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Compressive Strength of Dune Sand Reinforced Concrete

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Abstract: Concrete show many advantages related mechanical characteristics and economic parts of the construction, the brittle behaviour of the material remains a big impediment for the seismic and other implementations where flexible behaviour is basically required. The study examines the utilize of dune sand as fine aggregate in concrete and reinforced with polypropylene fiber to developed properties of concrete. In the present study the mix design of grade M25 (1:2:4) with W/C = 0.6 was calculated to prepare the concrete samples for the various proportion of polypropylene fiber such as (0, 1, 1.5 and 2%). In each case, the cubes compressive strength test was conducted. The results of the study show that the compressive strength properties of concrete utilizing dune sand improved by polypropylene fiber reinforced. The experimental results show that 1% content of polypropylene fiber slightly increase the compressive strength but obviously enhances the toughness index for the concrete, consequently it plays a role of improving toughness in concrete. The study has shown that dune sand can be used as economic and readily available alternative to sea sand and can therefore help to arrest the detrimental effects on the environment caused due to excessive mining of sea sand. Finally, the results of samples of various percentages of polypropylene fibers in concrete have been compared and the result of the study is explained.

INTRODUCTION

Quick growth in the infrastructure at the global level has made concrete the most widely and commonly used building material throughout the world. This has created massive pressure on the concrete industry to produce. huge quantity of concrete to meet the increasing request of infrastructure development. It is well known that ordinary concrete strength is affected by the proportion, of cement to mixture water, the proportion, of cement to aggregate, the bond between mortar and aggregate and the classing, shape, strength and size of the aggregates[1]. Sand used in a wide range of construction projects and for many different purposes. Although, concrete shows many

advantages concerning mechanical characteristics and economic aspects of the construction, the friable behaviour of the material remains a big handicap for the seismic and other implementations where flexible behaviour is essentially required. As you plan your project, it's crucial to familiarize yourself with the most common types of sand and know when it's appropriate to use which one[2]. The sand kind impact on concrete properties (besides gravels) has been the topic of several studies[3, 4]. Concrete is an inherently brittle material with a comparatively low tensile strength compared to compressive strength. Reinforcement with randomly distributed short fibers presents an effective approach to the stabilization of the crack system and improves the ductility and tensile strength of concrete[5]. The polypropylene fiber is a synthetic fiber with low density, fine diameter and low modulus of elasticity. It has several special characteristics such as high strength, ductility and durability, many resources, low cost and easily physical and chemical rehabilitations according to certain requests. Thus, it can be widely utilized in the field of concrete manufacture[6]. The performed experiments on concrete samples reinforced randomly with propylene fibers. The results offered that compressive strength did not change significantly. A research was conducted to test the impact of mixing additives with concrete to increase the strength and durability of the concrete. The observations in this study offered that polypropylene fibre could increase the maximum dynamic compressive strength of the concrete effectively[7]. Polypropylene fiber reinforcement is believed to be an active style for improving the shrinkage cracking characteristics, toughness and effect resistance of concrete materials[8, 5, 9]. The main objective of this study is investigating the performance of polypropylene fiber in enhancing the mechanical properties of concrete made by dune sand as fine aggregate.

MATERIALS AND METHODS

Experimental: The constituent materials used consisted of ordinary Portland cement according to ASTM C150-99a, natural dune sand with fineness modulus of 2.4, crushed limestone, tap water and polypropylene fiber. The crushed limestone had maximum grad sizes was 20 mm. The physical and mechanical properties of the polypropylene fiber were listed in Table 1.

Mix proportions: Table 2 epitomizes the mix ratio with comparatively content of polypropylene fiber utilized in these concrete materials. For each matrix mix structure, all constituent material amount was same to avert the effect of ratio of water to cement on mechanical properties of concrete.

