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A study of the effect of Polyproplen Fibers (PF) on fresh and hardened concrete grade 40 using Zillah sand

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ABSTRACT: *A year no longer passes only or more to hear and see new innovations invading this field and imposing themselves due to their great importance and among these developments is the use of fibers in concrete works to benefit from them to improve the properties of concrete and the fibers work to improve the resistance of concrete. This research is a collection of preliminary tests on the materials included in the concrete mixture, including the analysis of sieves on Zillah sand and aggregates as well as the slump test on fresh concrete, as well as some mechanical tests (compressive, tension and bending) on standard normal concrete. Concrete containing Polypropylene Fibers (PF) by 0.3% and 0.4% of the concrete volume and compared with the results of standard normal concrete.*

KEYWORDS - *Polyproplen Fibers (PF), Zillah sand, concrete, grade 40,*

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I. INTRODUCTION

Concrete is considered one of the most important building materials in the modern era, and these days it has become an expensive material due to the high prices of raw materials used in its manufacture. Concrete contains high rates of crushing stones, which reach 70% of the total volume of a cubic meter and this has a positive effect in reducing the total cost. For concrete installations, in addition to its high efficiency to withstand the harsh weather conditions surrounding it in some areas, it can also be formed into molds and according to demand, and concrete is used in various engineering facilities, especially in the infrastructure of the transportation sector, housing, etc. Therefore, long experience in understanding the construction behavior of materials and through Laboratory tests and tests Concrete can be adopted as a material with high efficiency and durability when exposed to moderate and moderate environmental conditions.

It is important to conduct research and studies related to this type of concrete, specifically in areas where concrete is exposed to many problems, including cracks that occur as a result of climate changes at high temperatures and low humidity, which always occur in the desert climate, which is described by our region as the temperature exceeds 45C° in the summer and the relative humidity is less than 15%. As a result, the quantities of evaporation are high and this leads to dry shrinkage.

II. LITERATURE REVIEW

Strengthening and supporting concrete has been the focus of attention of a large number of researchers in the field of concrete technology around the world, as adding PF to concrete does not have a significant effect on the concrete's resistance to compression, this was confirmed by " V- Ronald -1984"[1] through his tests of cubic concrete samples after 28 days. . Ramakrshnan-1987[2] confirmed that there is no effect of these fibers on the bending resistance of concrete. However, the absorption energy of concrete increases, especially when the percentage of fibers increases, and in return the surface friction resistance and snow resistance improves.

The addition of PF increases the protection of the reinforcing iron against rust, as well as reduces the water permeability of concrete due to the resistance of these PF to cracks and gives the concrete high flexibility to resist bending and bending loads. In general, the "Concrete Association 1994" confirmed that concrete made with PF is more durable than regular concrete. Q-Soronshain (1993)[21] also proved that there is a great lack of concrete subsidence when PF are added to concrete, but other results have been proven, including BEHNOOD in (2009) [26]. Adding PF to regular concrete increases the strength of concrete.

When the PF are increased, the concrete's resistance to compression improves. It is in line with the words of G-ParvizSoroushian in (2006) [10] who proved that the addition of PF to concrete affects the concrete's resistance to compression. H-M. B. H. Emara in (2002) [11] confirmed that adding 0.2% of PF to

concrete results in a slight decrease in the pressure resistance of the concrete. BEHNOOD in (2009) [26] confirmed in his results that adding polypropylene to concrete increases the tensile strength of concrete. A. Shah confirmed in (1991)[4] that adding a percentage of polypropylene to concrete does not affect tensile strength, but rather contributes significantly to linking cracks, and this is what This was confirmed by Q-Soronshain in (1993)[21] who confirmed that there is no significant change as a result of the tensile test of normal concrete and polypropylene fiber concrete in simple proportions.

