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Abstract

The "Tajogaite" volcano on La Palma (Canary Islands, Spain) produced substantial amounts of ash and slag in 2021. These volcanic materials may be classified as geowastes due to the necessity of removing them from the affected infrastructure, such as roads and pathways, and to identify potential applications for their retrieval. In this sense, the use of these geowastes in reconstructing damaged infrastructure represents a significant undertaking.

The basaltic nature of these volcanic materials renders them appropriate for the manufacture of building materials as stoneware tiles [1-3]. Ceramic samples were obtained by sintering on a laboratory scale, from different compositions developed by combining the volcanic ash with silica providing substances. The effect of temperature and time on sintering treatments was evaluated. Water absorption, apparent porosity, bulk density and Knoop microhardness were determined on selected samples.

Objectives

- ❖ To evaluate the suitability of the products emitted by the "Tagogaite" volcano for the manufacture of materials such as stoneware tiles.
- ❖ To optimise the parameters of the sintering process.
- ❖ To have a preliminary estimation of the performance of the obtained samples.

Materials

- Ash from the "Tajogaite" volcano on the island of La Palma.
- Red porphyry: an igneous rock used as building material
- Silica sand

Chemical compositions (major elements in wt %)

Source material	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	CaO	MgO	TiO ₂	Na ₂ O	K ₂ O
Volcanic ash	43,3	15,0	12,8	9,7	5,9	3,7	4,5	1,8
Red Porphyry	71,6	13,7	2,8	1,3	0,5	0,3	3,1	4,7
Silica sand	96,9	1,9	0,2	--	--	--	--	--
"Target" composition	71,5	18,1	0,6	0,2	0,1	0,2	1,9	2,7

Preparation of samples

Compositions prepared (in wt %)

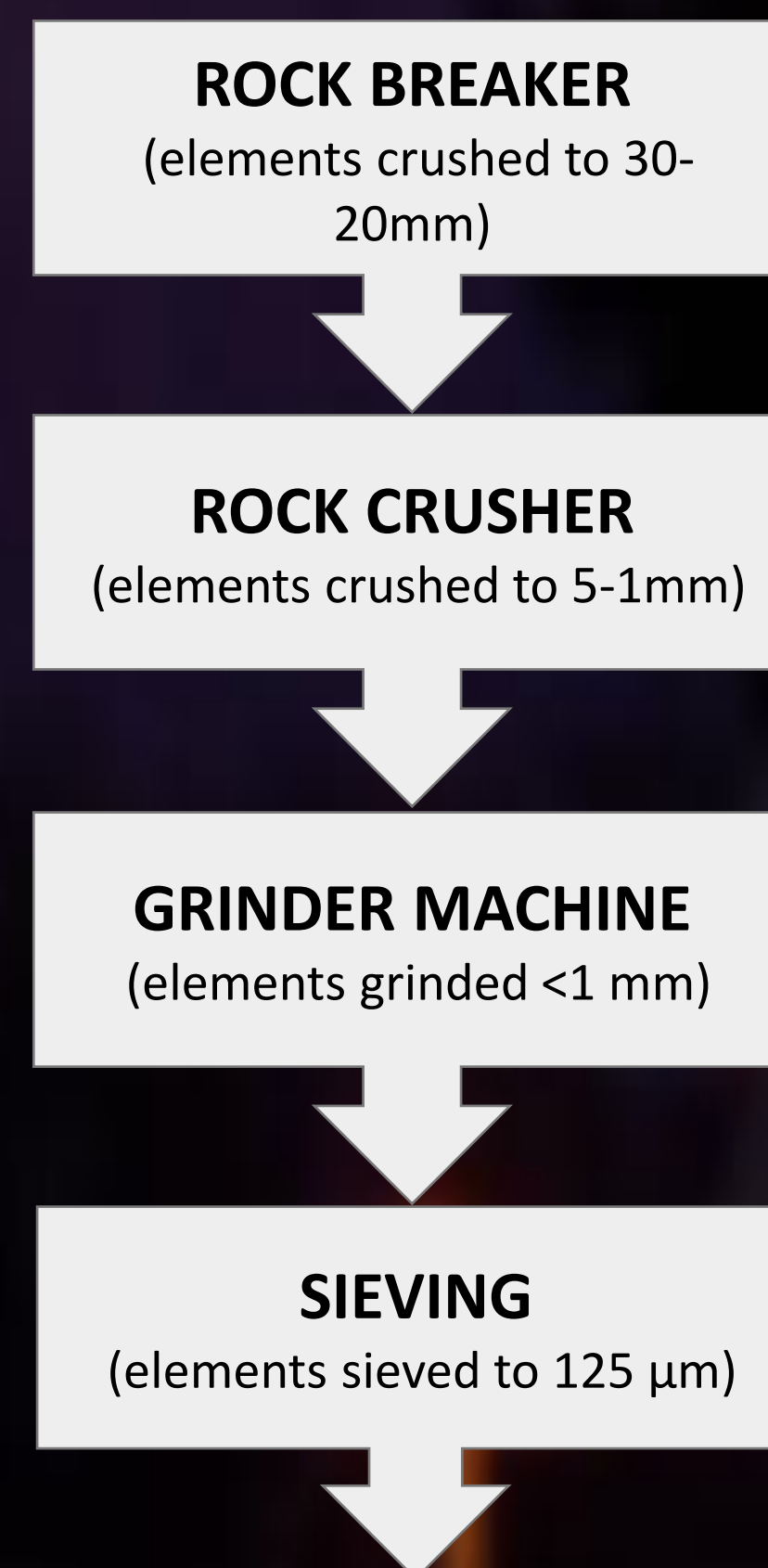
	1 st Sample	2 nd Sample	3 rd Sample
Volcanic Ash	40	45	50
Red Porphyry	40	30	20
Silica sand	20	25	30

