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Study of the tensile and compressive strength of fiber-reinforced concrete

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ABSTRACT

In this research, the effect of adding fibres from plastic bags waste to the Concrete mixed with local materials, its compressive strength and tensile strength were studied Percentages of cement weight (0.5-2%) while FP plastic fibres I used a reference mixture that is free of any additive and another that contains fibre w/c in the same proportions as the plastic fibres. The ratio of water to FPP polymeric cement For all mixtures are 0.50% and 0.55% and stabilized or weighed cement and large aggregates with Adjust or weigh the small aggregate to suit or weigh the added fibres. The results showed that with 1% with the first mixture and Fp, the compressive strength increased by 3.5%, corresponding to the percentage of fibres 2% of its resistance in the second Fp-free reference mixture is more than 3.9% at fibres. Concrete's tensile strength increases with the first mixture by 26% to 0%.

Added from the weight of cement 1% to 1.5%, it increases, and on the other hand, it increases The tensile strength is very similar to that of polypropylene-reinforced concrete To improve the tensile properties of concrete. The density of concrete FP on fibre capacity Those containing plastic are lighter than those containing polypropylene Light concrete, but it is necessary to pay attention to the presence of voids and the possibility of separation for concrete. Production of fibre-reinforced concrete from industrial waste is beneficial Environmental disposal of industrial waste that has a harmful environmental impact and This waste is plastic waste in addition to its availability and cheapness.

Keywords: Tensile, reinforced and plastic

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1. Introduction

Ordinary concrete is characterized by its high compressive strength and low tensile strength Weak because cracks arise as a result of volume changes. However, it is possible to improve. The weak properties of it to suit the requirements of the design, that another material is added to improve its properties. The addition of fibres to ordinary concrete leads to the production of a material Different construction compared to the structural materials used in construction, as shown in Figure 1. The past decades witnessed growth in the field of concrete applications, especially in the field of adding fibres to concrete[1]. So that the production of fibre-reinforced concrete has become from waste Industrial is widespread due to its availability and cheap price, in addition to the benefit Environmental disposal of industrial waste that has a harmful environmental impact.

Figure 1. The role of fibres in reducing crack widening and redistributing it

There are a large number of fibres that are used to improve its durability and other properties For concrete, has been used for a long time and nowadays it is available in different forms (see Figure 2) and thinner and often made of high-strength steel[2], and on the one hand, Other synthetic fibres have become of wide interest due to their moderate effectiveness in Reinforcement compared to steel fibres .

Figure 2. Examples of different fibre shapes

In some types of fibres, some scratches are added to the surface, or the surface is treated with materials To improve its bonding with concrete and to improve the resistance properties of concrete The fibres shall have a higher modulus of elasticity than concrete to which the fibres are added.

Even if the fibres have a low modulus of elasticity, it will improve the strength, impact resistance, stain absorption and control of cracks in fibre concrete. The main classes of fibres are steel, glass, synthetic and natural Table 1. shows the properties of some types of fibres. polypropylene fibres It is one of the types of

synthetic fibres that human intervention Polypropylene Fibers In its composition, it is a product of the petrochemical industries. Can be produced as a package of capillary fibres or larger diameters[3].
Recently, several studies have been conducted to consider the utilization of industrial waste for production Fibers, including:
They studied some properties in their research mechanical engineering of polymeric concrete reinforced with plastic waste fibres. where it showed the results showed an improvement in the properties of polymer modified concrete with an increase in the percentage of fibres. The most obvious improvement was in flexion resistance, reaching the age of 28. day to 4.24% (for a volumetric fibre ratio of 3.25%) over reference concrete polymer-containing and non-fibre-containing. While the amount of increase has a compressive strength of 1.4% compared to reference concrete containing polymers and it does not contain fibres, and for the same percentage of fibres, and the same age as the examination, as shown the results: There was no clear effect on the density of concrete by increasing the percentage of fibres[4].
There is a study on the effect of polyurethane propylene in volume proportions of the concrete mix components (0.1,0.2,0.3,0.4) On the properties of ordinary and high strength fibre concrete (soft density - Bearish - pressure resistance - fission tension - bending - rebound hammer and waves ultrasound (and through the results obtained, it was found that the addition of polyurethane fibres propylene does not affect the compressive strength, but its effect was noticeable on the tensile strength fission and bending.
There is a study that worked on making use of the fibreglass material in increasing the resistance of the concrete blocks to shear forces and bending moments, and the role of the fibres in alerting the occurrence of collapse. Where the mixing of the fibres grew glass with concrete in the ratio (0.6 kg/cm3 of cement weight) and four 10 cm) for the first beam of regular concrete, concrete beams with dimensions (70,20).
For control, the other was mixed with fibreglass over dimensions from the depth of the beam These cameras were subjected to a bending test and a careful study of the concrete strains. Where it was concluded by their research that glass fibres had an important role in improving the material Concrete as they increase the hardness of concrete, and delay the collapse of the beams Increase the area of the glass fibres in the tensile area[5].
In this study, the main orientation was to think about the effectiveness and efficiency of waste plastic bags as reinforcing fibres for concrete mixed with local materials and cement Ordinary Portlander in improving the properties of hardened concrete against tensile strength, especially and pressure in general. In this research, a comparison of fracture results for indirect tension and. was adopted With the results of FP pressure for fibre-reinforced concrete from waste plastic bags Reference concrete, that is, without additives and with concrete with fibres added It was based on changing the percentage of added fibres as a percentage of the weight of.FPP (polypropylene) of cement was studied as a binder with cement and the proportions were 0.5, 1, 1.5 and 2 %of cement. It was also relied on variable ratios of water to cement ratio and 0.55%. The goal is also to study the possibility of producing this type of concrete and using it in the future.