Varzavant (1993) [5] asserted that the bending resistance of concrete in fiber concrete is greater than that of normal concrete. F-Leung in (2003) [9] also confirmed that there is a slight improvement in the bending strength of fiber concrete compared to normal concrete. Moreover, the researcher also confirmed Lee in (2002)[12] that there is an improvement in the concrete's resistance to bending by adding percentages of fibers. He also confirmed that there is a kind of ductility in the behavior of concrete when the concrete reaches its maximum compared to normal concrete.

III. MATERIALS USED

The following materials have been used to produce of concrete samples grade 40.

1. Portland Cement (OPC)

Table 1: XRF analysis data of OPC

Chemical Composition	Percentage (%)
SiO_2	20.00
Al_2O_3	4.93
Fe_2O_3	2.52
TiO_2	0.22
CaO	65
MgO	3.12
Na_2O	0.21
K_2O	0.46
P_2O_5	0.81
SO_3	2.35
Mn_2O_3	-
Specific gravity	3.23
Color	Grey

2. Polyproplen Fibers (PF)

Table 2: Mechanical properties of the PF

Specific weight	***0.91***mm⁄cm^3
Length	18mm
Diameter	***18***micro meter
Tensile strength	300-400 (MPa)
Modulus of elasticity	6000-9000 (N/mm^2)
Point of softness	***160*** C^o

3. Zillah sand

In this research, sand from the city of Zillah was used because of its quality and high resistance, which this sand gives after 28 days of pouring concrete.

Table 3: Sieve Analysis of Zillah sand

Pass-through ratio (%)	Cumulative reserved ratio (%)	Reserved rate (%)	Reserved weight (gm)	Sieve number (mm)
98.3	***1,7***	***1.7***	***17***	***2.5***
85.1	***14.9***	***13.2***	***132***	***1.25***
15.7	***84.3***	***69.4***	***692***	0.63
2.7	***97.3***	***13***	***130***	***0.31***
0.6	***99.4***	***2.1***	***21***	***0.16***
0.1	***99.9***	***0.5***	***5***	Pan
	397.5	***99.9***	***997***	

IV. MIXING METHOD

The mixing method is done according to the following methods

1- Mix sand and cement in a mixer first for 90 seconds.
2- Aggregates are added to the mixer and mixed until the consistency of the mixture is assured.
3- A percentage of the fiber material is added to the mixture while it is dry, provided that the fiber is distributed in a correct manner so that no nesting process occurs.
4- We add the required amount of water to the mixture and the sample is mixed for 3 minutes.
5- Immediately after that, the concrete is placed in the designated molds and then to the water treatment.

Table 4: The weight of materials used in the mixture

FP Kg/m^3	Water Kg/m^3	Aggregate Kg/m^3	Zillah sand Kg/m^3	Cement Kg/m^3	Specimen Type
-	*199.59*	*1050*	*700*	*350*	Standard
2.70	*199.59*	*1050*	*700*	*350*	Fiber 0.30%
3.60	*199.59*	*1050*	*700*	*350*	Fiber 0.40%

V. TEST RESULTS

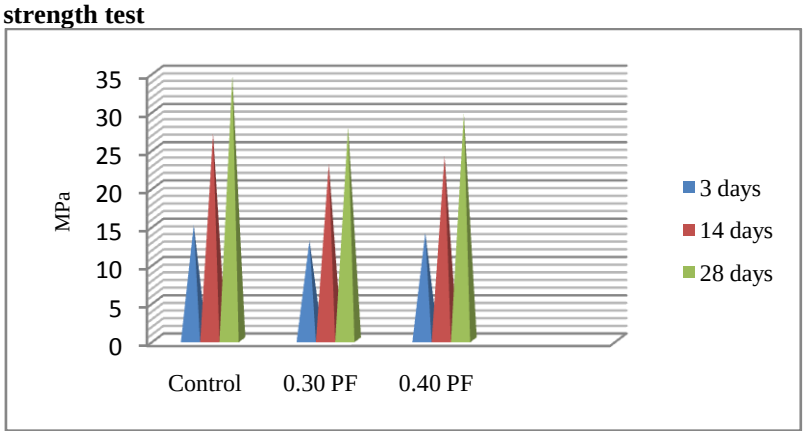
1. Los Angeles test results:

According to the Egyptian standard specifications, the impact coefficient of large rubble should not exceed 45% for concrete whose surface is not exposed to abrasion and corrosion, and 25% for concrete whose surface is exposed to abrasion and corrosion such as roads and walkways. In this research, the results of a test of the resistance of aggregates to abrasion were recorded 18.8% through the Los Angeles test to determine the resistance of the abrasive to large aggregates.

