Effect of spent filtering earths addition in rice husk ash geopolymers

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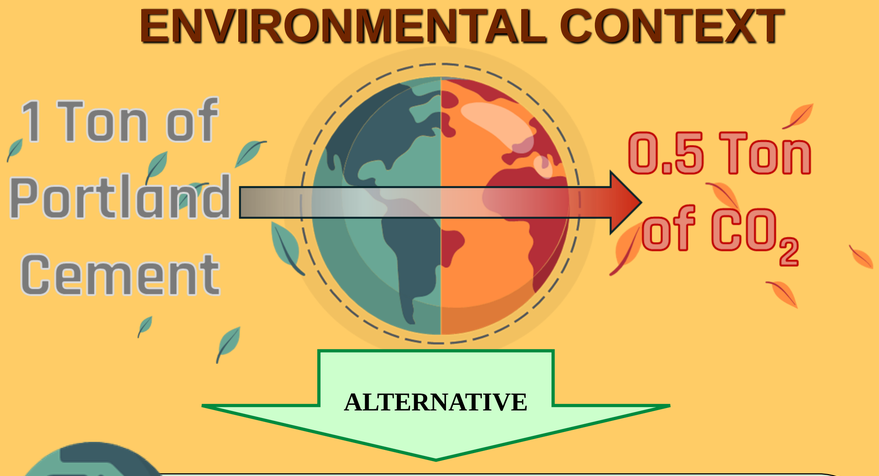
INTRODUCTION

ENVIRONMENTAL CONTEXT



GEOPOLYMERS OR ALKALI ACTIVATED MATERIALS

20-50 % CO_2 emissions reduction
No high temperatures in manufacturing

Good thermal and mechanical properties
High chemical attack resistance

PRECURSOR + ACTIVATOR = GEOPOLYMER

Solid waste. Source of aluminosilicate

ALKALI SOLUTION
NaOH 6 M + Na_2SiO_3 solution (1:1 weight ratio)

Sodium or calcium aluminosilicate hydrate chains

RAW MATERIALS

1. Rice husk ash (RHA)

Approximate growing surface in Spain: 100.000 Ha

Rice average production per Ha: 7-8 tn

Rice husk per ton of rice: 0.2 tn

Ash content in rice husk: 18 %
73.6% SiO_2 but no Al_2O_3

RHA AVERAGE POTENTIAL:
27000 Tons per year in Spain

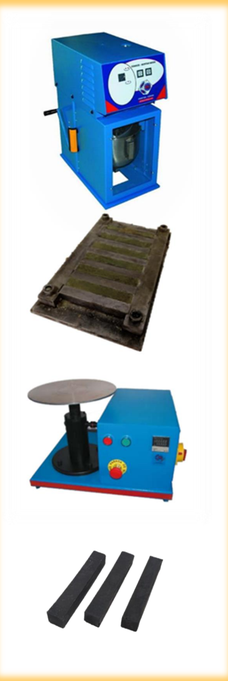
2. Spent filtering earths (SFE)

Byproduct from olive oil industry

84.3 % SiO_2 and 5.9 % Al_2O_3

SAMPLES MANUFACTURE

Rice husk ash + spent filtering earths + alkali solution (NaOH + Na_2SiO_3)



Planetary mixer homogenization (120 s)

Pouring into moulds (10 x 10 x 60 mm)

60 strokes on Proeti punching table

Samples demoulded at 24 h

Curing at room temperature until the age of test

RESULTS AND DISCUSSION

MIXTURES DESIGN

1. Raw materials composition

RHA		SFE	
SiO_2	73.60 %	SiO_2	84.29 %
P_2O_5	1.75 %	Al_2O_3	5.87 %
K_2O	1.63 %	Na_2O	3.47 %
CaO	0.78 %	Fe_2O_3	2.41 %
MgO	0.72 %	K_2O	1.51 %
Fe_2O_3	0.29 %	CaO	0.96 %
Na_2O	0.14 %	TiO_2	0.58 %
Other	0.26 %	Other	0.91 %
LOI	20.83 %		

