Durability of alkaline activated materials based on biomass bottom ash and steel slag.

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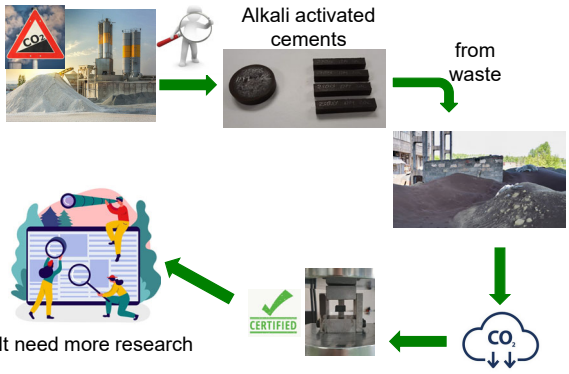
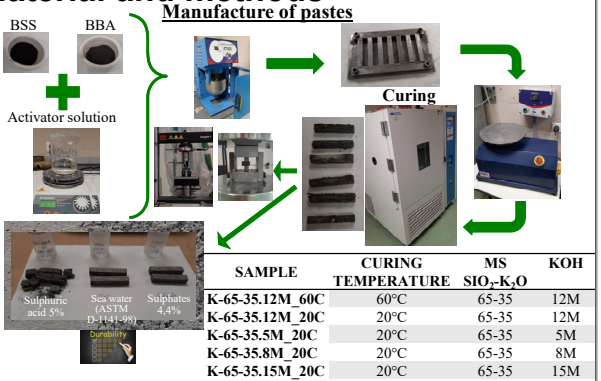
Introduction



Material and methods

A comparative study have been developed mixing 50 wt. % biomass bottom ash (BBA) and 50 wt. % black steel slag (BSS). Compositions were made with different curing method and activator solutions (Table 1), based on previous studies. First were used two different temperatures of curing: 60 ºC and 20 ºC. The best binder in terms of energy use was optimized by varying the molarity of KOH solution. Finally silica modulus (SiO2/K2O) was compared.

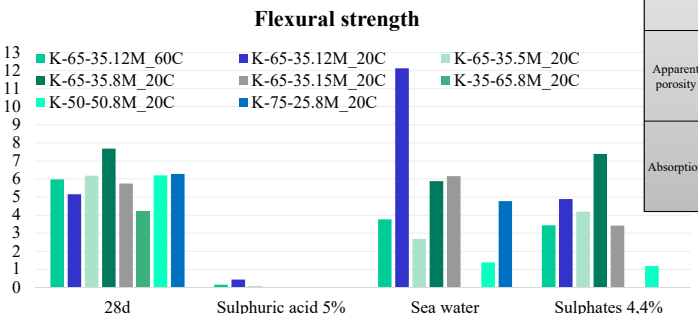


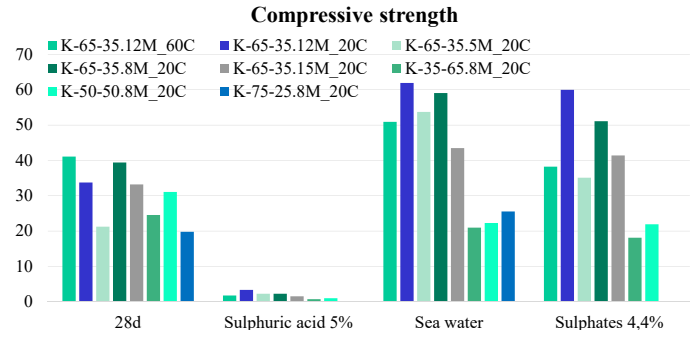
SAMPLE	CURING TEMPERATURE	MS SiO_2-K_2O	KOH
K-65-35.12M_60C	60ºC	65-35	12M
K-65-35.12M_20C	20ºC	65-35	12M
K-65-35.5M_20C	20ºC	65-35	5M
K-65-35.8M_20C	20ºC	65-35	8M
K-65-35.15M_20C	20ºC	65-35	15M
K-35-65.8M_20C	20ºC	35-65	8M
K-50-50.8M_20C	20ºC	50-50	8M
K-75-25.8M_20C	20ºC	75-25	8M