2. Slump test result

The results of the slump test for fresh concrete, where the results showed that adding PF to concrete increases concrete slump as the amount of slump for concrete is 100 mm for the standard sample and concrete supplied with 0.3% PF is 110 mm, which is the same result for concrete. Provided with 0.4% of PF, as the rate of increase of decline is 10% of the standard sample, and it is noticed that there is no significant change in the texture of concrete when adding PF. Which is that the result is consistent with the results of BEHNOOD (2009) [26] as it was shown that adding PF to concrete it increases the subsidence of concrete, and is also consistent with previous results conducted by Mazen Burhanuddin Abdul Rahman (2015) [3], where the results showed that the strength of concrete increased by adding PF to it.

3. Compressive strength test



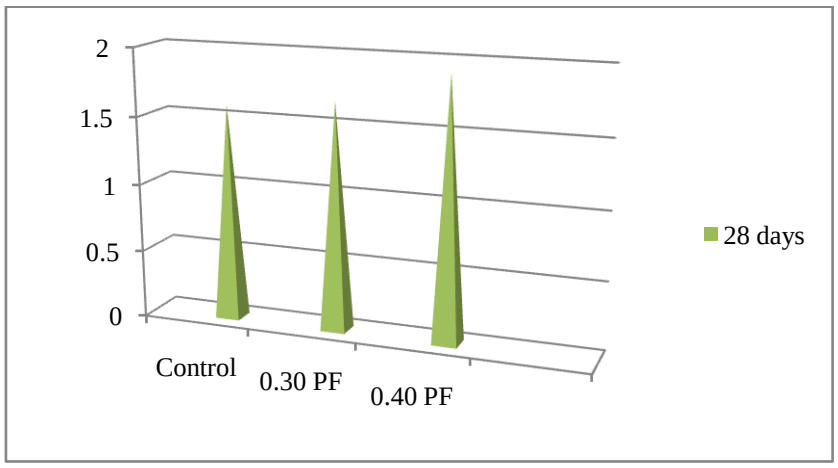
Graph 1: Results of Compressive strength test

Graph 1shows the results of the Compressive test for cubes. The results showed that the resistance of concrete after 28 days treatment was 34.58 Mpa for the standard sample, and when adding PF by 0.3%, the strength decreased to 27.83 Mpa. And it decreased to 29.63 Mpa when adding PF by 0.4%. While the concrete strength increased by 0.4% when adding PF, compared to 0.3% when adding PF.

This result contradicts the results obtained by BEHNOOD (2009) [26], where the researcher proved that the Compressive strength for normal concrete is 43.50 Mpa, and when adding PF by 0.3% is 45.31 Mpa, where the concrete resistance to compression increased by 5% from the standard sample means that the PF increase the concrete's resistance to compression, while the result of this research is consistent with previous results conducted within the Mazen Burhanuddin Abdul Rahman (2015) [3], which showed that adding PF to concrete reduces the concrete's resistance to compression, as the percentage of resistance decreased Concrete to strength 8% of the standard sample when adding 0.1% and 0.2% PF.

