A REVIEW PAPER ON EXPERIMENTAL INVESTIGATION ON PVA FIBER IN REINFORECED CONCRETE

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Abstract: The application of fiber reinforced concrete is more efficient in various special structures. Fiber can reduce the concrete grade for high quality of work that is for the special structures because it gives more compressive as well as flexural strength in less grade of concrete. By observing many research papers, the optimum content of Polyvinyl Alcohol fiber of 0.3% was find out. The content of polyvinyl alcohol fiber of 0.4% was added in the conventional concrete to check if further increase in the content of PVA fiber wills results in increase or decrease in the strength of concrete. The durability performance of PVA fiber concrete will be find out by immersing the concrete cubes in sodium chloride (NaCl), sodium sulphate (Na_2So_4), and magnesium sulphate ($MgSo_4$) for 90 days .

Index terms PVA Fiber as a crack arrest, Durability, Compressive strength

I. INTRODUCTION

Plain cement concrete obtained a very low tensile strength, limited ductility and little resistance to cracking. Internal micro cracks are inherently present in the concrete and its poor tensile strength is due to the propagation of such micro cracks, eventually leading to brittle fracture of the concrete. A composite material consisting of mixtures of cement mortar or concrete and discontinuous discrete uniformly dispersed fibers is known as fiber reinforced concrete. Fiber is a hair like reinforcing material possessing certain characteristic properties. They can be circular or flat. The fiber is mostly described by convenient parameter known as aspect ratio. The aspect ratio of t0he fiber is the ratio of its length to its diameter. Typical aspect ratio value ranges from 30 to 150. The use of PVA fiber is effective as small size particles arrest the cracks in concrete and making it durable. Hence, we can say that use if PVA fiber as a filler in concrete reduces this problem effectively.

Figure 1 PVA fiber

II. LITERATURE REVIEW

1. **Mr.M.Ganesh kumar, Dr. M. Devi, Mr.L.Kannan, Mr.T.S.Venkatachalam. (2018)**

In this paper, author use PVA fiber as the investigating agent for the durability studies on polyvinyl alcohol fiber (PVA) reinforced concrete. The undisputed adequacy of polyvinyl alcohol fiber (PVA) amongst civil engineering application is very vital considering the strength and durability of PVA fiber concrete over conventional steel reinforced concreting methods. In today's need, the construction quality and concrete shall be durable and at the same time cost effective. Therefore we will herein present the analysis report about the PVA fibers in terms but not limited to durability, strengths, cost effectiveness etc. The detailed study and design carried out for selected PVA fiber materials to be mixed with normal concrete in different proportions/concentrations i.e. 0%, 01.1%, 0.2%, 0.3% & 0.4% by its cement content weight proportion. The analysis itself defines that how after 28 curing days the tensile and compressive strength increased by just adding 0.3% concentration of PVA fibers. Ultimately the above stated conclusions will reduce the aggregate material cost and maintenance of construction.

2. **Subhan Ahmad and Arshad Umar (2018)**

The purpose of this experimental work was to study the effect of glass and polyvinyl alcohol fiber on fresh and hardened properties of SSC. For this purpose, seven mixes; SCC, SCC with 0.1%, 0.2% and 0.3% of glass and PVA fibers by volume of SCC were prepared with a water-powder ratio of 0.35. The Hardened properties estimated for all four mixes were Compressive strength, flexural strength, splitting tensile strength, modulus of elasticity and Ultrasonic pulse velocity. Experiments revealed that after the addition of fibers workability. After the addition of fibers, Hardened properties were improved and this improvement was observed to be more in SCC mixtures with glass fibers. The concrete that is able to consolidate under its own weight while maintaining its homogeneity and completely filling the form work even in the presence of congested reinforcement is known as self-compacting concrete.

3. **Erxia Du, Yuji Yan , Jiao Guo (2017)**

Based on orthogonal test the PVA –ECC concreting mixture is enhanced. With conventional aggregate size and lesser fiber content the PVA fiber concrete is made for satisfying the structure requirements and less capita investment. The testing phase of concrete cubes is initiated to precisely study the properties like compressive strength, rupture strength, load deformation curves and its influence factors. The test clearly suggests that the rupture strength is directly influenced by the sand size, water binder ratio and fiber contents. The rigidity and compressive strength is found reduced by adding fibers to it. The average decrement amplitude is app. 22%. The average increment amplitude is 2.55%, over about 12 times of normal concrete.

4. **Muhammad Lutfi Manfaluthy, Januarti Jaya Ekaputri (2017)**

The geo-polymer concrete properties by using PVA fibers when mixed with fresh concrete are studied under this experimental investigation. The volume of PVA fibers when mixed with fresh concrete were varied at different proportions i.e. at 0%, 0.3%, 0.5%, 0.8% for getting optimum results of mechanical properties. The mixture also contains fly ash, aggregates and alkali activators. The alkali activator is formed by the mixture of Sodium silicate (Na2SiO3) and sodium hydroxide (NaOH). The properties like compressive strength, splitting strength, uniaxial tensile strength, elastic modulus, and flexural strength were acquired. It has been noticed through the overall test that the proportion of 0.8 % PVA fibers was the highest recorded strength. The same proportionate of PVA fibers is responsible for 50% increment of direct tensile strength. On the contrary the elastic modulus was inversely proportional to the quantity of fiber content which means if the fiber content increased then the elastic modulus will decrease for the concrete.

