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Using blast furnace slag from iron ore “green briquette” on cements - Part 2: physical-mechanical characterization

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Objectives

- To compare physical, rheological and mechanical parameters of cements blended with blast furnace slags from using “green briquette” on the metallic burden with a reference slag.
- To evaluate if the high sodium “green briquette” slag cements can be used for mitigating the potential of expansions by alkali-aggregate reaction

Research Significance

- To understand whether the new low carbon “green briquettes” for blast furnaces will or will not bring any backlash on the use of slags as a supplementary cementitious material

Results and Discussion

Slag Cements			PSC-SR	PSC-SGBA	PSC-SGBB
Hardened State	Compressive strength (MPa)	7d	22.8	21.2	21.4
		28d	30.3	28.9	26.5
	Flexural tensile strength (MPa)	7d	4.9	4.3	5.3
		28d	6.9	6.7	5.7
	Dimensional variation (mm/m)	28d	-0.98	-1.02	-0.62
	Reduction of expansion by alkali aggregate reaction (%)	Reactive Aggregate 1	23.8	28.5	19.0
Reactive Aggregate 2		15.6	12.5	6.3	
Fresh State	Apparent viscosity	(Pa.s)	2.064	1.082	1.452
	Plastic viscosity	(Pa.s)	1.30	0.66	0.93
	Yield stress	(Pa)	76.43	47.62	46.94
	Mini slump	(mm)	51	49	25
	Setting time (min) ^(b)	Start	<i>n.t.</i>	210	195
		Final	<i>n.t.</i>	285	285
	Total hydration heat (3d)	(J.g ⁻¹)	256.5	260.4	255.5

PSC-SR: Cement blended with 30% Reference Slag

PSC-SGBA and PSC-SGBB: Cements blended with 30% samples of “green briquette” Slags

- The compressive strength, tensile strength, and dimensional variation were similar, showing little influence of the briquette.
- The potential attenuation of expansions by alkali-aggregate reaction shows that the three compositions are effective as attenuating materials
- The viscosity and yield stress were lower for “green briquette” slags, however, it could be caused by the difference in specific area between the slags
- The cumulative heat in 72h of the three cements were similar, showing low impact on hydration

Conclusions

- Although the “green briquettes” slags present a higher amount of alkali than the reference slag, the blended cement with them also can be used for mitigation potential of expansions by alkali-aggregate reaction
- The physical, rheological and mechanical parameters indicate the feasibility of application as a supplementary cement material without significant alteration in the properties

Outlook and Future Issues

- To apply studies focusing process optimization, durability and performance of these cements;
- To use higher reactivity slags, the reference and the green briquettes ones.
- To evaluate slags produced with higher content of the green briquettes on the metallic burden