# STUDIES ON THE MECHANICAL PROPERTIES OF POLYVINYL ALCOHOL FIBER CONCRETE-REVIEW

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***ABSTRACT***-Concrete is very strong and versatile mouldable construction material. It consists of cement, fine aggregate, coarse aggregate and water is used for mixing. Many researchers adding new materials to the concrete for getting better results when compare than conventional concrete. Polyvinyl alcohol (PVA) fibre is considered as one of the most suitable polymeric fibers to be used in concrete, though the unique microstructure characteristics of PVA fiber add challenge to the material design. There are different types of fiber are available in the market but using this PVA fiber in this project, for the purpose, it was nontoxic and has more tensile strength when compared to many other fibers.

***Keywords***:**Polyvinyl alcohol, Fibre Reinforced Concrete.**

## 1. INTRODUCTION

### 1.1 FIBRE REINFORCED CONCRETE

Concrete is the most widely used construction material in Civil Engineering projects in worldwide. Huge quantities of different types of concrete have been produced annually. From various kind of concrete fibre reinforced is one of the most interesting subjects for researchers. The ingredients of conventional concrete are cement, fine aggregate, coarse aggregate and water. Some improvements in the concrete field, which can be made by adding of some new material in to it**[1]**,adding every new material makes some kind of impact on the concrete but the impact should be positive and it is pleasant. Fibre reinforced concrete (FRC) is made by naturally adding and mixing discontinuous small randomly fibers with in concrete. Incorporation of polymeric fibres in concrete are recognised to be most effective in controlling the plastic shrinkage, cracking. Certainly, limited research carried out to date on the innovative inclusion of polyvinyl alcohol (PVA) fibers in engineered cementitious composites has proven that ductility and post ultimate behaviour may be enhanced **[2]**Fibres are known to increase energy absorption capacity and toughness when added to concrete. Concrete is considering being a brittle material that is weak in tension and strong in compression. The ductility of concrete may be improved by using fibre to enrich the tensile and flexural properties.

### 1.2 POLYVINYL ALCOHOL

Studied that the effect of non-coated PVA fibres in different volume fractions ranging from 0.25% to 1% in two geometric lengths, 6 and 12mm, have been investigated. Fresh properties and compressive strength were tested and the results compared to the control concrete mix.

Less workability is observed for mixes having more fibre even with a higher amount of HWR. Mixes with longer fibre show lower slump compared to shorter fibre for the same fibre volume addition. As a result, it can be concluded that adding PVA fibre decreases concrete slump. Air content is increased by introducing fibre into the concrete mix and it has an increasing trend by fibre volume addition. Mass per unit volume of concrete is decreased by adding fibres in the mix. This is possibly due to the lower density of the fibres contributing to a lower volume density. Characteristic compressive strength at 28 days ($f'$c) increases by fibre addition and optimum fibre volume fraction is found to be 0.25% with approximately 16% improvement in $f'$c**[6]**. It can also be concluded that shorter fibres act better in terms of compressive strength compared to the longer fibre. Strength gain rate from 7 to 28 days is almost double for FRCs compared to the control concrete. It can be concluded that PVA fibres help with improving the compressive strength in later ages.

### 1.3 PVA-ECC

Explained that micromechanics models have been proven a powerful tool in PVA-ECC designThrough interface and matrix tailoring, PVA-ECC delivers tensile strain capacity exceeding 3%, along with tensile strength is above 5 MPa, flexural strength is above 15 MPa, and compressive strength is above 70 MPa. Crack width in PVA-ECC is a material property, and is controlled to below 60 µm. In addition, PVA-ECC exhibits excellent freeze-thaw durability. Although drying shrinkage of PVA-ECC is higher than structural concrete due to high binder content, the cracking behaviour under restraint shrinkage is much better than concrete due to strain hardening`discussed that composition and strength of the initial cementitious matrix:**[5]**as shown in both the masonry and the concrete structure application studies discussed in this paper, the lower strength matrices may benefit more from fiber addition compared to stronger base mixtures. volume fraction (between 1% and 2%) can affect energy absorption, modulus of rupture, fracture toughness, and impact resistance of the resulting FRC. Our studies have shown significant impact in these characteristics with 0.25%–0.6% volume fractions of fibres, confirming that when the base matrix is of a lower strength, the effect of fibres may be amplified. The size of the fibres: our findings showed that Nano fibres have negative effects on the FRM/FRC, and macro fibres do not fit well with masonry applications. Micro fibres should be preferred for masonry applications. For applications where additional improvements in strength and ductility are desired, hybrid mixtures of micro and macro fibres may be considered. Geometry and surface texture of the fiber: as stated when describing the problems when using horse hair, excessively oily and smooth fiber surfaces tend to pull out instead of stitching cracks.

