World Congress and Expo on
Recycling
July 20-22, 2015 Barcelona, Spain

Recycling of olive pomace bottom ash for fired clay bricks

D. Eliche-Quesada [1]

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

Tef.: +34953211861 ; Fax: +34953212141;

e-mail: deliche@ujaen.es

Introduction

The common disposal of biomass ash is landfill in sites next to the power plants, but this alternative is the least attractive in the environmental management.

Dry olive pomace ash are being mainly used as fertilizer due to its high content in potassium. Other studies describes potential used of olive pomace ash as soil amendment [1], as adsorbent to remove copper (Cu^{2+}) ions from aqueous solutions [2], as raw materials for cement based products [3], and building materials [4].

Biomass ash present a potential applicability in the construction sector, where the current scarcity of natural resources and regulatory requirements favour the search for new materials that include the possibilities of waste from industrial processes that are capable of the constructive technical needs within a framework of sustainable.

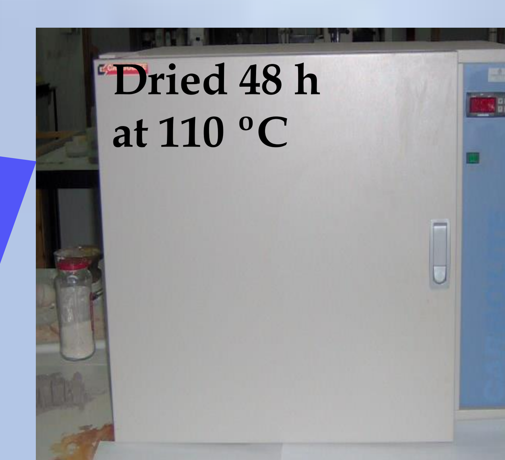
Objetives

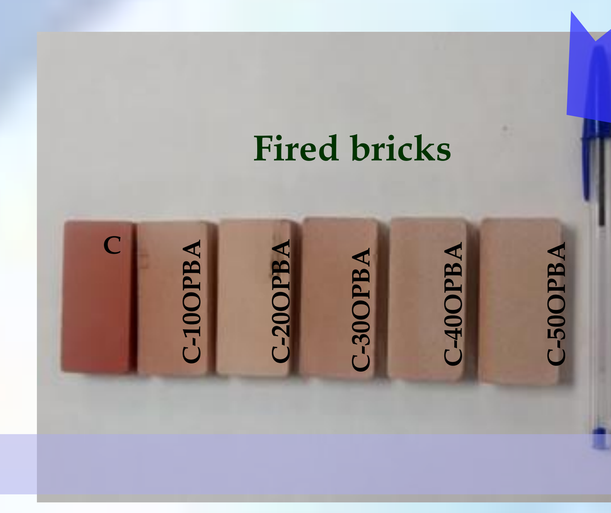
Characterization and possible use of olive pomace bottom ash, focussed in the determination, by means of laboratory scale tests, of the technological properties of raw materials in the preparation of clay bricks optimizing the quantity of residue to added, checking the physical, mechanical y thermal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

Samples Preparation

0-50% olive pomace bottom ash (OPBA)

