concrete by partially replacement of cement with 30% of sulfur 42.56N/mm^2 in 7 days and 60.94 N/mm^2 in 28days
- The split tensile strength of concrete by partially replacement of cement with 30% of sulfur 4.24 N/mm^2 in 7 days and 6.08 N/mm^2 in 28 days.

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