Fig 1: Cubes after strength test

4. Tensile strength test



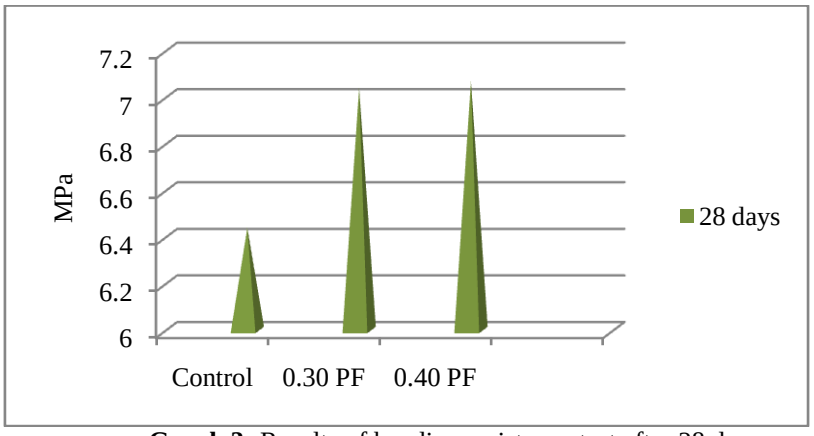
Graph 2: Results of tensile strength test after 28 days

Concrete is considered weak tensile strength, as the value of the tensile strength of concrete ranges from about 8% to 12% of the pressure resistance, and through the table we note that the tensile strength of concrete for standard samples is 1.59 Mpa and when adding PF to concrete by 0.3% the tensile strength of concrete increases to 1.67 Mpa. The resistance also increases when PF is added by 0.4% to become 1.91 Mpa.

That is, adding PF to concrete increases the tensile strength. This result is consistent with BEHNOOD (2009) [26] who proved in his results that the tensile strength of normal concrete is 3.7 Mpa and when PF were added by 0.3%, the tensile strength of concrete became 4.71 Mpa, where the tensile strength of concrete increased by 27% from Standard sample. That is, adding PF to concrete increases the tensile strength of concrete. These results differ from previous results conducted within the College Mazen Burhanuddin Abdul Rahman (2015) [3], where these results showed that adding PF to concrete reduces the tensile strength of concrete when adding PF by 0.1% and 0.2%.

Fig 2: The tensile strength test after 28 days

5. Bending resistance test



Graph 3: Results of bending resistance test after 28 days

Graph 3 shows the results of the concrete's bending resistance test. Where in the concrete strength was 6.44 Mpa for the standard sample. Note that when PF are added to concrete at a rate of 0.3%, the concrete's resistance to bending increases to become 7.04 Mpa. When adding PF to concrete by 0.4%, the concrete resistance to bending also increased to become 7.07 Mpa, meaning that adding PF to concrete lead to increase the concrete resistance to bending.

This result is consistent with BEHNOOD (2009) [26], where he proved in his results that the bending resistance of normal concrete is 5.53 Mpa, and the bending resistance of concrete when adding 0.3% PF is 7.08 Mpa, where the concrete's resistance to bending increased by 28% of the sample. Standard, i.e. adding PF to concrete increases the concrete's resistance to bending.

And to some extent consistent with previous studies by Mazen Burhanuddin Abdul Rahman (2015) [3], where the results proved that adding PF to concrete increases the concrete's resistance to bending when adding PF by 0.1% and 0.2%, and through the results we note that The higher the percentage of PF in the concrete, the higher its resistance to bending.

In general, we notice that the results differ from one research to another, and the reason is due to the difference in the materials used in the concrete mixture, their sources, components, chemical composition (water, aggregates, and cement), the method of mixing and how the fibers are distributed within the mixture during mixing.

Fig 3: The bending resistance test after 28 days

VI. CONCLUSION

1- The concrete containing PF is randomly distributed in all directions throughout the concrete block.
2- The PF have the ability to improve concrete's resistance to tensile, bending, shear and shrinkage and reduce cracks.
3- Adding PF to concrete makes it more homogeneous and uniform, reduces the permeability of concrete to water, and increases concrete's resistance to corrosion and friction.
4- PF is considered a viable alternative to secondary reinforcing mesh.
5- PF embody the process of reproduction and restoration of concrete, in addition to that, it is highly aesthetic and environmentally friendly.
6- PF are divided into natural and synthetic fibers. We have dealt with a study of a type of synthetic fiber, which is PF, where these fibers have a little economic cost compared to other synthetic fibers.

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