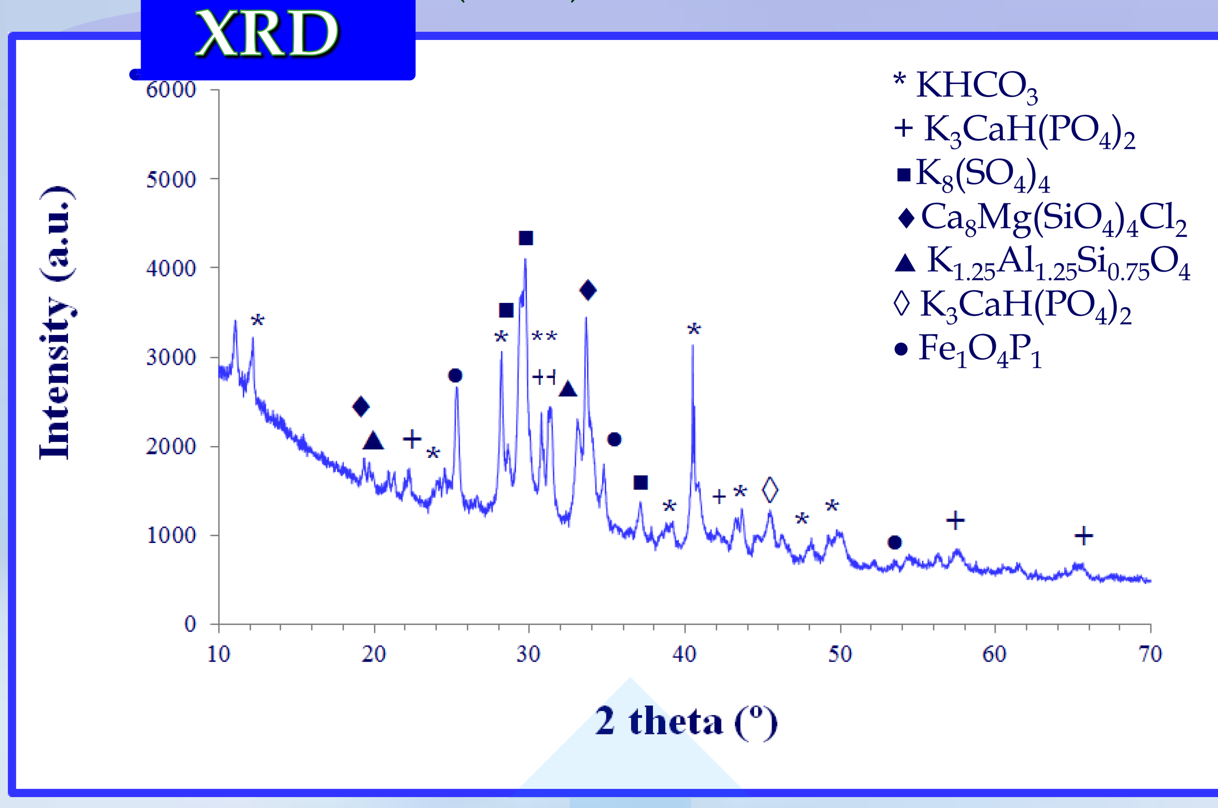
Homogenization





Results and discussion

XRD



The mineralogical characterization of the olive pomace bottom ash showed the presence of an alkaline carbonate kalicinite ($KHCO_3$), a potassium sulphate ($K_8(SO_4)_4$), a calcium chlorosilica mineral containing magnesium, rondorfite ($Ca_8Mg(SiO_4)_4Cl_2$), a potassium aluminosilicato ($K_{1.25}Al_{1.25}Si_{0.75}O_4$), a potassium calcium hydrophosphate ($K_3CaH(PO_4)_2$) and an iron phosphate ($Fe_1O_4P_1$)