**1.4 HYBRID FIBRES**

Detailed about the Flexural Strength of Conventional Concrete was found to be lesser in comparison with ECC with Steel, PVA and Hybrid Fibres. If the percentage of Steel fibres is increase from 3 to 4 then nearly about 15% of increase in flexural strength is noticed whereas in PVA fibres if percentage is increase from 1.5 to 2 then 20% of increment in flexural strength is noticed. **[9]**In Hybrid fibres, Flexural strength was found in the average range of SECC 3 & PVA 1.5 with reducing the balling effect of fibres. In failure pattern it is observed that the CC fails into two parts where as in ECC only crack is developed which reflects its ductile behaviour.

Noushini1 et.al (2013) explained about The effect of adding PVA fibres to concrete were investigated in this study. The compressive strength of concrete ismarginally increased with increasing fibre content and the optimum volume fraction goes to 0.25% for geometric lengths, 6 and 12 mm, with approximately 10% improvement compared to the plain concrete. The same trend for tensile and flexural strength is also observed with increasing fibre content. **[11]**The average strength development of 20% in flexure and 30% in splitting tensile at 0.25% volume fraction shows to what extend fibres can improve the properties of plain concrete. Furthermore, FRCs showed lower flexural stiffness together with providing a higher load bearing capacity compared to the control. This results in a higher ultimate deflection for FRCs where the peak load values were remained constant

Briefed about experimental results of his study, it can be found that the addition of PVA fibers enhanced the mechanical properties of concrete. The workability of fiber-reinforced concrete decreases by increasing the volume fraction of PVA fibers. A maximum reduction of 40% has been determined for OPS concrete with 0.5% PVA fiber content. Furthermore, the addition of PVA fibers with low specific gravity to the OPS mixtures reduces the density of the concrete. However, PVA fibers that contribute to the marginal reduction in density cannot be ignored **[9].** The compressive strength of OPS concrete has increased for all ages with an increase in PVA fibers. The effect of PVA on compressive strength of lightweight concrete has been shown more prominent at latter ages due to better fiber/matrix interface adhesion. The 28-day compressive strength of PVA fiber-reinforced OPS concrete is found to be within 43– 49 MPa. The addition of PVA fiber up to 0.375% had a positive effect on the compressive strength loss under no curing (AC) condition. Therefore, it can be deduced that PVA fibers can be used to reduce the sensitivity of OPS concrete in poor curing environments. The inclusion of PVA fiber to OPS concrete increases the strain capacity corresponding to peak stress, which causes OPS concrete to become more ductile. **[10]**The addition of PVA fibers also enhances the splitting tensile and flexural strengths significantly up to 30 and 32%, respectively, compared to the control concrete. The inclusion of PVA fibers into OPS concrete has a significant effect on the modulus of elasticity. The value measured in this study is 16.1 GPa, which is higher compared to previous studies. Hence, it can be concluded that PVA fiber-reinforced OPS LWC showed the possibility and accepted performance for potential application in producing green composite concrete structures. From the study of journals, PVA fibre concrete gives better results in flexural and split tensile strengths than conventional concrete. Optimum strength has attained between 0.5% to 0.75% fiber added in the concrete. The addition of PVA fibre enhances the splitting tensile and flexural strengths significantly up to 40%. PVA fibre is a toxic and it's was biodegrade slowly.

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