Determination of the slags suitability from hazardous waste incineration for the production of composites for construction

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Medical waste is one of the most problematic wastes for epidemiological and psychological reasons. During their thermal processing, a number of residues are obtained, mainly slags, ashes and sorbents, which are currently classified as hazardous waste under the law, regardless of the method of their production and chemical composition. Depending on the method of incineration of medical waste, products of different composition are obtained, mainly differing in carbon content. Currently, the most of these incineration residues are deposited in dedicated landfills. The method of thermal treatment of medical waste is widely used because it allows for the elimination of potential epidemiological threats, reducing the volume of the waste produced and recovering the thermal energy contained in it (Kae-Long *et al* 2005, Yangcheng *et al* 2006).

This study presents the potential direction of the use of materials from thermal processing of medical waste for the production of building composites. The influence of the amount of additive on water absorption and flexural and compressive strength of the obtained composites based on C20/25 concrete (PN-EN 2016+A1:2016-12) was determined. Mass addition of 1, 5, 10, 15 and 20% was used to obtain concrete composites. Ground material with a grain size of less than 0.5 mm was used in the tests. In addition, tests were carried out with the addition of burnt slag at the temperature of 800°C. The results obtained from the mechanical strength tests are presented in Table 1.

Table 1. Comparison of the results of concrete slag application tests

No.	Type of additive	Amount of additive (%)	Analyzed parameter		
			Breaking force (MPa)	Compressive force (MPa)	Water absorption (%)
0	Reference	-	4.05	17.6	5.405
1	Slag from rotary klin	1	4.13	17.5	5.675
2		5	4.03	18.0	6.131
3		10	4.08	13.7	5.905
4		15	3.68	14.5	6.722
5		20	1.42	4.20	10.98
6	Sediment pipeline	1	3.42	12.8	7.280
7		5	3.16	12.3	7.396
8		10	3.05	12.0	7.417
9		15	3.66	14.0	7.360
10		20	3.33	9.8	8.055

In most of the obtained composites, an increased water absorption in relation to pure concrete samples is noticeable, from 0.1% to 5.5%. In most cases, the obtained composites had a compressive strength above the minimum value of 15 MPa after 28 days of curing (for C20/25 concrete). In addition, the leachability of metals (PN-EN 12457-4) such as Fe, Cd, Pb, Cu, Cr, Mg, Ca, Ti, Al, Ni, Zn in the obtained composites was determined. Apart from the presence of calcium and magnesium compounds, no other heavy metal compounds were found in the water extracts obtained.

The management of slags and other residues as an addition to concrete is a potentially alternative direction for their safe management outside the currently used storage. The tests carried out showed that the addition of up to 5% does not reduce the strength values of concrete and does not worsen the water absorption of concrete. In addition, the use of a strongly alkaline environment effectively mobilizes potentially present heavy metals in slags, which is an additional advantage of the developed method

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