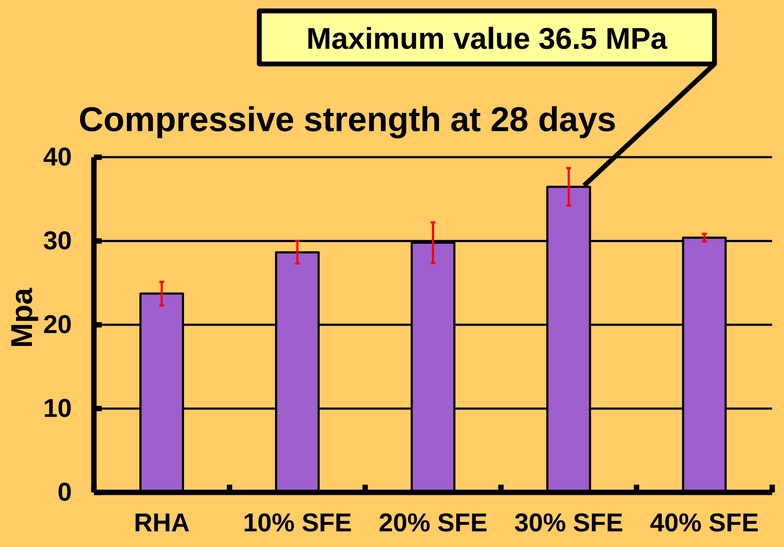
2. Mixtures composition

Sample	RHA	SFE	*NaOH 6 M + Na_2SiO_3 Solution (1:1)*
RHA	200 g	0 g	280 g
10% SFE	180 g	20 g	300 g
20% SFE	160 g	40 g	320 g
30% SFE	140 g	60 g	330 g
40% SFE	120 g	80 g	340 g

(Ratio water/binder was adjusted to maintain workability)

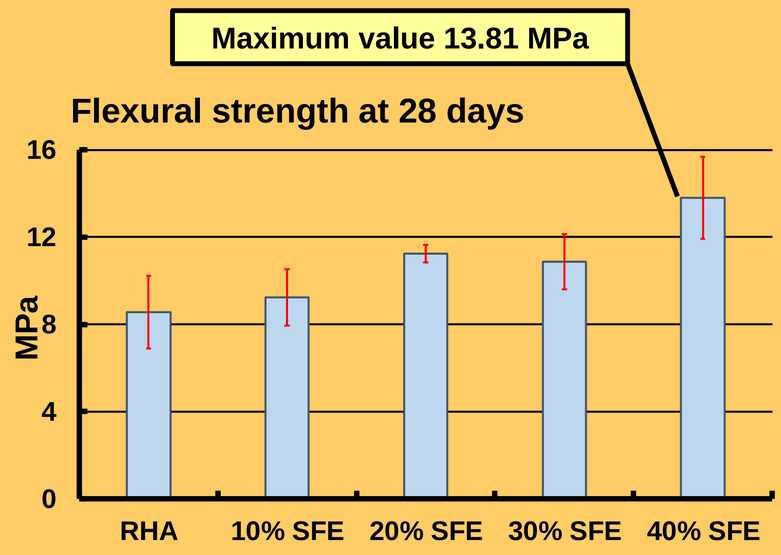
COMPRESSIVE STRENGTH

SFE addition generally improves the compressive strength in percentages up to 30 %



FLEXURAL STRENGTH

RHA geopolymers seems to improve their flexural strength with SFE addition.



CONCLUSSIONS

The data indicate that the incorporation of spent filtering earths in the mixture, produce an improvement of the mechanical properties, flexural and compressive strength, due to the formation of more geopolymer gel and presumably due to the incorporation of the alumina necessary during the process of alkali activation. The compressive strength is increased from 23.7 MPa for the control geopolymers to 30.4 MPa with the addition of 40 wt% SFE. Maximum value was obtained with 30% addition (36.5 Mpa). Therefore, this preliminary study confirms the use of these by-products or industrial wastes for the manufacture of geopolymers to bring us closer to a circular economy.

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