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Strength Studies on Concrete by Dunite Powder as Cement Replacement and Tamarind Kernel Shell Powder as Additive

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ABSTRACT: The search for environmentally friendly and sustainable building materials has prompted researchers to investigate substitute ingredients in the creation of concrete. This study examines the performance of concrete that has tamarind kernel shell powder (TKS) added and dunite powder used as a partial substitute for cement. Because of its pozzolanic qualities, dunite, a magnesium-rich rock, has a lot of potential applications as a cementitious material. A by-product of the tamarind processing industry, tamarind kernel shell powder has qualities that can improve the performance of concrete and is high in polysaccharides. Concrete mixes were created and tested in this experimental investigation using different amounts of dunite powder (20%, 40%, and 60% by weight) in place of cement, and TKS added at a constant 0.5% by weight of cement. We assessed the concrete's fresh properties, such as workability and setting time. Furthermore, at 28, 56 and 90days, the compressive strength and split tensile strength were evaluated.

KEY WORDS: Tamarind Kernel Shell Powder, Dunite Powder, Polysaccharides, Compressive Strength and Split Tensile Strength.

I.INTRODUCTION

Infrastructure development greatly benefits from the use of concrete, one of the most popular building materials in the world. However, because of the high energy requirements and CO₂ emissions involved in its manufacturing process, its production necessitates the consumption of large amounts of cement, a primary binder with significant environmental impacts. Furthermore, there are environmental issues associated with the disposal of industrial and agricultural byproducts. A growing number of people are interested in creating sustainable concrete substitutes that use additional cementitious materials and environmentally friendly additives in response to these worries.

Using tamarind kernel shell (TKS) as an ingredient and dunite powder as a partial substitute for cement is one possible method. When finely powdered and added to mixes, dunite, a naturally occurring rock rich in magnesium, has pozzolanic qualities that can aid in the hydration and development of concrete's strength. Moreover, polysaccharides and other organic compounds found in tamarind kernel shell, a byproduct of the tamarind processing industry, have been demonstrated to improve the qualities of concrete.

Concrete's sustainability, performance, and environmental impact may all be enhanced by using TKS as an additive in place of cement and dunite powder as a cement substitute. The purpose of this study is to look into how adding TKS and dunite powder affects the workability, strength, and durability of concrete both when it's new and when it has hardened.

This research adds to the expanding body of information on sustainable building materials by examining the performance of concrete mixes using dunite powder and TKS. It also offers insights into the viability of using these alternative components in the manufacturing of concrete. The study's conclusions have ramifications for the building sector and provide possible directions for robust and ecologically friendly infrastructure development.

II. OBJECTIVES

1. To evaluate how Dunite and Tamarind Kernel Shell Powder are used in cement.
2. To ascertain the concrete's compressive and split tensile strengths.

III. MATERIALS

3.1 Cement: Cement serves as a binding agent in construction, holding the other building elements together. Coarse aggregate makes up most of the material in concrete, with fine aggregate filling in the voids left by the coarse aggregate. Unlike concrete, which is simply cement mixed with coarse material, mortar is made of only ordinary cement, water, and fine aggregate.

3.2 Fine Aggregate: During mining, naturally existing sand particles are taken out of the earth to become fine aggregates. You can use any size of crushed stone particles that are $\frac{1}{4}$ " or less. Because of the aggregate's size or grade, this product is commonly referred to as 1/4" minus. Fine aggregate is material that flows through an IS Sieve with a 4.75 mm opening. Sand in the Grade II Grading Zone of the River. Medium grain size.

3.3 Coarse Aggregate: Coarse aggregate is defined as aggregate that has been retained over IS Sieve 4.75 mm. Generally, the maximum size of the particles used in self-compacting concrete is between 10 and 20 mm, while it has been observed that even 40 mm can be used.

3.4 Dunite Powder: Dunite powder is produced by crushing and grinding dunite rock into fine particles, often with specific size distributions tailored to various applications. It can be utilized as a supplementary cementitious material in concrete production, thanks to its pozzolanic properties. When dunite powder is mixed with water and calcium hydroxide (a by-product of cement hydration), it undergoes a chemical reaction that forms additional calcium silicate hydrate (C-S-H) phases, contributing to the binding and strength development of concrete.

3.5 Tamarind Kernel Shell Powder : The process of producing TKS powder involves finely powdering the husks or outer shells of the tamarind seeds. Numerous chemical components, including fibers, are abundant in this powder. TKS powder is suited for a range of industrial uses, including the manufacturing of concrete, because of its composition, which confers upon it certain advantageous features.

3.6 Water: When considering concrete mixtures, one of the key components that holds the cement, aggregate (such as crushed stone or sand and gravel), and any additional materials together to create a cohesive and workable combination is water.

IV. EXPERIMENTAL INVESTIGATIONS

4.1 Compressive Strength Results: Concrete specimens are cast and cured under controlled conditions in accordance with conventional methods to ascertain the material's compressive strength. These specimens are usually tested in a compression testing apparatus, where the specimen is subjected to progressively higher compressive forces until failure. The compressive strength of the concrete is often given in megapascals (MPa) or N/mm², which is the maximum compressive load that the specimen can withstand divided by its cross-sectional area.

Table 1: Compressive Strength of Concrete With Constant Percent Of Tamarind Kernel Shell Powder and Dunite Powder as Partial Replacement of Cement.

S.No	0.5% of TKS+ % of Dunite Powder	Compressive strength results,(N/mm ²)		
		28 days	56 days	90 days
1	0%	49.16	53.54	57.38
2	0.5%+20%	66.14	72.04	76.81
3	0.5%+40%	68.72	74.22	79.74
4	0.5%+60%	67.01	72.99	78.33

4.2 Split Tensile Strength Test: An equipment with two compressive platens and a cylindrical specimen is positioned horizontally between them to evaluate the split tensile strength of concrete. The specimen experiences diametric compression, which splits and splits it throughout its length. Split tensile stress is defined as the tensile stress that develops perpendicular to the force applied.

Table 2: Split tensile Strength Of Concrete With Constant Percent Of Tamarind Kernel Shell Powder and Dunite Powder as Partial Replacement of Cement.

S.No	0.5% of TKS+ % of Dunite Powder	Split tensile strength results,(N/mm ²)		
		28 days	56 days	90 days
1	0%	4.81	5.22	5.59
2	0.5%+20%	6.49	7.07	7.53
3	0.5%+40%	6.83	7.45	7.99
4	0.5%+60%	6.58	7.18	7.64

V. CONCLUSIONS

1. The compressive strength results for 28, 56 and 90 days of normal concrete are 49.16, 53.54 and 57.38 N/mm².
2. The split tensile strength results for 28, 56 and 90 days of normal concrete are 4.81,5.22 and 5.59 N/mm².
3. 0.5% of Tamarind kernel shell powder is maintaining constant and varying different percentages of dunite powder at 40% optimum the compressive strength results for 28, 56 and 90 days is 68.72,74.22 and 79.74 N/mm².
4. 0.5% of Tamarind kernel shell powder is maintaining constant and varying different percentages of dunite powder at 40% optimum the split tensile strength results for 28, 56 and 90 days is 6.83,7.45 and 7.99 N/mm².

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