2. Materials used in the study

To investigate the behaviour of fibre concrete, there are many measures taken, including:
Examinations of materials, finding mixing ratios, etc., where tests and tests were conducted In the laboratory of the Department of Civil Engineering / University of Benghazi and the materials used in the study[6]:

- Cement: Ordinary Portland cement was used locally from the Zliten factory (Fig. 3), which is one of the types available in the local market, where after testing it met the approved specifications It has to control the quality of the cement as shown in Tables 2 and 3 for the chemical properties This cement has its natural properties and compare it with British specifications.
- Large and small aggregates: The physical properties of the aggregates were examined, as large aggregates were extracted from quarries Al-Abyar, southeast of the city of Benghazi, and the small rubble (sand) from the Shatt Al-Baden area As Figure 4 shows the aggregate used. The tests were carried out on the rubble (BS) large and small before starting the design process according to British specifications results of the tests that were conducted on the used aggregates.
- Mixing water: Ordinary drinking water was used in preparing the mixtures for this study, Use the same water to treat samples from cubes and cylinders.
- It is a synthetic fibre produced by the petrochemical and industrial industries: Textiles, which are the most widely used synthetic fibres, and are available in the local market It has a diameter of 18

microns and a length of 18 mm with a colour kg/m3 and a density of about 910. The recommended dose is about 0.1 Mpa760-white and the tensile strength is 310. This is according to the specifications (-900 gr/m3 to 0.3% of the concrete volume, i.e. (600). The dose used in the study is ASTM (C1116 1997 Type III). 0.5%,1%,1.5%,2% (of the weight of cement. These fibres are characterized by their strength) High tensile strength, so it is used to improve mechanical properties and reduce subsidence And cracks in the concrete blocks. It is added in the case of the mixture by adding soft materials First (sand, cement and fibre) and then adding coarse aggregate. It must be ensured that The distribution of fibres on the mixture, and Figure 7 shows the shape of the fibres used in the study. In which FP is transported and stored, as for the used fibres from the waste of plastic bags Cereals and legumes were emptied into long strips and then cut into fibres of the same size glass fibres. Also, the specific weight of the plastic used to make this type of. The bags are 1.285 and the colour is white as shown[7].

Figure 3. The fibres used in the study. FP and FPP

2.1. Concrete mix design

And it relied on (ACI) data, it has relied on the method of the American Concrete Institute
Specific and properties of the materials used in mixing and these data are:

1. The maximum size of the coarse aggregate = 19-20 mm.
2. Workability is medium, high so that the downside amounts are about) 25- 100mm
3. Target 28-day-old compressive strength = 35—30 Mpa
4. Does not contain air and the ratio of water to cement is =0.55-4%
5. Knowing that it has been relied on that the specific weight of cement is 3.15 and density The specific gravity of the large aggregate is 2.66 kg/m3 and the dry aggregate is 1710. Its absorption rate is 1.86% with a moisture content of 2.58%. The specific weight of sand is 2.62 %. As for the amount of softness, it has 2.8, and its absorption rate is 1.5.

3. Study of the tensile and compressive strength of concrete reinforced with fibres from bag waste PVC

0.07 where m was added. Mixing was achieved using a 3 . horizontal basin mixer, Coarse and fine aggregates and cement were placed in the basin mixer, and then Mix these dry materials for half a minute to obtain a homogeneous mixture texture, and then plastic fibres or polypropylene are added, and then water until The mixture is homogeneous and the fibres are distributed well. After that, the concrete is poured into the Cubic moulds and cylinders after painting the inner surface of the moulds with motor oil, Each layer was compacted by a mechanical vibrator for 7 seconds before pouring the layer On the other hand, the surface of the models has been processed to obtain a flat surface. After completing the process Pouring concrete forms were left in the laboratory atmosphere for 24 hours for completion Harden them, then take out the concrete models and immerse them in water in the treatment basin 0.0347 is sufficient to pour 4 m cubes for 28 days[8]. The volume of the mixture is 3 . To complete a set (150 x 300 mm) and four cylinders (150 x 150 x 150 mm).

