STUDY OF THE INFLUENCE OF THE USE OF SOLID WASTE FROM PORCELAIN TILE POLISHING IN THE TWICE-FIRE PROCESS

José Angelo Amboni Bianchi, Adirlei Cechinel, Francisco Guimarães da Rosa, Marilene V. Folgueras

Dirección: Centro de Pesquisa Eliane
Rua Maximiliano Gaidzinski, 245
88845-000 Cocal do Sul – SC
Brasil
http://www.eliane.com.br

INTRODUCTION

A great drawback to the porcelain tile production process is the waste that arises from the polishing stage. There have been many attempts to use these wastes, which have been very difficult to recycle. The present study was undertaken to find an economic and ecological solution to these potential pollutants.

CHEMICAL ANALYSIS OF THE SOLID WASTE.

Oxide	%
SiO_2	61.1
Al_2O_3	14.1
Fe_2O_3	1.3
CaO	0.5
Na_2O	1.5
K_2O	4.1
MgO	6.3
TiO_2	6.3

Oxide	%
SO_3	0.4
Cl	0.9
ZrO_2	2.0
HfO_2	0.1
BaO	0.1
Cr_2O_3	<0.1
MnO	<0.1
L.O.I.	6.7

CONDITIONS USED

- 2, 4 and 6 % of the solid waste from the polishing branch was added to a standard twice-fire formulation (STD).
- Milling was run in laboratory horizontal mills with a capacity of 5.5 litres and a reject of 4,9 to 5,2 % on a 63 μm mesh screen.
- Pressing was performed on a laboratory press with a pressure of 250 kgf/cm^2 and 7 % moisture content.
- The test specimens were fired in a laboratory kiln at a temperature of 1115 °C and cycle of 50 minutes, and also in an industrial kiln at a temperature of 1070 °C and 38 hour cycle.

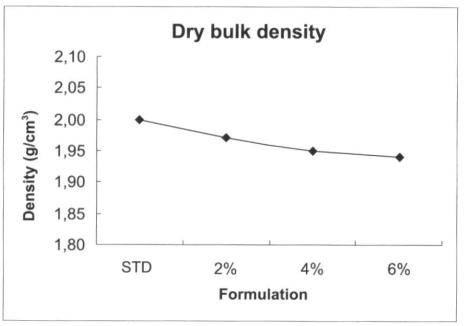
TESTED FORMULATIONS.

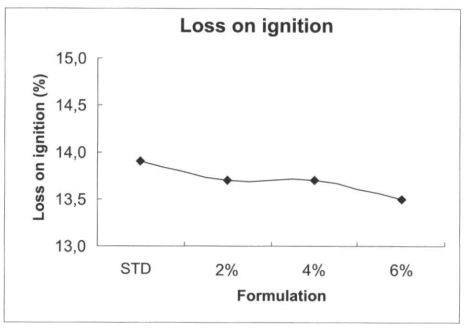
Raw Materials	STD	2 %	4 %	6 %
Twice-fire formulation	100%	100%	100%	100%
Polishing waste	-	2/100	4/100	6/100

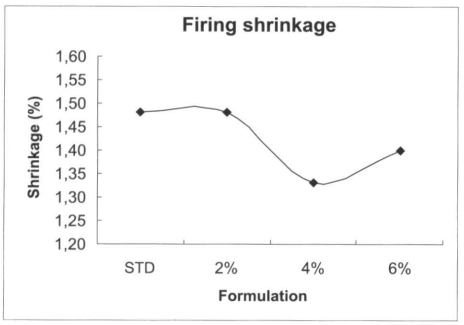
RESULTS OBTAINED.