Table 1: Technical specifications of polypropylene fiber of 18 mm length

Characteristics	Material property
Diameter	18-micron nominal
Density	0.91 gm nominal
Melt point	160°C
Ignition point	365°C
Acid resistance	High
Alkali resistance	100%

Table 2: Concrete mix proportions

Mix No.	Cement (kg m^{-3})	Fine Agg. (kg m^{-3})	Coarse Agg. (kg m m^{-3})	Water (kg m^{-3})	Fiber (%)
M0	350	700	1050	210	0
M1	350	700	1050	210	1
M2	350	700	1050	210	1.5
M3	350	700	1050	210	2

The current research consists of experimental study of polypropylene fiber in development of mechanical property of concrete. The concrete was mixed in a 0.50 m^3 rotary drum mixer. Fresh mixtures were tested for workability by slump test method (BS 1881-102)[10, 11]. Specimens for hardened materials tests were then manufactured by casting fresh concretes inside plastic molds. The concrete was vibrated using a vibrating poker. After casting, the specimens were covered with sheets and left in their molds for 24h. After 24h, the specimens were taken out of their molds and cured for 28 days in water tank according to ASTM C192 All the tests were carried out at the age of 28 days[12, 13]. The compressive strength test was performed on hardened concrete specimens 150×150×150 mm cubic specimens were cast for compressive strength testing in accordance with BS 1881-116 standard.

RESULTS AND DISCUSSION

Workability: The workability of concrete was measured in terms of the slump value. The values of slump were measured in mm and are exhibited in Fig. 1. The results indicate that, the slump values for concrete mixes with dune sand decreased at higher percentages of polypropylene fiber, thereby indicating that polypropylene fiber has slightly a negative influence on concrete slump.

Compressive strength: Compressive strengths test results for concrete at 28 days, is presented in Fig. 2. The compressive strength is observed to increase with the polypropylene fiber reinforcement, while the compressive strengths tend to be reduced in the presence of more ratio of polypropylene fiber. At 1% content of polypropylene fiber, the average compressive strength is greater by 3.46% than the corresponding property of normal concrete and 1.5 and 2% of polypropylene fiber is slightly decrease than corresponding property of normal concrete. The compressive strengths of concrete tend to be reduced by an average of 2.78 and 7.96%, respectively. However,

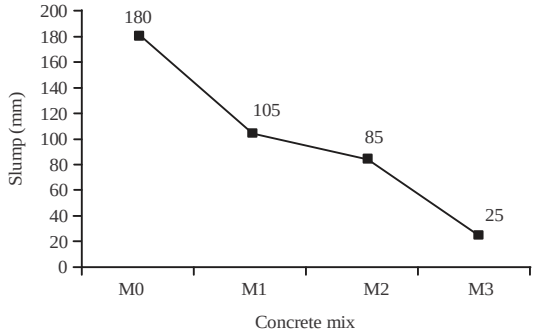

Fig. 1: Slump test graph

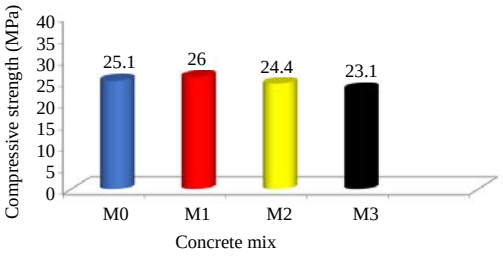

Fig. 2: Compressive strength of concretes

polypropylene fibers reinforcement improves the compressive strengths thus produce improvements in the strength of concrete. Polypropylene fibers rarely increase the compressive strengths of concrete have little influence on the strength of concrete.

The impact of polypropylene fiber on the compressive strength of concrete was discussed in many literatures[5, 8, 14, 15]. The experimental results showed polypropylene fiber either decreased or increased the compressive strength of concrete but the impact is little. In fact, the impact of a low volume of polypropylene fiber on the compressive strength may be concealed by the experimental mistake.

CONCLUSION

The impact of polypropylene fiber on the mechanical properties of dune sand concrete was studied. All the normal and fibrous concretes were prepared to have the same matrix mix ratio. Besides normal concrete, polypropylene fiber reinforced concrete mixtures with fiber content. Based on the results offered in this paper, the following conclusions can be drawn:

The decrease in the slump with addition of polypropylene fiber was observed but it can be fixed by increasing the paste content and including water reducing admixture, especially high range water reducing admixture[16].

The obtained 28 days compressive strengths of reinforced concrete were from 62 MPa for 1% content of fiber, what meet the requirements for strength concrete. However, the highest values of mechanical properties were obtained for concrete with 1.0 wt.% of polypropylene fiber.

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