4. Discussing the results

Looking at Tables 8 and 9, we find that the compressive strength of concrete with fibres added FPP% of polypropylene increases by increasing the percentage of fibres, as the best percentage of fibres As a percentage of cement weight, it was 1.5% in the first mixture and 2% in the second mixture So that the compressive strength increased 11% for the first mixture 19% for the second mixture compared to For the reference fibre-free mixture see also Figures 1 and 2. knowing that The proportions selected in the study are from the weight of the cement and within the limits of specifications Which stipulates that the proportion of fibres does not exceed 0.3% of the concrete volume to maintain The volumetric stability of concrete and the reduction of voids and permeability and other defects that Reduce the resistance of concrete. Also, we do not neglect the economic and environmental aspects of the building The study should try to create alternatives to reduce the use of industrial materials and chemicals To reduce environmental pollution[9]. We also find that the compressive strength of concrete added to it is Less than the resistance of the reference mix and the container FP fibres from waste plastic bags Even a 1% added percentage increases by 3.5% in the first mixture, while FPP In the second mixture also, the resistance decreases until the percentage of additive 1.5% so that the resistance increases Compression of 3.9% compared to the fibre-free reference mix. When Compared with FPP concrete, the tensile strength of concrete is compared to that of concrete with fibre additives Without fibres, we find that its resistance to tensile increases with the increase in the proportion of fibres. we find that The amount of increase in tensile strength increased by 17% to 38% with the mixture[10].
As for the second mixture, the tensile strength increased by 25 to 51. The additive is 2%. The tensile strength of concrete with FPP added is the best fibre ratio Compared with fibre-free concrete, we find that it increases by increasing the proportion of FP fibres. We find that the amount of increase in tensile strength by up to 25% with the first mixture As a percentage of cement weight 1%. As for FP%, it was the best value for the percentage of fibre In the second mixture, the amount of tensile strength increased up to 50%, and the best percentage of fibres was, where added is 1.5% FP.
It can be seen from the results of the density test, a slight discrepancy in the density is due to the fact that the density of polypropylene and plastic fibres is very low compared to the density of the components Other concrete, due to its low weight, knowing that it was calculated as an additive from the weight cement.

5. Conclusion

This research aims to study the effect of adding plastic bag waste fibres on the Compressive strength and tensile strength of concrete. As it was added as a percentage of weight Cement to show its behaviour as a cement-supporting binder. And show the results of the analysis Compressive and indirect tensile strength tests The compressive strength of concrete The resistance decreases up to 1% of the additive[11], so it increases by the amount of FP added to it 3.5% with the first mixture, but with the second mixture also[12], the resistance decreases until the percentage of additive 1.5 FP so that the compressive strength increased by 3.9%. This is explained by the fact that the fibre A material is manufactured for other than the purpose of adding it to concrete mixtures so that it can Easily amalgamation and diffusion[13], and this is also the effect of the water-cement ratio It has the same compressive strength and also that the fibres do not absorb water[14].
We find that the amount of FP increase to the tensile strength of concrete with fibre added In the tensile strength of up to 25% in the first mixture, and the best value for the ratio was As a percentage of the weight of the cement 1% and the second was the amount of increase up to FP% fibre Added is 1.5%, which is attributed to the fact that FP is 50% and the best percentage of fibres as Plastic bags are important during their manufacture to have high ductility and resistance The tensile strength is large so that it serves the purpose of making the bags from them and strengthening the concrete against tensile strength As well as concrete reinforced with polypropylene fibres. It is noted that the use of High amounts of fibres produces concrete with low workability and leaching capacity Air is trapped in a lower amount and density by weight, and this causes a decrease in resistance compression. Hence, it becomes clear how important it is to correct the proportion of aggregates when using large quantities of fibre as was done in this study[15].
After completing this study, we can summarize some recommendations as follows:

1. Raising awareness and urging the production of fibre-reinforced concrete from waste industrial due to its availability and cheap price, in addition to the environmental benefit represented Disposing of industrial waste with a harmful environmental impact plastic waste.
2. Conduct a study on the resistance of reinforced concrete with plastic fibres to impact loads. explosions, fires, heat, sound, and moisture insulation, and the production of a kind of Concretes are highly tensile

and compressive and light in weight. and so Industrial and other waste that is produced from the materials we use in our daily lives It can be used to produce different types of concrete with special and new features Low cost.

3. Adoption of concrete techniques in adding fibres in rehabilitation and maintenance works buildings.
4. Recommendation for the use of fibre ratios in the targeted concrete mixtures With elements subjected to significant tensile forces and stresses.

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