# Behaviour of Concrete by using Pineapple Leaf Fibre

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***Abstract*— Concrete is one of the most widely used construction material nowadays. Concrete have excellent compressive strength and the overall strength can be enhanced by the addition of reinforcements. Steel is the major reinforcement material used in concrete. But nowadays fibres are also used for reinforcement. The use of plant fibres in concrete holds a pre-dominant position in the concrete industry. It helps to reduce the negative impacts caused by the man-made fibres as well as to incorporate the natural resources as a substitute for artificial resources. Pineapple leaf fibre (PALF) is one among them. PALF is abundantly available at low cost in tropical areas, especially in Kerala. It has high tensile strength compared to other type of natural fibres. It also reduces shrinkage and cracks in concrete. This work highlights the behaviour of pineapple leaf fibres added to concrete. The diameter is taken as an average value of 80 µm and different lengths are taken. In this study the different length at which PALF taken are 5mm, 15mm and are added at fixed concentration of 0.4 % by weight of cement and is reinforced in concrete. Concrete is prepared with a mix ratio of 1:1.5:3 and the properties of fresh and hardened concrete are studied.**

***Keywords: PALF (Pineapple Leaf Fibre), Compressive Strength, Slump, Workability***

## I. INTRODUCTION

Concrete is one of the most used composite in the world and is mostly used in construction activities. It is made up of filler materials like aggregate which is glued using binding materials like cement. It is widely used due to its properties of good compressive strength, high mouldability and plastic when fresh, durable, impermeable and fire resistant when hardened. The strength of concrete can be improved by the introduction of fibre material into the composite. Pineapple leaf fibre is a good option due to its high strength and easy availability. Natural plant fibres like pineapple leaf fibre are better than artificial materials or other chemically active materials. Fibres help in reducing the shrinkage and cracks in concrete and also help in improving the strength and toughness of the composite.

## II. LITERATURE SURVEY

**Kayibanda Patrick, Richard Ocharo Onchiri, Geoffrey N (2019)** proposed suitable proportions for the production of Pineapple Leaf Fibers (PALF) reinforced Normal Strength Concrete. Pineapple leaf fibres were chosen for study due to their high tensile strength and high cellulose content. The PALF percentage was taken on basis of weight of cement, which is 0%, 0.2%, 0.4%, 0.6%, 0.8%, and 1%. PALF were treated in 4% of Sodium Hydroxide it increases fibers roughness by chemically modifying and cleaning the fibre surface. The incorporation of PALF increased the water absorption of the mix which continued to increase with increased fibre content. The results showed that PALF can be used to improve the strength of Normal Strength Concrete. PALF have also shown that they can reduce cracks in the structure and improve the strength of concrete. The best percentage was obtained from 0.2% to 0.8% as the slump was in range. PALF reinforced concrete was seen not workable after 1% PALF addition.

**R Abhirami and D. S Vijayan(2020)** presented the comparison on behavior of Pineapple Leaf Fibre composite in different fibre ratios with conventional concrete. PALF are used within the concrete to increase its strength. PALF is cheap and easily available. Addition of fibre to the concrete is done to improve its properties. It can be used as a replacement of steel reinforcement. The studies show that the compressive strength was increased up to 30.62% on addition of PALF at 0.1%. PALF reinforced concrete has increased mechanical properties as compared to conventional concrete. Aggregate along the PALF gives less crushing value as

compared to normal aggregate alone. Hence this can be used in airport and shopping mall pavements as it has less crushing value and high strength as compared to conventional concrete.

**Linto and Mathew (2017)** investigated the mechanical strength of pineapple fibre reinforced concrete after subjected to higher temperature. The fibre contents were chosen as 0.05%, 0.10%, 0.15%, 0.20% and 0.25%. The maximum compressive strength was attained at 0.10% addition of the fibre at 7 days and 28 days. The mechanical strength was found to be decrease at larger fibre content.

**R. Roseline and Dr. M.S Ravikumar (2019)** done experimental investigation on pineapple reinforced concrete, and the obtained conclusion was that the pineapple fibre can effectively be used as reinforcement for the production of concrete. The maximum strength was attained at 0.75% addition of fibres at both the ages of 7 and 28 days. The results also show a maximum strength achievement of 14.40% at 7 days and 13% at 28 days when compared to the control specimen.

## III. OBJECTIVE OF WORK

This study aims to compare the effect of fixed proportion of PALF at different length on compressive strength of concrete.