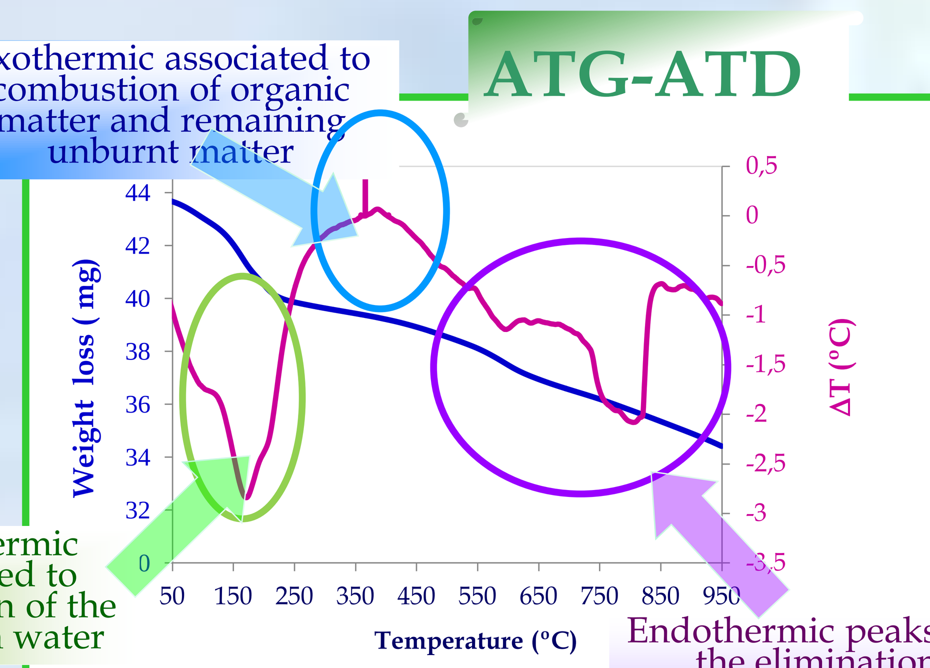
FRX

Oxide Content (%)	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	MnO	Na_2O	K_2O	TiO_2	P_2O_5	SO_3	NiO	ZrO_2	LOI
Clay	47.1	12.5	6.5	13.5	2.1	0.05	0.30	3.6	0.8	0.14	1.6	0.01	0.04	10.6
OPBA	10.88	1.68	1.38	13.07	1.92	0.03	0.13	38.01	0.13	3.67	1.40	0.008	0.007	25.5

The major oxides (> 10 wt%) present in decreasing order of abundance are K_2O and CaO. The high content of K_2O is because it is a major component of the pomace used as fuel. The oxides SiO_2, P_2O_5, Fe_2O_3, MgO and Al_2O_3 ordered similarly are in the proportion of 1-10 wt%, whereas Na_2O is the minor oxide (0.1-1 wt %).

ATG-ATD

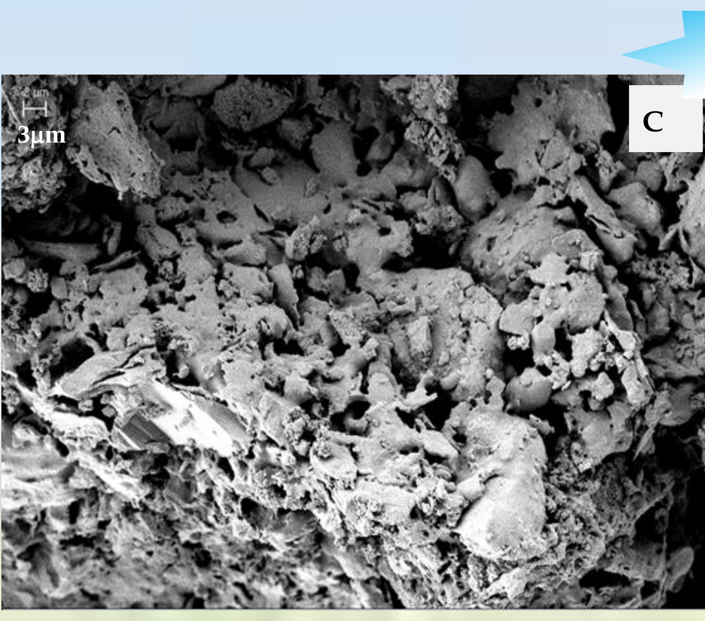
Exothermic associated to combustion of organic matter and remaining unburnt matter



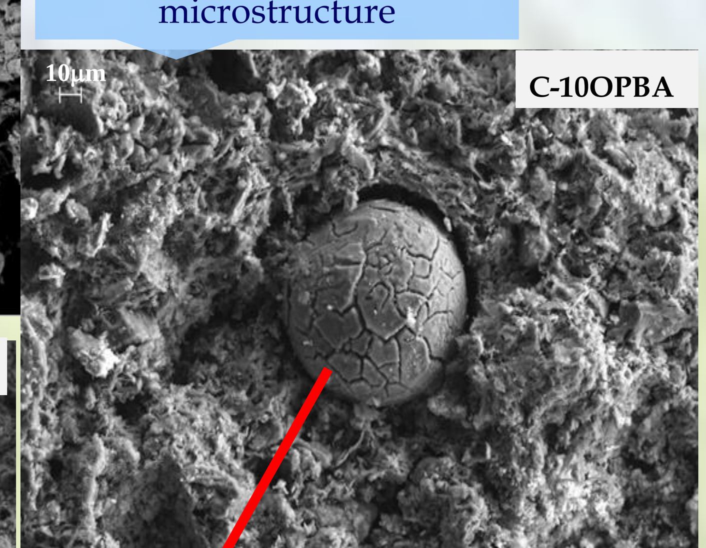
Endothermic associated to elimination of the hydration water

