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Practical Applications of Dispersely Reinforced Concrete with Polypropylene Fibers: Beams

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Abstract

The practical applications of dispersely reinforced concrete with polypropylene fibers are various; one of them may be achieving concrete beams reinforced by steel bars and dispersely spread polypropylene fibers.
The paper presents some practical tests showing the combined effect of steel and fibers reinforcement over the bending load bearing capacity, the shear strength and deformations for concrete beams. The test results could represent a small contribution to the development of knowledge in the dispersely reinforced concrete aria using one type of polypropylene fibers, for which the information on their field of application is scarce or missing.

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Keywords: concrete beams; reinforcement; polypropylene fibers.

1. Introduction

The issue of the continuous concrete performance improvement is one of high interest, given the extremely wide scope of its use in constructions.

The idea of concrete reinforcement using different types of fibers dispersed in its mass is very old, a concrete proof of this being represented by the existence of buildings or parts of buildings made of this material. On the other hand, polypropylene fibers used in concrete are something newer [1].

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Polypropylene fibers are of many kinds, also having different uses [2], [3]. Polypropylene fibers include Fibrofor® Multi, some of the cheapest on the market and with a limited area of application [4].

The paper aims to develop the applicability domain of these cheap polypropylene fibers. For this, an experimental program has been made. Two types of concrete beams were executed (long and short beams) for tests on the bending capacity and shear resistance. To obtain different information, the trials were carried on control elements made by normal reinforced concrete and on probes made by dispersely reinforced concrete with polypropylene fibers.

Also, two concrete recipes were used, varying the sand and gravel types. All trials were made in an authorized laboratory, under laboratory conditions.

2. Experimental Program

2.1. Polypropylene fibers of Fibrofor® Multi type

The choice of the fiber type was based not only on the lack of information regarding its limited field of application, but also on other criteria, such as: price per kilogram, fibers quantity recommended by the manufacturer to be added to the mixture, their physical and mechanical characteristics.

Table 1 indicates through comparison three types of polypropylene fibers on the Romanian market. It can be noticed that *Multi* fibers have the poorest physical and mechanical characteristics and the smallest quantity recommended in mixture by the manufacturer; the result being the lowest price on cubic meter of dispersely reinforced concrete with fibers.

Table 1. Characteristics of polypropylene fibers (according to the manufacturer) [5].

	Fibrofor Multi	Fibrofor High Grade	Concrix ES
			
Dosage: minimum	0.6	1.0	2.0
[kg/m^3] maximum	0.9	6.0	7.5
fire-resistant concrete	2.0	5.0	-
Form	multifilament	fibrillated	structured fibers in bundles
Diameter	34 μm	80 μm	500 μm
Length (+/- 5%)	6.3mm (tip 63)	19mm (tip 190)	50mm
	12.7mm (tip 127)	38mm (tip 380)	
Density	0.91 g/cm^3	0.91 g/cm^3	0.91 g/cm^3
Resistance to acids / alkali	inert	inert	inert
Tensile strength	300 – 400 MPa	400 MPa	510 MPa
Modulus of elasticity	4900 MPa	4900 MPa	>10000 MPa
Melting point	150°C	150°C	150°C
Colour	white	beige	yellow
Packing	bags 0.9 kg	bags 1 kg	bags 3 kg