## IV. MATERIALS

**Cement**- OPC grade 53 cement was used for the experimentation works as per IS 12269-2013. As per the Indian standards the initial and final setting time are 30 minutes and 10 hours respectively. The specific gravity was observed as 3.10 g/cm$^3$ and initial setting time was obtained as 32 minutes.

**Fine and Coarse Aggregates**- The aggregates was chosen with respect to SP 21: 2005 and the testing was done as per IS 2386 (Part 1)- 1963. Fine aggregate have a size less than 4.75mm with a specific gravity of 2.3 g/cm$^3$. Coarse aggregate chosen was in the size range of 4.75mm to 20 mm. It had a specific gravity of 2.6 g/cm$^3$.

**PALF**- Fibres extracted from pineapple leaf was treated with 5% NaOH solution to enhance its strength. The obtained fibre was cut down to 5mm and 15mm lengths. PALF has an average diameter of 80µm with a density of 1.32 to 1.543 g/cm$^3$. Its tensile strength and toughness was observed as 654MPa and 95MPa [2].

Fig. 1- Pineapple Leaf Fibre

**Water**- Potable water was selected as per IS 456: 2000.

## V. METHEDOLOGY

### A. *Testing Of Materials*

Cement was tested for specific gravity and setting time. The specific gravity of both fine and coarse aggregate is determined.

### B. *Preparation of PALF*

Fibre from pineapple leaf is extracted after retting and treated with 5% NaOH solution. It is then sundried and cut down to the required length.

### C. *Preparation and Testing of Concrete*

Concrete of mix proportion 1: 1.5: 3 is prepared for control mix and PALF reinforced concrete mix, with fibre length of 5mm and 15mm at a fixed fibre-cement ratio of 0.4%. The adopted water-cement ratio was 0.5. Workability was determined using slump cone value. The cube specimen of size 150×150×150mm is prepared for compressive strength test. The specimens are cured for 28 days and compressive strength is determined using compression testing machine.

## VI. RESULTS AND DISCUSSION

The slump value was found to be decreasing with the increase in fibre length. The reduction in slump is due to the increased water absorption by the fibre from the concrete matrix.

TABLE I. SLUMP VALUE

| Specimen | Slump Value [a] |
|---|---|
| MPF 0 | 45 |
| MPF 5 | 13 |
| MPF 15 | 9 |

[a] Values in mm

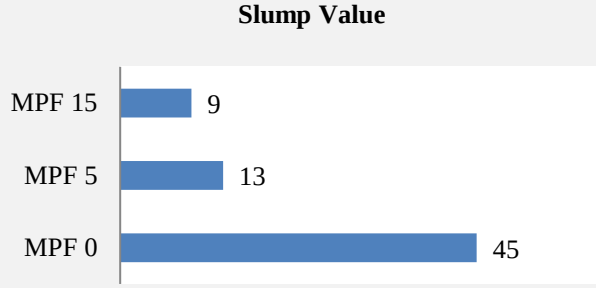


Fig. 2- Comparison of slump value

Result of compressive strength test on the 28$^{th}$ day was observed to be increasing. There was an increase of 6.7% and 9.75% in compressive strength for specimen with 5mm and 15mm PALF respectively when compared to the control mix.

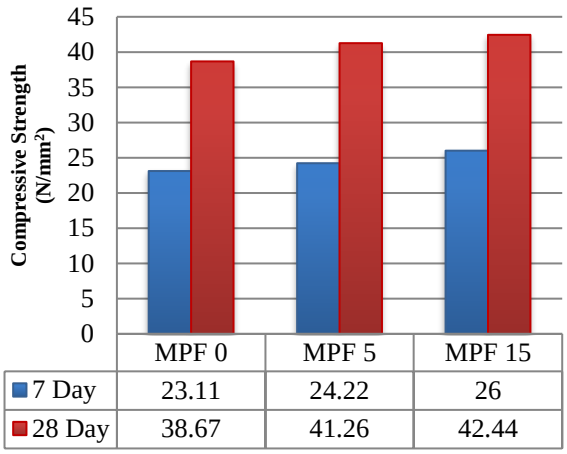


Fig. 3- Comparison of Compressive Strength of test specimens.

## VII. CONCLUSION

The test results showed that workability of PALF reinforced concrete was reduced. This type of concrete with low slump value can be utilized in road construction and in construction of liquid storing tanks. The compressive strength increased with the increase in length of fibre.

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