5. **Ming Kun Yew, Hilmi Bin Mahmud, Bee Chin Ang and Ming Chian Yew (2014)**

In the era of day by day construction reforms it is very vital to build environmentally friendly sustainable structures. Considering the possibility of utilizing agricultural wastes and industrial by-products as construction materials will be highly advantageous in terms of practical and economic benefits. Oil palm shell (OPS) is a form of agricultural solid waste. It is technically proven in many researches from past two decades that OPS can be used as a lightweight aggregate concrete. 20-25 % lower density of OPS concrete over normal weight concrete. To determine the consistency, the slump tests has been initiated and carried out of fresh concrete. Fibers are known substance responsible for the great workability and ability of smooth flowing of plain concrete. The decrease is recorded in the slump of fresh oil palm shell concrete due to an increase in volume fraction of the PVA fibers.

The water quantity and slump quantity is kept constant for all mixes in this whole study. The addition of fibers into the mixtures from 0 to 0.125, 0.25, 0.375 and 0.50 decreases the workability by 5.0, 7.5, 22.5 and 40.0%, respectively and it also reported that the addition of monofilament PVA fibers into the mixtures from 0 to 0.5% the density of OPS will reduced at about 20% on various curing conditions up to 28 days. With continuous moist curing within the range of 43-49 MPa it has been proven that the strength of oil palm shell fiber reinforced concrete (OPSFRC) increases. Therefore the PVA fibers can be used as an alternative material to enhance the quality of OPSFRS

6. **Amin Noushini ,BijanSamali, Kirk Vessalas (2013)**

The effect of uncoated polyvinyl alcohol (PVA) fiber addition on dynamic properties of fiber reinforced concrete (FRC) has been investigated in the current study. PVA fibers of two geometric lengths (6 and12 mm) with aspect ratio of 428 and 857, respectively, were utilized. Fly ash was also used as partial replacement with Portland cement in all mixes. Based on total concrete volume, two fiber fractions of 0.25% and 0.5% were evaluated for their effect on fundamental frequency, dynamic modulus of elasticity and damping ratio of FRC. 28-Day static mechanical properties are also measured. From the results, it can be stated that although PVA fiber addition in low volume fractions used in this study significantly enhance the mechanical properties of FRC, it has no considerable effect on concrete material damping characteristics. There is no doubt that dynamic properties of concrete materials are of great significance, particularly in vibration control and noise mitigation. A process whereby vibration energy is dissipated over a period of time is called damping. For avoiding the resonance of a specific structure at typical modes, whether at material level or member and structural level, damping is useful in reducing vibration and resonance.

7. **Wei Hu,Xingguo Yang, Jiawen Zhou,Huige Xing, Jian Xiang (2013)**

The mechanical properties of polyvinyl alcohol (PVA) concrete are studied experimentally. By keeping same proportion & concentration but by adding different fiber contents the concreting mixtures are formed. The test is carried out for compressive, split tensile and direct tensile for the concrete cube. The water consumption of concrete mixture increased with the concentration or dosage of polyvinyl alcohol fibers which is the primary outcome of the tests. The slump was decreased for the concrete mixture. Simultaneously before the ages of 28 days, a quick increase in compressive strengths and splitting tensile strengths has been noticed. The compressive strength is inversely proportional to the quantity of fibers but on the contrary the splitting tensile strength is directly proportional to the quantity of fibers. It also being noticed that by increasing the dosage of PVA fibers the elastic modulus of concrete was decreased but tensile strength increased.

8. **Allahverdi, K. Kianpur and M. R. Moghbeli (2009)**

Portland cement is considered as main ingredients/component for the concrete which is most widely used material for construction. This research analysis is carried out considering the effects of polyvinyl alcohol (PVA) fiber on the properties of Portland cement. The study includes their effects on tensile, compressive and impact strengths to achieve best concrete quality by minimizing the weight percentage of PVA fibers. Also at minimum proportionate weight of polymer (PVA fiber) combined with concrete mixture are investigated in accordance to indentify the flexural strengths and other physical property like resistance to crack propagation.

The polymers (PVA fibers) have been dissolved in water with five different proportions ranging from 0.004, 0.008, 0.012, 0.016 and 0.020 with respect to cement's percentage proportion by weight 0.28, 0.30 and 0.32. The specimens cube casted were cured up to 28 days and then tested to compressive, flexural and tensile strength. The outcome of the tests significantly proves that when the concrete mixer is combined with polymer like PVA fibers it gives comparatively higher strength results and higher resistance to cracks.

III. CONCLUSION

Based on literature review it can be concluded that

- The optimal content of PVA fiber is 0.3% by unit weight of cement.
- It will reduce aggregate material cost and maintenance of construction.
- It increases the compressive, flexural and split tensile properties of concrete
- PVA fiber also increases durability of the concrete.
- After the addition of fibers workability Properties like passing ability, flow ability and resistance to segregation were reduced slightly.

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