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MECHANICAL CHARACTERISTICS OF LIGHTWEIGHT CONCRETES OBTAINED BY AGGREGATE REPLACEMENT

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Abstract: *The paper presents the experimental results of studies on lightweight concrete prepared by replacing the aggregates with waste of saw dust in different dosages. The concrete was prepared with cement, fly ash and aggregates in three sorts and saw dust waste. The aggregates 0-4 mm were replaced by the waste in dosages between 40% and 100%. The density of hardened concrete and mechanical properties such as compressive strength, flexural strength and split tensile strength were experimentally determined and discussed. The densities of all mixes were under 2000 kg/m3. The density and mechanical properties are decreasing when the waste dosage is increasing.*

Key words: *lightweight concrete, waste substitution, saw dust, mechanical characteristics*

1. Introduction

In the last years the researcher in building materials and constructions in general are preoccupied to obtain sustainable products which protect the environment and take care of natural resources. In this direction, it is necessary to consume the wastes of any type and to replace where it is possible the use of natural raw materials with sub/by-products from industry [2,3,17]. In the construction industry there are some ways for using wastes in different domains, such as: obtaining concretes and mortars, prefabricated elements, infrastructure, bridges, repairs and consolidations, etc. [4-6]. In the concrete industry a lot of new concretes have been developed, such as: high strength concrete, polymer concrete, lightweight concrete, self-compacted concretes, etc. [1,7,8,14]. The lightweight concrete can be obtained by using lightweight aggregate (natural or industrial products) or by replacing the natural aggregates with different materials (polystyrene granules, saw dust, etc.) [13,15,16]. The article presents the experimental results obtained for the mechanical properties of a lightweight concrete obtained by replacing different dosages of aggregate.

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2. Experimental Program

2.1. Materials

The dosages of components materials of lightweight concrete were: composite cement type CEM II 42.5, in a dosage of 324 kg/m^3, aggregate sort I (sand) in a dosage of 803 kg/m^3 , aggregate sort II of 4-8 mm in a dosage of 384 kg/m^3 and sort III of 8-16 mm in a dosage of 559 kg/m^3. The water was in a dosage of 172 l/m^3 and the superplasticizer type GLENIUM-BASF was 1% from the cement dosage. To the mix the fly ash in a quantity of 10% from cement was added. The experimental mixes were prepared by replacing the aggregate sort I in dosages of 40%, 60%, 80%, 100% with saw dust and noted S1 to S4. Saw dust is a waste from wood industry and which was graded with sizes between 0-4 mm.

2.2. Samples

The compositions were prepared by moistening firstly the saw dust in water, for few minutes. Then after missing the dry components, the saw dust was added and 1 minute of mixing was necessary for a good homogeneity of the mix. Then the water and superplasticiser were added and after 2 minutes of mixing the concrete was poured in moulds. For determining the density and mechanical characteristics (fc, fti and ftd) according to [9-11], the following moulds were used: cubes of 150 mm sizes and prisms of 100 mm x 100 mmx 550 mm. The samples were kept according to standard conditions until testing at 28 days [12].

3. Results and Discussions

3.1. Density

For all experimental mixes were determined the densities according to standard. The results are presented in Fig. 1.

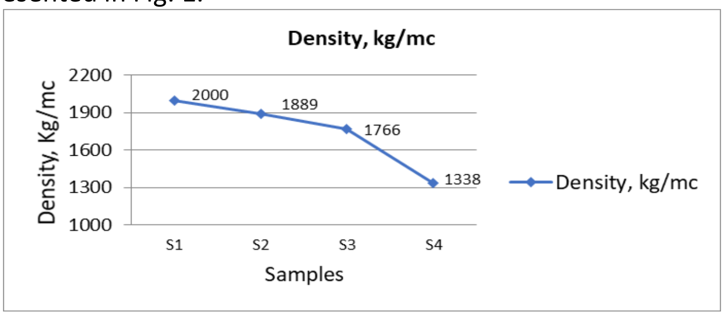

Fig. 1. *Density of lightweight concrete with saw dust*

From the Fig. 1 it can observe that all concretes are lightweight concrete (the density is smaller than 2000 kg/mc). The density is decreasing with the increasing of dosage of aggregate replacement with saw dust. The smallest value of density is obtained for a replacement of aggregate sort 0-4 mm with 100% saw dust.

3.2. Compressive strength

The test results obtained on experimental mixes are presented in Fig. 2.

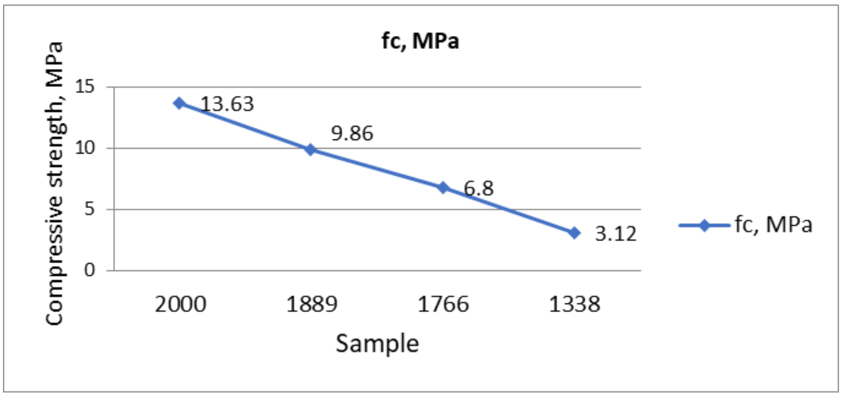

Fig. 2. *Variation of compressive strength of lightweight concrete*

From the results of Fig. 1 it can observe that fc decreased with the increasing of aggregate replacement by saw dust. For a dosage of 40% replacement the value of fc has a value that can be considered as good for a lightweight concrete, but for total replacement of aggregate sort 0-4 mm the value of fc is very small, and this concrete cannot be proper used as construction material.

