Recycling of rice husk ash as secondary material to produce eco-friendly construction bricks

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D. Eliche-Quesada, J. A. López- Pérez, M.A. Felipe-Sesé

(1) Department of Chemical, Environmental, and Materials Engineering. Higher Polytechnic School of Jaén. University of Jaen, Campus Las Lagunillas s/n, 23071 Jaén, Spain

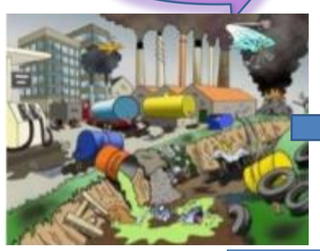
* Tel.:+34953211861; e-mail address: deliche@ujaen.es

Introduction

The construction sector is one of the less environmental sustainable activity on the planet

Construction industry

Industrial wastes



Ceramic properties optimization

Reduction of cost

Minimizing the environmental problem

Organic wastes or biomass

Inrganic wastes

Similar composition of ceramic raw materials, which mainly have a composition rich in oxides in the system SiO_2-Al_2O_3-CaO.

Ceramic sustainable

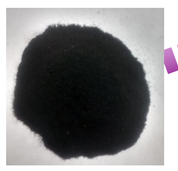
Objetive

Characterization and possible use of rice husk ash, focussed in the determination, by means of laboratory scale tests, of the technological properties of raw materials in the preparation of clay bricks optimizing the quantity of residue to added, checking the physical, mechanical y thermal properties of the new materials, compared with those obtained using only clay (control bricks).

Sample preparation

Raw clays

Rice husk ash (RHA)



0-30 wt %

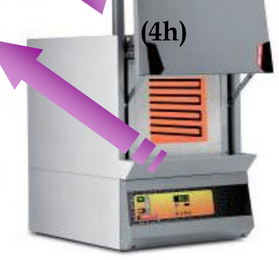
Dried 48 h at 110 °C

3°C/min

1000 °C

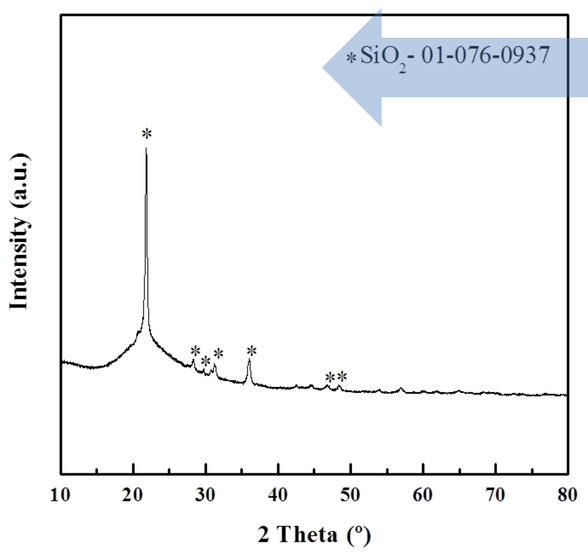
(4h)

RHA-clay bricks



Results and Discussion

XRD



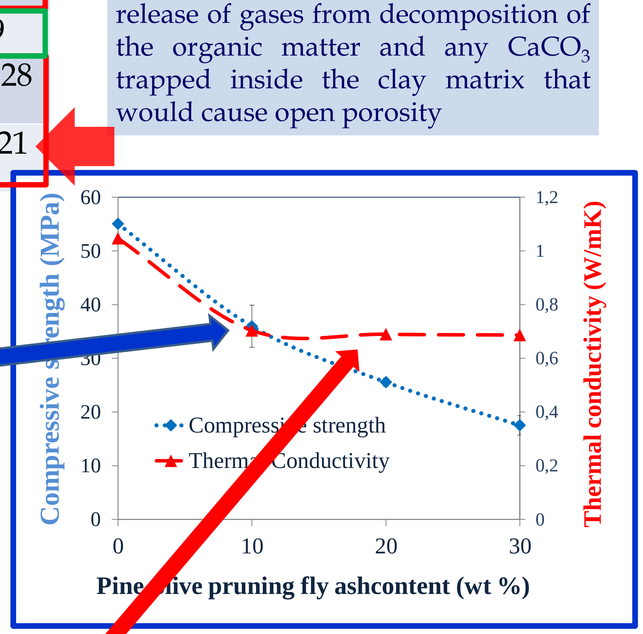
X-ray diffraction of RHA indicated that the biomass fly ashes are mainly composed of silica in the form of cristobalite, SiO_2 polymorphs formed during the combustion process of the RH

