

# Waste Reinvented: Carbonated MSWI Bottom Ash in Concrete

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## GENERAL OVERVIEW OF THE PROJECT

The CARBOC project focuses on the accelerated carbonation of municipal solid waste incineration bottom ash (MSWI BA) to enhance its physical and environmental properties. By promoting CO<sub>2</sub> sequestration, the process not only stabilizes the material but also reduces its environmental footprint. The treated ash can then be reused safely in construction applications, contributing to circular economy goals.

## PARTNERS



### CONTEXTE

MSWI BA is typically subjected to aging or weathering treatments to enhance its stability. This involves natural exposure to air and moisture for a minimum of 18 weeks, promoting carbonation and hydration reactions. Our objective is to significantly reduce this treatment time using accelerated carbonation.



### ACCELERATED CARBONATION



MSWI BA was carbonated in a CO<sub>2</sub> chamber for 24 hours under the following conditions:

- Temperature: 30 ± 3 °C.
- Relative humidity: 60 ± 3%.
- BA water content: 20 ± 3%.
- CO<sub>2</sub> Concentration: 12 ± 1%.

### MSWI BA PROPERTIES

After the carbonation treatment, the physical and geotechnical properties of the carbonated BA were measured and compared with those of the maturated BA.

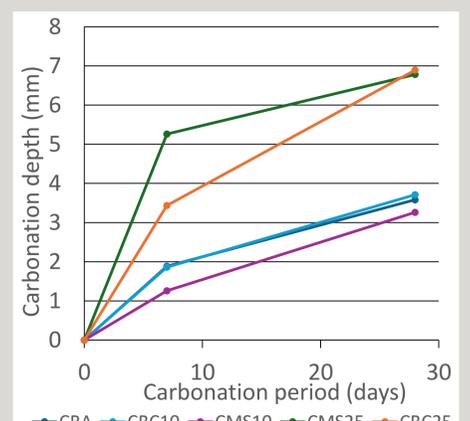
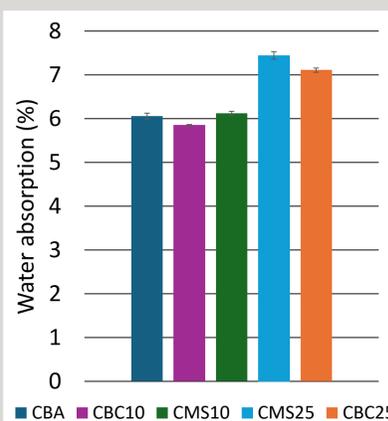
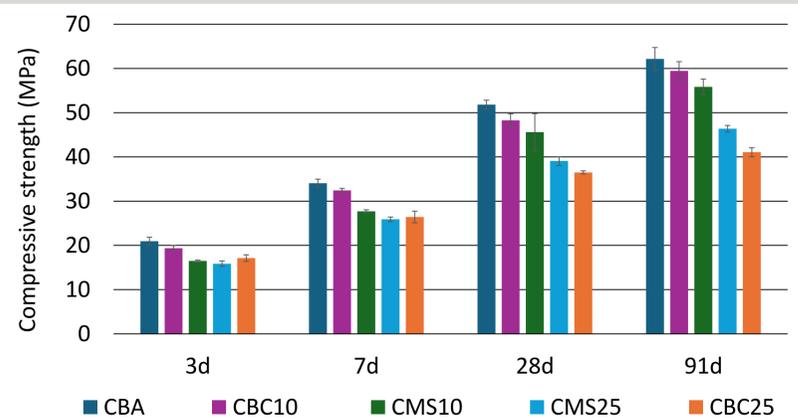
	Carbonated BA	Maturated BA
Fines BA (0-4 mm) density (kg/m <sup>3</sup> )	2145	2239
Coarse BA density (4-20 mm) (kg/m <sup>3</sup> )	2360	2239
Fines BA (0-4 mm) Water Absorption (%)	7.3	8.2
Coarse BA (4-20) Water Absorption (%)	2.4	4
Wear resistance (%)	24	21
Freeze-Thaw resistance (%)	20	19

### CONCRETE PROPERTIES

Four different concrete mixes were prepared, incorporating 10% and 25% of MSWI BA treated by accelerated carbonation and traditional weathering treatment as partial substitutes for natural sand and aggregates to make a C30/37 grade concrete. Mechanical and durability tests were performed according to the following standards:

- Compressive strength (NBN EN 12390-3).
- Water absorption (NBN B15-215).
- Carbonation resistance (NBN EN 12390-12).

Formulations :	Reference (CBA)	25%vol. Carbonated BA (CBC25)	25%vol. Maturated BA (CMS25)	10%vol. Carbonated BA (CBC25)	10%vol. Maturated BA (CMS25)
CEM III/A 42.5N	350	350	350	350	350
Sand 0/2	120	105	105	122	122
Sand 0/4	685	509	509	650	650
CC 2/6	207	0	0	142	142
CC 6/20	828	708	708	690	690
BA 0/2	0	143	117	0	0
BA 2/6	0	126	109	0	0
BA 6/20	0	118	109	158	156
SP	2.60	2.95	2.77	2.80	2.86
Water	179	194	196	180	183
W <sub>eff</sub> /C	0.49	0.49	0.49	0.49	0.49



### CONCLUSION

This study demonstrates that:

- Accelerated carbonation significantly reduces the treatment duration of MSWI bottom ash (BA).
- Replacing up to 10% of natural sand and aggregates with MSWI BA allows to produce C30/37 grade concrete.
- Concrete properties remain comparable whether MSWI BA is treated by accelerated carbonation or cured traditionally, confirming the reliability of both treatment methods.

