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# Strengthening on Pine Apple Leaf Fiber Concrete with Silica Fume

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**ABSTRACT:** This study looks into the mechanical characteristics of concrete that has been treated using pine leaf fiber and cement instead of silica fume. Fibers made from regenerating pine trees, known as pine leaf, are being investigated as a viable substitute for conventional concrete reinforcing elements. Cement is also used in place of silica fume in an effort to improve the environmental impact of concrete production. Distinct concentrations of silica fume blends with cement—5%, 7.5%, and 12.5% as well as 0.3% of pine leaf fibers were used to make distinct concrete compositions. Mechanical experiments were performed to examine the performance of the amended concrete, which included assessments of its split tensile strength and compressive strength. The findings show that adding pine leaf fibers to concrete improves its tensile strength and resistance to cracking. To assess strength at 28, 56 and 90 days.

**KEY WORDS:** Silica Fume, Pine leaf fibers, Environmental impact Compressive Strength and Split Tensile Strength.

## I. INTRODUCTION

As the most popular building material in the world, concrete has undergone constant innovation to satisfy the needs of sustainable development. Traditional concrete production uses a lot of non-renewable resources, such as cement and aggregates, which raises environmental issues because of the high energy use and carbon emissions. In this environment, researchers and practitioners have focused a great deal of attention on the investigation of substitute materials and additives to enhance the sustainability and performance of concrete.

The use of natural fibers in concrete mixtures is one such potential approach. Natural fibers provide a number of benefits, such as being inexpensive, renewable, and able to improve the mechanical qualities of concrete. Among the natural fibers that have attracted attention are pineapple leaf fibers (PALF), which are abundant as agricultural waste and have the potential to efficiently strengthen concrete.

The use of supplementary cementitious materials (SCMs) in addition to natural fiber reinforcing has been extensively researched to improve concrete performance. The manufacture of silicon and ferrosilicon alloys leaves behind silica fume (SF), a widely used SCM with pozzolanic qualities. Concrete mixtures can be strengthened, made to last longer, and made more resistant to chemical attacks by adding silica fume. In addition, the application of silica fume promotes sustainability in the building sector by mitigating greenhouse gas emissions linked to cement manufacture.

## II. OBJECTIVE

1. Examine the effects of adding silica fume in place of some of the cement on the strength, durability, and sustainability of pineapple leaf fiber concrete.

## III. MATERIALS

**3.1 Cement:** Ordinary Portland cement is the type of cement that is most often used in construction worldwide. It is an essential component of concrete, mortar, plaster, and most nonspecialty grouts. Cement is the main material that is used to make concrete. The characteristics of concrete will change significantly if the cement content is altered. Ordinary Portland cement of grade 53 was used in this project in compliance with IS 12269-2013.

**3.2 Fine Aggregate:** When making concrete with crushed stone or natural sand, fine aggregate is the most important ingredient. The fine aggregate's density and quality have a significant impact on the properties of the cured concrete.

**3.3 Coarse Aggregate:** The coarse material utilized was 12.5 mm in lowest size and 20 mm in maximum size. It was conveniently located nearby. The aggregates were cleaned to get rid of dust and filth, and then they were dried until the surface was the only thing that was damp. According to IS: 383-1970, the aggregates were determined to be compatible.

**3.4 Silica Fume:** Silica fume is used as a supplementary cementitious material in concrete. When added to concrete mixtures, it improves various properties such as compressive strength, durability, and resistance to chemical attack and abrasion. It achieves these effects by filling in the spaces between cement particles and reacting with calcium hydroxide to form additional calcium silicate hydrate (C-S-H) gel, which enhances the strength and density of the concrete.

**3.5 Pine Apple Leaf Fiber :** Bio composites and material science have greatly benefited from pineapple leaf fiber composite. It has been demonstrated that PALF is a good alternative to artificial filaments because of its rational and endless character. The leaf fibers are created by separating the outermost layer of the leaves from the leaf fibers, which are subsequently dried.

**3.6 Water:** Making mortar, mixing cement concrete, and curing work are just a few of the many processes that require water, one of the most important building elements. The quality of the water used has a direct impact on the strength of the cement concrete and motor in the construction project.

#### IV. EXPERIMENTAL INVESTIGATIONS

**4.1 Compressive Strength Results:** To find the compressive strength of concrete, specimens are cast and cured under carefully monitored conditions using standard procedures. Typically, compression testing is used to test these specimens, subjecting them to increasing compressive forces until they break. Megapascals (MPa) or N/mm<sup>2</sup>, which represent the maximum compressive load that a specimen can support divided by its cross-sectional area, are commonly used to express the compressive strength of concrete.

**Table 1: Compressive Strength of Pine Apple Leaf fiber Concrete With 0.3% Constant Percent and Varying Percentage of Silica Fume as Partial Replacement of Cement.**

S.No	0.3% of PALF+ % of Silica Fume	Compressive Strength results, (N/mm <sup>2</sup> )		
		28 days	56 days	90 days
1	0%	39.08	42.41	45.43
2	0.3%+5%	48.34	52.57	56.45
3	0.3%+7.5%	51.67	56.31	60.48
4	0.3%+12.5%	47.72	51.95	55.82

**4.2 Split Tensile Strength Test:** The split tensile strength of concrete is assessed using apparatus consisting of two compressive platens and a cylindrical specimen positioned horizontally between them. The specimen is diametrically compressed, causing it to split along its length. The term "split tensile stress" refers to tensile stress that develops in the opposite direction of the applied force.

**Table 2: Split tensile Strength of Pine Apple Leaf fiber Concrete With 0.3% Constant Percent and Varying Percentage of Silica Fume as Partial Replacement of Cement.**

S.No	0.3% of PALF+ % of Silica Fume	Split tensile Strength results, (N/mm <sup>2</sup> )		
		28 days	56 days	90 days
1	0%	3.81	4.25	4.48
2	0.3%+5%	4.74	5.16	5.53
3	0.3%+7.5%	5.12	5.57	5.99
4	0.3%+12.5%	4.67	5.09	5.46

### V. CONCLUSIONS

1. The compressive strength results for 28, 56 and 90 days of normal concrete are 39.08, 42.41 and 45.43 N/mm<sup>2</sup>.
2. The split tensile strength results for 28, 56 and 90 days of normal concrete are 3.81, 4.25 and 4.48 N/mm<sup>2</sup>.
3. 0.3% of Pine apple leaf fiber in concrete and at 7.5% of silica fume the compressive strength results is optimum for 28,56 and 90 days is 51.67, 56.31 and 60.48 N/mm<sup>2</sup>.
4. 0.3% of Pine apple leaf fiber in concrete and at 7.5% of silica fume the split tensile strength results is optimum for 28,56 and 90 days is 4.67, 5.09 and 5.46 N/mm<sup>2</sup>.

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