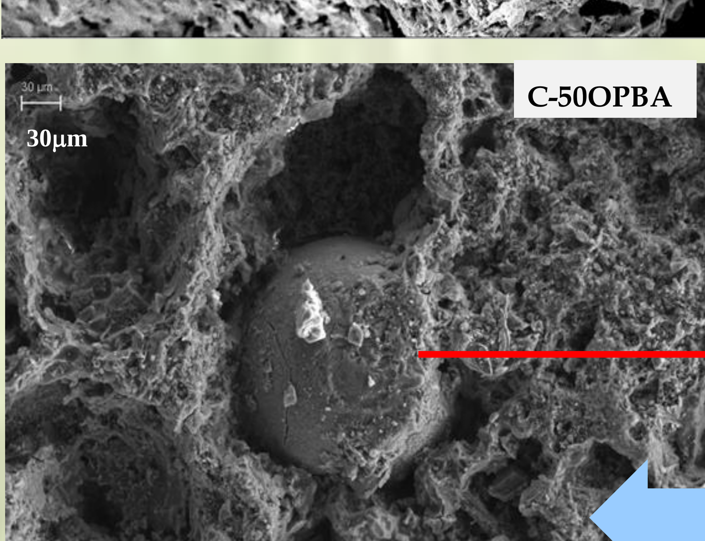
Endothermic peaks due to the elimination of structural water from the hydroxide and from decarbonation reactions.

SEM



The addition of low amount of OPBA (10 wt %) changed in small proportion clay microstructure





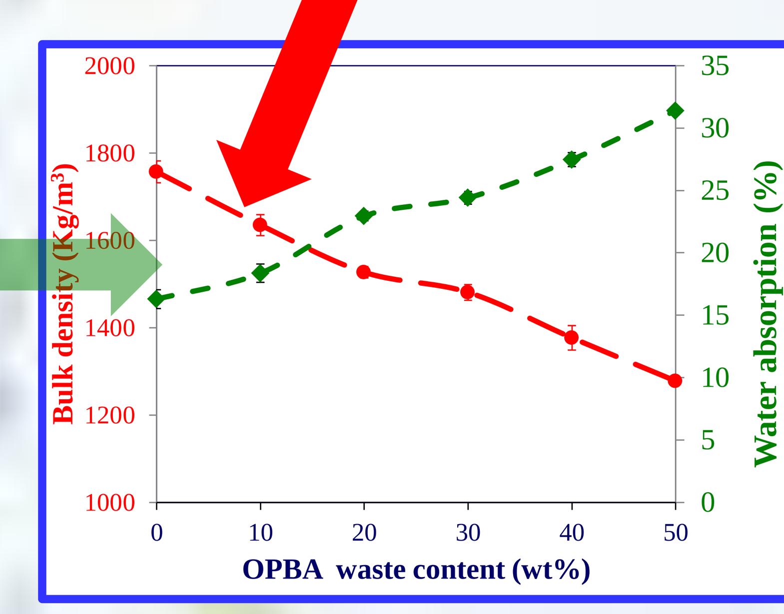
Cenospheres :some tiny sphere

High amounts of OPBA, produced formation of lots of open porosity, as well as, larger macropores and small particles that become isolated and nearly spherical,

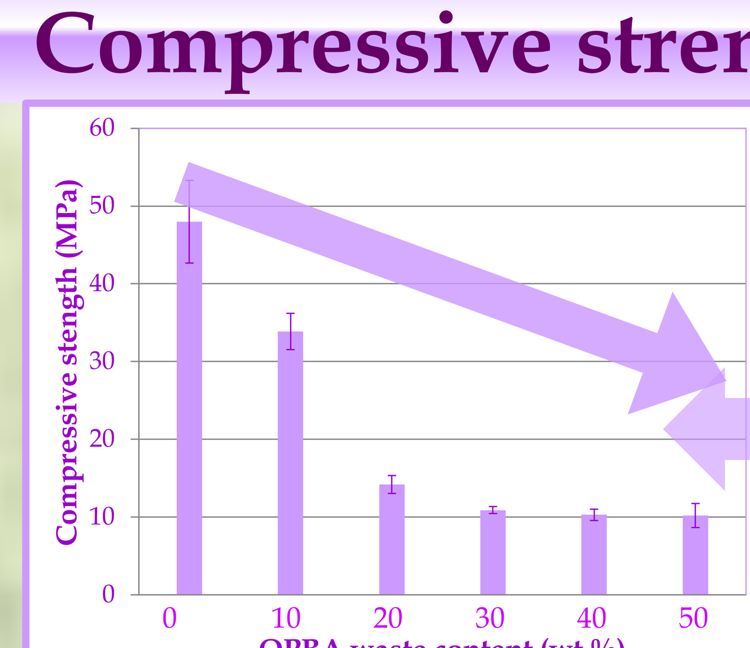
Bulk density and water absorption

The bulk density of the fired brick decreased with an increase in the proportion of residue, decreasing this value between a 6.9 % when it is added by 10 wt % of waste until a 27.3 % with the addition of 50 wt % of olive pomace bottom ash.

