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Characterization of Polymer Concrete with Different Wastes Additions

Marinela Barbuta[a,]*, Mircea Rujanu[a], Alina Nicuta[a]

"Gheorghe Asachi" Technical University of Iasi, Iasi,700050, Romania

Abstract

A lot of types of wastes pollute today the environment and occupy great soil surfaces. One way for consuming wastes is to obtain green materials. Polymer concrete is a new advanced composite material which is used in construction industry due to its superior properties in comparison with ordinary Portland cement concrete such as: higher mechanical strengths and chemical resistance.

The paper characterizes the polymer concrete obtained by adding different types of wastes, such as: argillaceous powder, calcareous powder, marble powder and fly ash to a witness mix obtained by mixing epoxy resin and aggregates in two sorts (0-4 mm and 4-8 mm). The microstructure of polymer concrete was analyzed by electronic scanning. The mechanical properties (compressive strength, flexural strength and split tensile strength) were experimentally determined. The calcareous and fly ash addition in polymer concrete mix improved the mechanical properties. The argillaceous powder addition decreased the values of mechanical strengths in comparison with the witness.

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Keywords: epoxy resin; wastes; compressive strength; flexural strength; split strength.

1. Introduction

Significant amounts of different types of wastes are disposed worldwide and they are polluting the environmental. For their elimination, a lot of studies and technologies were elaborated especially for using them as resources for different industries. In building materials industry there are used different types of wastes for obtaining new materials, for improving the mechanical and durability characteristics of ordinary materials, for obtaining

* Corresponding author. Tel.: +040-232-233-368, fax +040-232-278-680
E-mail address: barbuta31bmc@yahoo.com

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materials with specific properties, etc. By using the silica fume, slag, fly ash or ferrochromium, new materials such as high strength or high performance concretes are prepared [1,2,3,4], or if they are used as filler, the wastes can improve the properties of polymer concrete [5, 6, 7,8]. Silica fume and fly ash can be used for entire replacement of cement in geopolymer concrete [9,10], or as partial replacement of cement for obtaining green concrete [11].Wastes like tire powder, PETs fiber are used as replacement of aggregates in mortars or concretes or as fine additions in cement concrete [12,13,14]. Other types of wastes, for example mineral powder of marble, or calcareous or rocks are used for replacing different sorts of natural aggregates or for obtaining concrete bricks [15, 16].

The paper presents the experimental researches on polymer concrete obtained with different wastes used as powder additions: argillaceous, calcareous, marble and fly ash. The mechanical properties are analyzed in order to determine the use domain of each new concrete.

2. Experimental program

2.1. Materials

For preparing polymer concrete as binder is used a polymeric material, i.e. thermoset resin which binds the aggregates. In the experimental program was used an epoxy resin type ROPOXID produced in Romania by Policolor SA Bucuresti which was combined with hardener type ROMAMID 700, from the same producer. The aggregates were in two sorts: sort I (0-4 mm) and sort II (4-8 mm) from river gravel.

Near the witness (BP), which was prepared with 12.4% epoxy resin and the two sorts in equal dosages of 43.8% , the additions type argillaceous (BPA and BPNA), calcareous (BPCa), marble (BPM) and fly ash (BPFA) were added in the mix in a dosage of 12.8%, by reducing the aggregates dosage to 37.4 % for each sort. The aggregates and the filler were mixed together, after that the epoxy resin with hardener were combined with dry components. All mixes of fresh concrete had a good workability. For each mix the test samples were poured: cubes of 70 mm sizes and prisms of 210x70x70 mm sizes for determining mechanical characteristics such as: compressive strength (f_c), flexural strength (f_{ti}) and split tensile strength (f_{td}). The mechanical tests were done according to Romanian standards [17-19] after 14 days.

The mixes for polymer concrete with additions were established from the condition of using the lowest quantity of epoxy resin, but enough for a good concrete workability, Table 1.

Table 1. Composition and density of polymer concrete with additions.

Mixes	Epoxy resin Dosage (%)	Addition Powder (%)	Sort I (%)	Sort II (%)	Density of hardened concrete (kg/m^3)
Witness BP	12.4	-	43.8	43.8	1876.0
BPA	12.4	12.8	37.4	37.4	2062.3
BPNA	12.4	12.8	37.4	37.4	2257.4
BPCa	12.4	12.8	37.4	37.4	2062.3
BPM	12.4	12.8	37.4	37.4	2104.1
BPFA	12.4	12.8	37.4	37.4	2120.1

3. Results and discussions

The results of experimental tests on hardened polymer concrete with additions are given in Table 2. The densities of hardened epoxy polymer concrete with additions are given in Table 1. All mixes with additions powder had densities bigger than witness and bigger than 2000 Kg/m^3.