Property	Rice husk ash (wt %)			
	0	10	20	30
Loss on ignition, %	12.10 ± 0.29	13.01± 0.08	13.94 ± 0.11	14.04 ± 0.48
Linear shrinkage (%)	-0.38 ± 0.06	-0.27 ± 0.01	0.12± 0.08	0.29± 0.20
Bulk density (kg/m³)	1,865± 5	1,691± 6	1,538± 17	1,396± 9
Apparent porosity (%)	30.13 ± 0.36	36.62 ± 0.27	40.89 ± 0.50	45. 10 ± 0.28
Water absorption (%)	16.19 ± 0.20	21.65 ± 0.22	26.63 ± 0.35	32.21 ± 0.21

Bricks with RHA showed higher water absorption, reaching values of up to 32.2 % when 30 wt% of waste is added. Adding RHA in the clayey matrix can result in the formation of liquid phase with sufficient viscosity to avoid release of gases from decomposition of the organic matter and any $CaCO_3$ trapped inside the clay matrix that would cause open porosity

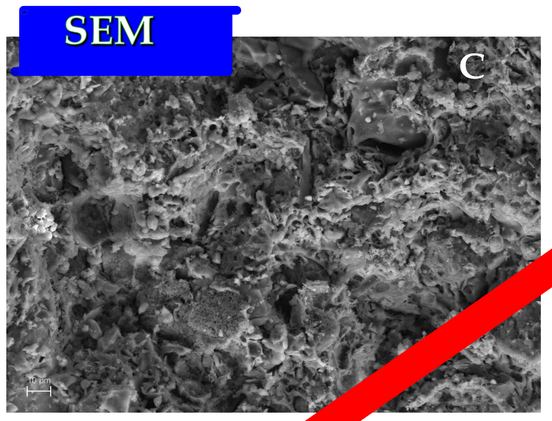
Bulk density decreases with increased biomass ash, indicating that this type of waste promotes an expansion reaction at lower firing temperatures.

Compressive strength decreases with the addition of RHA, according to data from water absorption. High compressive strength for the fired bricks is achievable at the lowest levels (10 wt %) of the biomass fly ash (36 MPa).

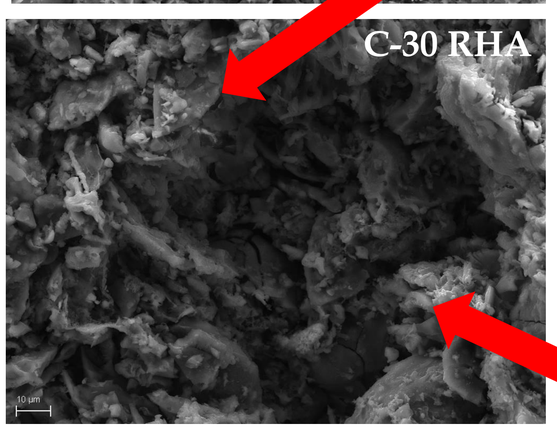


Thermal conductivity of the sample with 10 wt% RHA (1000 C-10 RHA) fired at 1000 ºC (0.70 W/mK) showed over 30% reduction relative to the reference brick (1.05 W/mK). Addition of more RHA up to 30 wt% produced a small improvement in thermal conductivity, shrinking up to 0.68 W/mK, and significant loss of mechanical properties

SEM



High amounts of RHA, produced formation of higher open porosity, as well as, larger macropores



Cenospheres :some tiny sphere

Conclusions

- Physicochemical characterization indicates that RHA have appropriate composition for use as secondary raw material in the manufacture of clay bricks. The results encourage recycling of these biomass ash wastes and help to reduce manufacturing costs, as they require fewer raw materials.
- RHA modified the bulk density of the clay bricks, making them lighter.
- The results indicate that it is possible to obtain ceramic bricks with 10 wt% of RH-ash that fulfill the technological standards and mechanical properties of traditional bricks containing only clay, with a reduction of 30 % in thermal conductivity. Samples with more amount of RHA do not meet the standards established for water absorption values.

Acknowledgments

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