The influence of replacement on the density and fc of lightweight concrete is represented in Fig. 3.

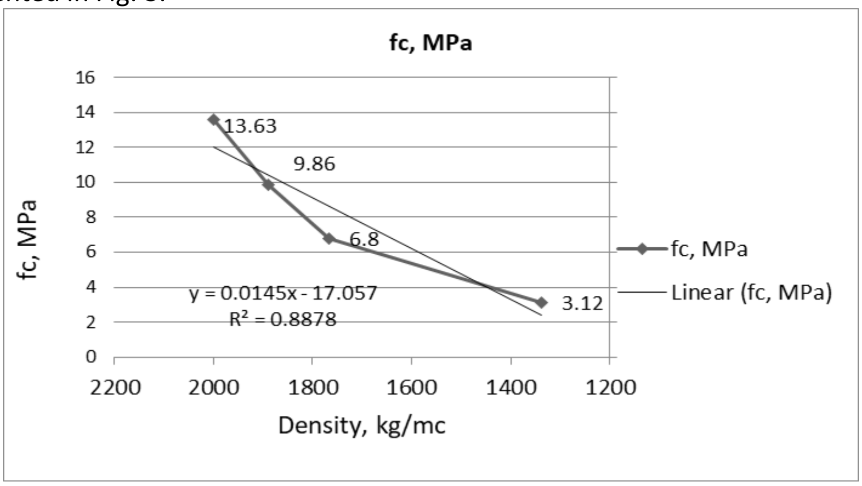

Fig. 3. *Variation of compressive strength with density*

In the Fig.3. the decreasing of density results in a decrease of fc of lightweight concrete. In the case of high replacement of aggregate sort 0-4 mm with saw dust the decreasing of compressive strength is very important, and it does not satisfy the reduction of the density.

3.3. Flexural strength

The values of f_{ti} are represented in Fig. 4.

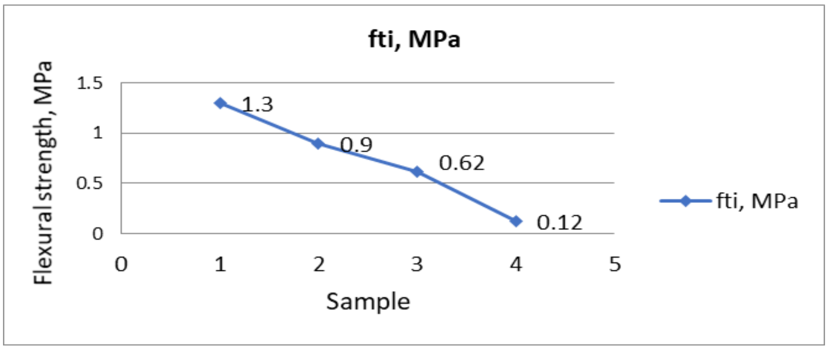

Fig. 4. *Variation of flexural strength*

The values of f_{ti} decreased with increasing of aggregate replacement dosage. For a replacement of 100% of aggregate sort 0-4 mm the value of f_{ti} is very small to be use as building material even for a reduced density.

3.4. Split tensile strength

The experimental results obtained for f_{td} are represented in Fig. 5.

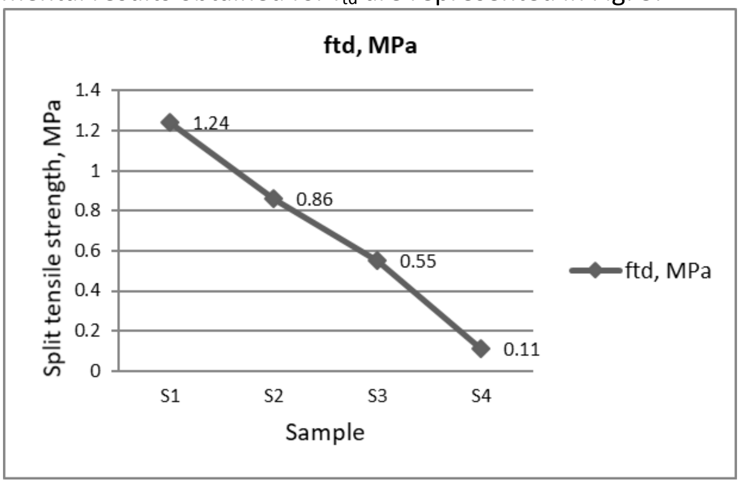

Fig. 5. *Variation of split tensile strength*

The values of f_{td} decreased with increasing of aggregate replacement dosage. For a replacement of 100% of aggregate sort 0-4 mm the value of f_{ti} is very small to be use as building material even for a reduced density.

4. Conclusions

In the paper was studied a lightweight concrete of density smaller than 2000 kg/m^3 that was obtained by replacing the aggregate sort 0-4 mm by waste of saw dust of same sizes of particles. The densities were smaller than 2000 kg/m^3 for all experimental mixes. For replacement of aggregates under 50% the concrete can be used as non-structural material. For higher replacement of aggregates over 80%, the mechanical properties such as compressive strength, flexural strength and split tensile strength decreased very much and only in special cases the concrete can be used (for example for architectonical elements, etc).

The use domain of these types of lightweight concrete must be indicated by analysing also other characteristics of concrete with saw dust, such as: thermal conductivity, noise protection, durability, etc.

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