Pellets preparation

- ❑ Mixing powder samples in a balls mill
- ❑ Pellets of 13mm diameter were made using a laboratory hydraulic press (Gabbrielli 40T Touch) applying 10 t.
- ❑ Potato starch was used as natural binder of the powders.

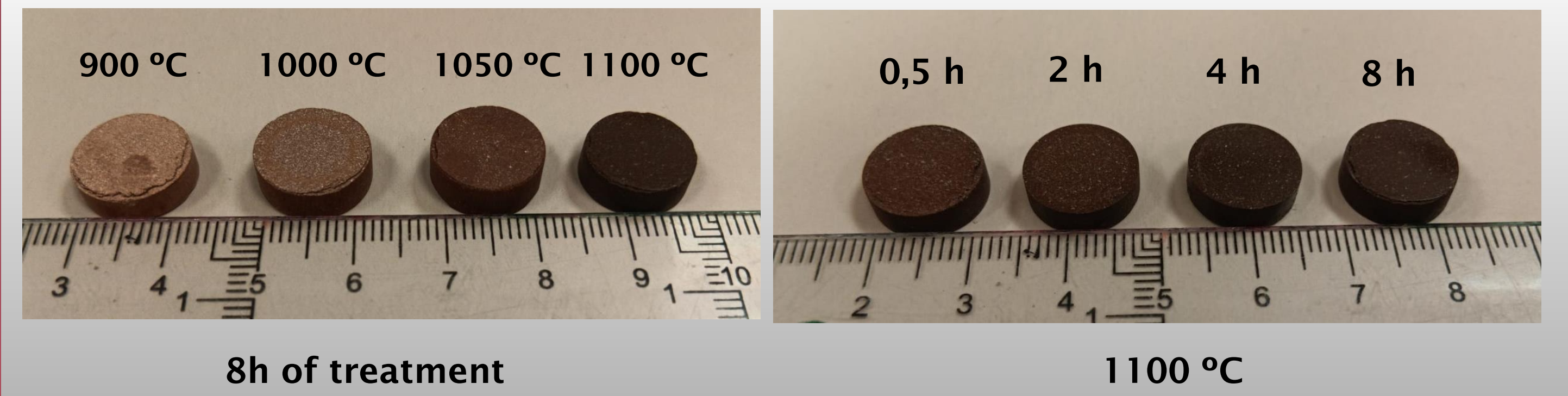
Sintering process

- ❑ A laboratory electric furnace has been used (ROHDE 1300°C max.)
- ❑ Treatments start with a step of 30 min. at 270°C to eliminate the binder
- ❑ Temperatures: 900,1000, 1050 and 1100 °C
- ❑ Time of treatments: 0,5, 2, 4 and 8 hours:

