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RECYCLING OF IRON-RICH INORGANIG POLYMERS

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Introduction

Inorganic polymers (IP) can be formed via a reaction between (iron-)aluminosilicate precursors and alkalis, most often K-, Na- silicates. In a number of cases, the precursors are highly amorphous industrial residues or residues from municipal solid waste incineration / vitrification processes. However, prior to granting IP a green label, other significant environmental impacts should be investigated. One of the important aspects of the sustainability is their end-of-life impact. This become even more important in the view of latest research, that has proven the generation of IP waste increases. It is therefore the aim of this work is to investigate whether the waste of iron,silicate-rich IP could be incorporated as a precursor in a new matrix and to contribute to the topic that relates to IP's sustainability.

Chemical composition of the as-received slag, activating solution and the mix design for IP samples (in wt%)

Table 1

FeO	SiO_2	Al_2O_3	ZnO	MgO	others
41	39	8	6	3	3

Table 2

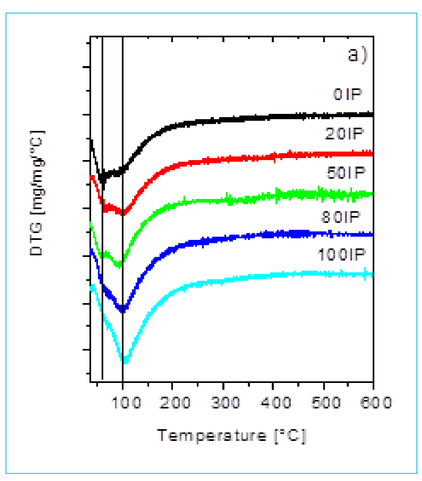
K_2O	SiO_2	H_20
20.8	20.4	58.8

Table 3

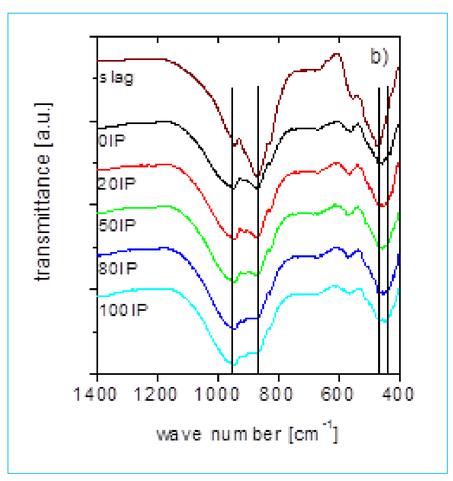
Sample name	Recycled IP	Fayalite slag	Solid / solution
0IP	0	100	3.7
20IP	20	80	3.6
50IP	50	50	3.4
80IP	80	20	3.3
100IP	100	0	3.2

Experimental and results

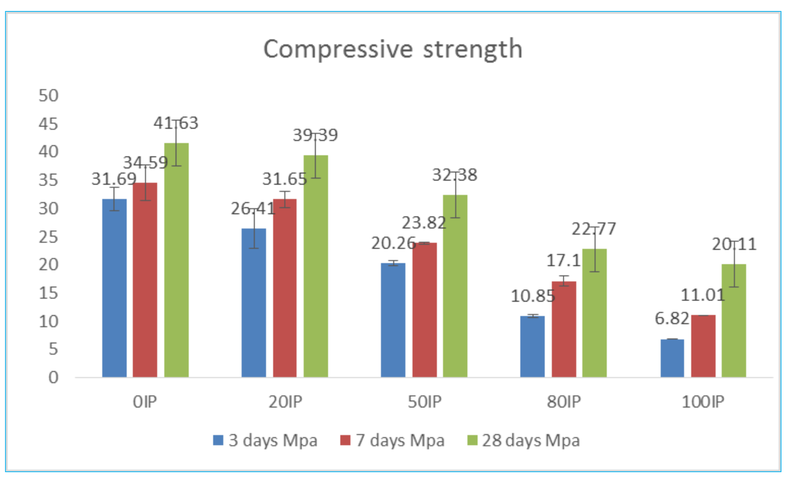
The IP was prepared by activating the slag with a potassium silicate solution (1.6 SiO_2/K_2O molar ratio and H_2O of 58.8 wt%, Table 2), with the slag/solution mass ratio (S/L) equal to 3.67. This IP (0IP) was cured at room temperature (RT, 21 ° C ± 1 ° C) for 28 days and then dried at 105 ° C for 2 days. Subsequently, the IP was crushed with a disk mill (Fritch, Pulverisette 13) and milled in an attritor mill (Wiener 1S) for 1 hour. The milled IP was then used to synthesized five types of samples, varying the IP powder content (Table 3).



Thermogravimetric analysis



FTIR



Mechanical strength

Conclusions

In the work herein it was demonstrated that "end-of-life" inorganic polymer could be incorporated in new formulations, contributing to the synthesis of a new inorganic polymer matrix. The inorganic polymers with recycled IP have microstructural differences and mechanical strength evolution with different kinetics and ultimate values compared to the reference materials. Nonetheless, the IP that was synthesised solely from recycled IP had approximately 50% of the mechanical strength of the reference sample at 28 days, which might still be adequate for certain applications.