PHYSICAL AND MECHANICAL PROPERTIES OF CEMENT COMPOSITES MADE WITH EXPANDED CLAY AND EXPANDED GLASS

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INTRODUCTION

The results of experimental tests, conducted on Self-compacting concrete (SCC) made with lightweight aggregate and fly ash/silica fume, will be presented in this paper. Two types of lightweight aggregate were used, namely expanded clay and expanded glass (also known as "poraver").

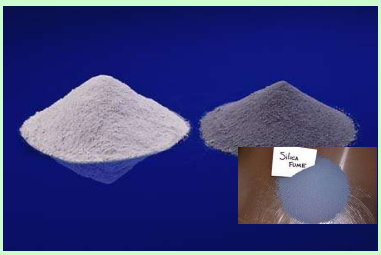
MATERIALS

Cement PC 42.5 R:

Powder		Paste					Mortar	
Sieve residue 0.09mm, %	Specific surface (Blaine), cm^2/g	Water for standard consistency, %	Setting time, min		Soundness		28d Flexural strength, MPa	28d Compressive strength, MPa
			Initial	Final	Cake	Le-Chatelier, mm		
0.5	4280	28	170	270	Sound	1.0	9.0	49.4

Fly ash:

LOI	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	TiO_2	Na_2O	K_2O
1.6%	51.9%	22.0%	11.9%	4.8%	3.4%	1.0%	0.9%	1.1%



Silica fume:

LOI	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO
1.9%	91.9%	1.0%	0.9%	1.8%	1.4%

COMPOSITION

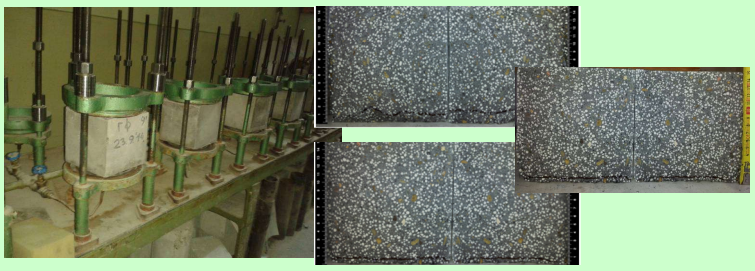
Series made with expanded glass - Poraver

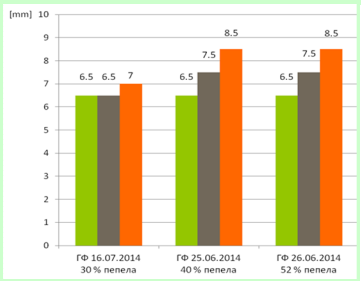
Concrete	Cement (kg/m^3)	Fly ash (kg/m^3)	Water (kg/m^3)	River aggregate (kg/m^3)	Lightweight aggregate (kg/m^3)	Silica fume (kg/m^3)	Dynamon SX (kg/m^3)	Viscofluid SCC 10 (kg/m^3)	Density of concrete (kg/m^3)
16.07.2014	531	159	273	390	135	27	6.9	5.4	1530
25.06.2014	499	199	268	380	134	25	7	10	1523
26.06.2014	421	218	252	330	203	21	7.6	12.6	1464

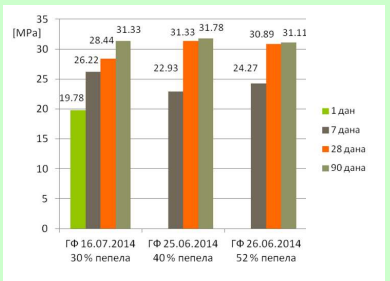
Series made with expanded clay

Component	Gravity (kg/m^3)	SCLC A (kg/m^3)	SCLC B (kg/m^3)	SCLC C (kg/m^3)
Cement	3100	550	550	550
Fly ash	1900	355	271	221
River aggregate (0/4)	2610	0	246	172
River aggregate (4/8)	2615	0	82	0
Expanded clay (0/5)	806	210	221	248
Expanded clay (5/10)	723	28	0	48
Superplasticizer (1.2% m_c)	1070	6.6	7.2	7.7
Viscosity modifier	1000	5.5	0.8	0.8
Water	1000	293	263	262

Comparative tests were carried out in the fresh (density, t_{500}, slump-flow, J-ring) and hardened state (density, compressive, flexural strength, water permeability, adhesion to concrete).







CONCLUDING REMARKS

Test results showed that SCC concrete with lightweight aggregate have all properties of self-compactibility (slump flow app. 750 mm) and bulk density lower than 1650 kg/m^3. This indicates an increased viscosity of the concrete mass, implying a bit slower placeability. However, having in mind that these concretes are lightweight, increased viscosity was necessary to prevent the floating of light grains of expanded clay, and thus to ensure the homogeneity of mixtures.

The presented composites showed a satisfactory compressive strength (app. 30 MPa) and durability proven by water permeability. Based on the obtained values of strength, the SCLC concretes belong to classes LC20/22 and LC25/28, which can be regarded as a good result for lightweight concretes with densities of 1350-1650 kg/m^3.

Acknowledgement

The work reported in this paper is a part of the investigation within the research project TR 36017 "Utilization of by-products and recycled waste materials in concrete composites in the scope of sustainable construction development in Serbia: investigation and environmental assessment of possible applications", supported by the Ministry of Education and Science, Republic of Serbia. This support is gratefully acknowledged.

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