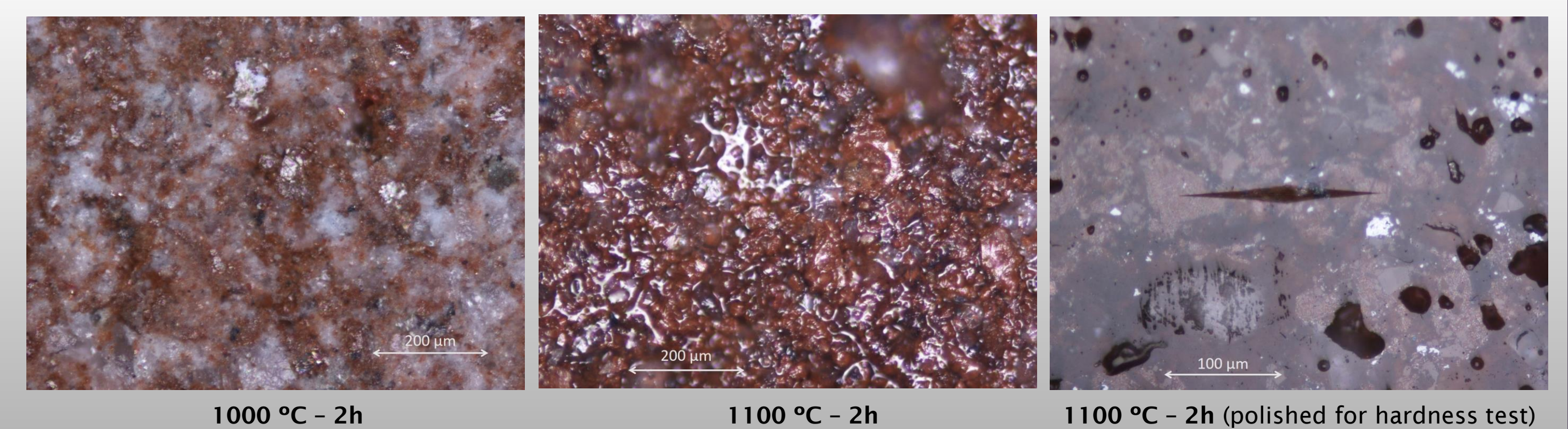


Results

Effect of temperature and time in samples with 50 % of volcanic ash



Optical microscopy images of some samples with 45 % of volcanic ash

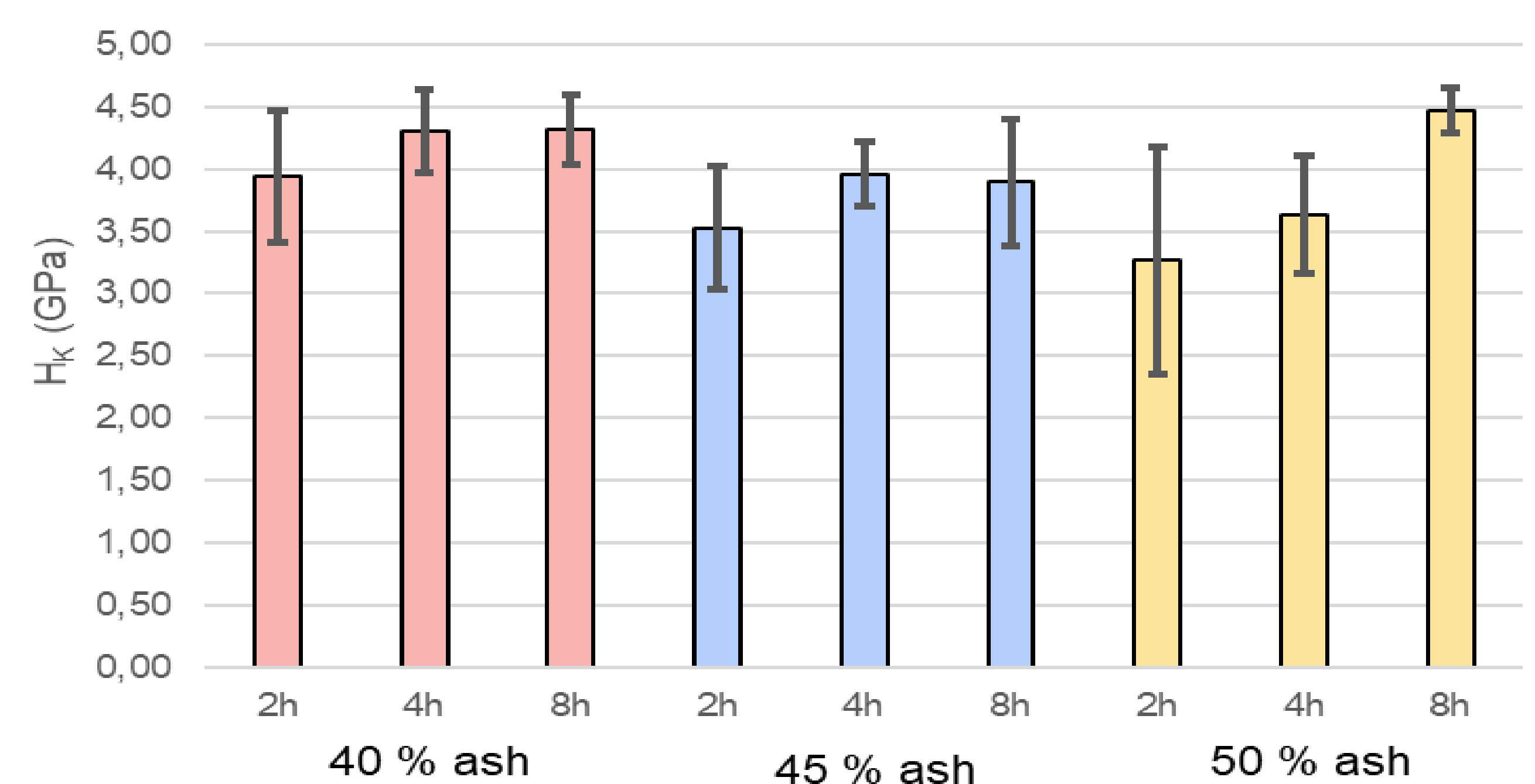


Physical properties of samples sintered at 1100 °C for several times

According to UNE-EN-ISO-10545-3:2018 standard method

Volcanic ash (wt %)	40			45			50		
Treatment time (h)	0,5	2	4	0,5	2	4	0,5	2	8
Apparent Density (g/cm ³)	2,26	2,36	2,44	2,28	2,35	2,49	2,29	2,33	2,44
Open porosity (%)	14,1	10,0	3,5	15,0	11,4	2,1	15,4	13,2	5,9
Water absorption at atmospheric pressure (%)	6,2	4,2	1,4	6,6	4,8	0,9	6,7	5,7	2,4

Knoop microhardnes (H_{K1}) of samples sintered 2, 4 and 8 hours at 1100°C



Conclusions

- ❖ Samples with up to 50 % in weight of volcanic ash were made by sintering process
- ❖ Best results in sintering were found for temperatures of 1050-1100 °C for 4h or more
- ❖ Regarding the ash content, the 45 wt % proportion presented the higher densification
- ❖ For the samples sintered at 1100 °C, the Knoop hardness results showed lower dispersion as time of treatment increases, while the mean values have a tendency to increase.

References

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