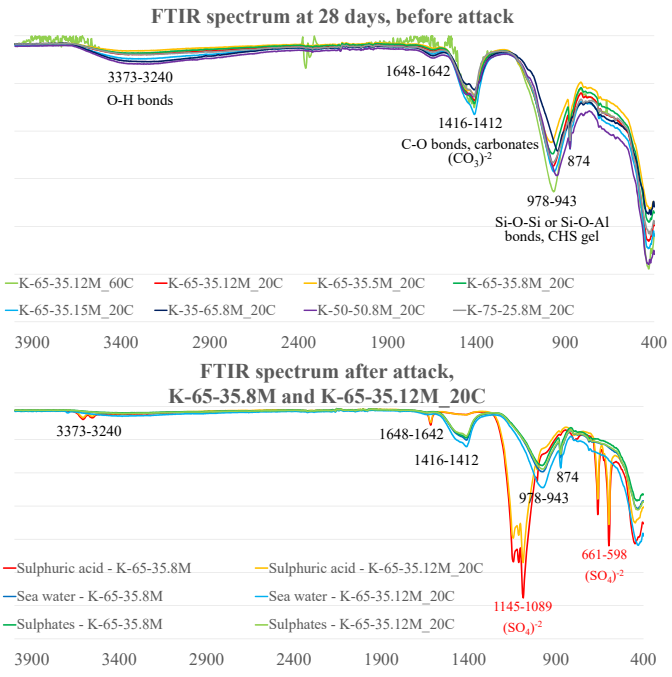
Results and discussion

The best sample was K-65-35.8M_20C. Besides obtained great results front attack solution. Although K-65-35.12M_20C is the most resistant under solutions, even it improve its behaviour after attack.

		K-65-35.12M_60C	K-65-35.12M_20C	K-65-35.5M_20C	K-65-35.8M_20C	K-65-35.15M_20C	K-35-65.8M_20C	K-50-50.8M_20C	K-75-25.8M_20C
Bulk density	28d	1687,34 ± 17,06	1581,23 ± 5,11	1781,24 ± 11,16	1792,75 ± 6,77	1544,42 ± 15,94	1576,06 ± 16,92	1618,96 ± 12,05	1776,15 ± 4,13
	Sulphuric acid	1247,35 ± 5,20	1202,6 ± 45,71	1236,33 ± 0,35	1263,18 ± 13,43	1216,82 ± 5,72	1189,36 ± 8,87	1236,89 ± 5,07	nd
	Sea water	1569,16 ± 9,10	1671,99 ± 1,60	1757,34 ± 1,50	1729,50 ± 7,33	1636,16 ± 5,64	1493,21 ± 3,90	1553,22 ± 0,78	1742,80 ± 0,64
	Sulphates	1545,51 ± 2,60	1706,42 ± 4,25	1703,90 ± 3,35	1726,36 ± 16,71	1647,14 ± 11,71	1479,72 ± 0,70	1539,93 ± 3,02	nd
Apparent porosity	28d	37,44 ± 0,03	41,10 ± 0,29	29,32 ± 0,35	29,24 ± 0,41	38,77 ± 0,39	35,97 ± 1,32	35,16 ± 0,72	31,71 ± 0,21
	Sulphuric acid	51,50 ± 0,04	51,97 ± 0,02	51,58 ± 0,10	51,19 ± 1,29	50,63 ± 0,93	51,34 ± 0,56	51,25 ± 0,65	nd
	Sea water	40,93 ± 0,04	36,73 ± 0,07	33,72 ± 0,03	35,60 ± 0,04	38,69 ± 0,08	34,08 ± 0,09	33,73 ± 0,02	31,11 ± 0,01
	Sulphates	41,17 ± 0,22	36,37 ± 0,28	35,51 ± 0,39	35,88 ± 0,63	38,97 ± 0,24	33,77 ± 0,02	33,44 ± 0,07	nd
Absorption	28d	22,02 ± 0,32	25,94 ± 0,24	16,43 ± 0,29	16,28 ± 0,24	26,46 ± 0,34	22,79 ± 1,09	21,68 ± 0,58	17,82 ± 0,16
	Sulphuric acid	41,205 ± 0,20	43,19 ± 1,63	41,64 ± 0,92	40,46 ± 1,45	41,53 ± 0,96	41,35 ± 0,97	40,64 ± 0,46	nd
	Sea water	26,03 ± 0,13	21,92 ± 0,07	19,15 ± 0,03	20,54 ± 0,11	23,60 ± 0,13	21,59 ± 0,06	21,86 ± 0,01	17,49 ± 0,01
	Sulphates	26,59 ± 0,10	21,27 ± 0,11	20,80 ± 0,27	20,75 ± 0,56	23,62 ± 0,31	21,40 ± 0,01	21,68 ± 0,04	nd







Conclusions

- The best paste front attack solution was K-65-35.12M_20C, although K-65-35.8M also obtained great results.
- Sulphuric acid attack was too strong, none specimen resisted.
- In general, all the samples improved compressive strength. The same did not happen with flexural strength.
- Specimens that improved mechanical properties also improved physical properties.
- FTIR spectrum kept its shape, except when samples were attacked with sulphuric acid.
- The best activator in terms of durability was K-65-35.12M_20C, although at 28 days without attack it was not the most resistant to compression and flexural strength.

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