Results of water absorption ranged in (16.3-31.0 %) for bricks with 0 wt % and 50 wt % of OPBA respectively. The incorporation of more than 20 wt % of OPBA resulted in bricks with very high water absorption values that do not fall within the standard of the conventional bricks. Bottom ash is a water absorbent material that increased the water absorption capacity of hardened matrix when recycling in it



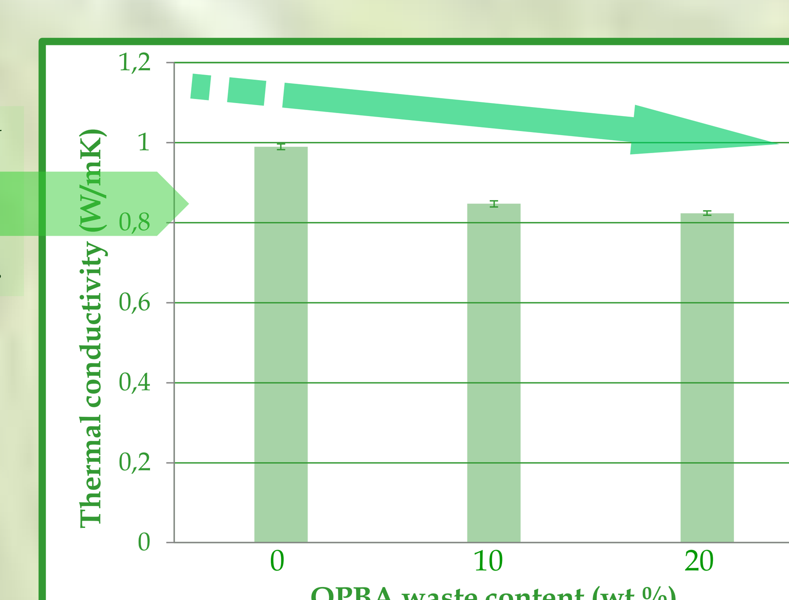
Compressive strength



The compressive strength decreases as waste content increases and increases open porosity, being more pronounced the effect with additions exceeding 10 wt% of OPBA

Thermal conductivity

The thermal conductivity of the clay was 0.99 W / mK and decreases with the addition of the waste.



Conclusions

- **The maximum amount of OPBA to be added is limited to 20 wt %, higher proportions of waste (30-50 wt %) resulted in bricks with very high water absorption and low compressive strength that do not fall are at the limit**
- **The optimum amount of OPBA was 10 wt % since confirm a good balance between the effect provided by the melting capacity of waste and the role of OPBA as pore forming agent. The waste-clay bricks presented optimal technological properties that meet more than the brick quality standards.**

Acknowledgments

This work has been funded by the Project "Valorización de distintos tipos de cenizas para la obtención de nuevos materiales cerámicos sostenibles" (UJA2014/06/13), Own Plan University of Jaen, sponsored by Caja Rural of Jaen.

References

[1] Nogales R, Melgar R, Benitez E. Potential use of olive waste ash from cogeneration plantas as soil amendment. J Environ Sci Health B 2006; 41: 1405-15.
[2] Bouzi d J, Elouear Z, Ksibi M, Feki M, Montiel A. A study on removal characteristics of copper from aqueous solution by sewage sludge and pomace ashes. J of Hazard Mater 2008; 152: 838-45.
[3] Cruz-Yusta M, Mármol I, Morales J, Sánchez L. Use of olive biomass fly ash in the preparation of environmentally friendly mortars. Environ Sci Technol 2011, 45: 6991-6.
[4] Fernández-Pereira C, de la Casa JA, Gómez-Barea A, Arroyo F, Leiva C, Luna Y. Application of biomass gasification fly ash for brick manufacturing. Fuel 2011; 90: 220-32.