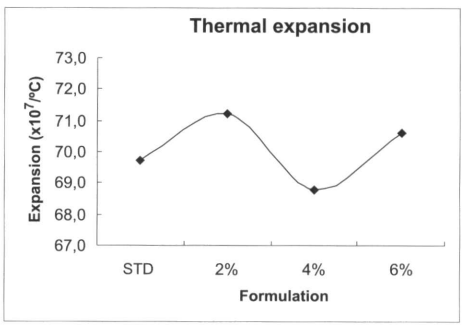
	In laboratory kiln				In industrial kiln			
Formulation	STD	2 %	4 %	6 %	STD	2 %	4 %	6 %
Milling time (min.)	20	20	20	20	-	-	-	-
Milling reject on a 63 μm screen	4.9	4.9	4.9	5.2	-	-	-	-
Pressing moisture content (%)	7.3	7.4	7.4	7.5	-	-	-	-
Dry bulk density (g/cm^3)	2.00	1.97	1.95	1.94	-	-	-	-
Dry mechanical strength (Kgf/cm^2)	26	23	25	24	-	-	-	-
Firing shrinkage (%)	1.48	1.48	1.33	1.40	0.98	1.03	1.12	1.15
Water absorption (%)	18.0	18.8	19.2	19.5	19.1	19.3	20.0	20.3
L.O.I. (%)	13.9	13.7	13.7	13.5	14.2	14.0	13.9	13.9
Fired mechanical strength (Kgf/cm^2)	168	162	171	145	-	-	-	-
Thermal expans.(25,325°C)($x10^{-7}/°C$)	69.7	71.2	68.8	70.6	67.6	68.7	68.1	69.0
Firing kiln	Lab.	Lab.	Lab.	Lab.	Tunnel	Tunnel	Tunnel	Tunnel
Peak firing temperature (°C)	1115	1115	1115	1115	1070	1070	1070	1070
Firing cycle	50 min.	50 min.	50 min.	50 min.	38 hours	38 hours	38 hours	38 hours

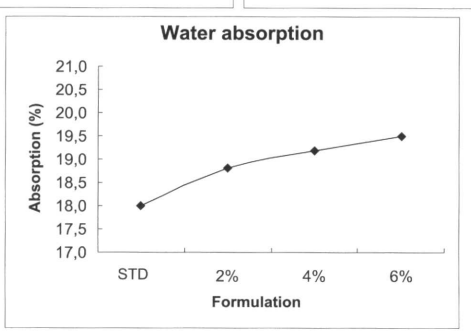
RESULTS OBTAINED IN THE LABORATORY KILN (EXPLORER).



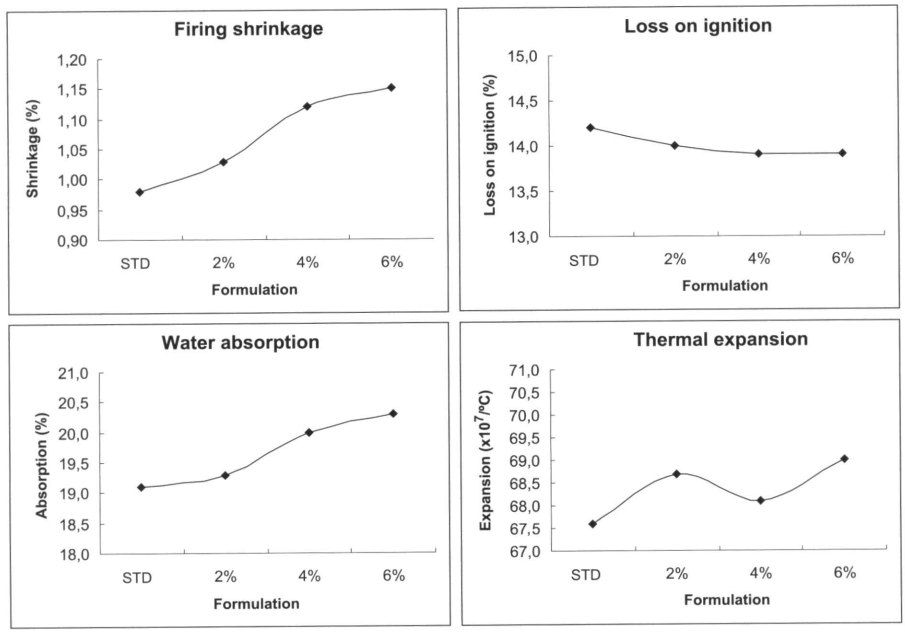






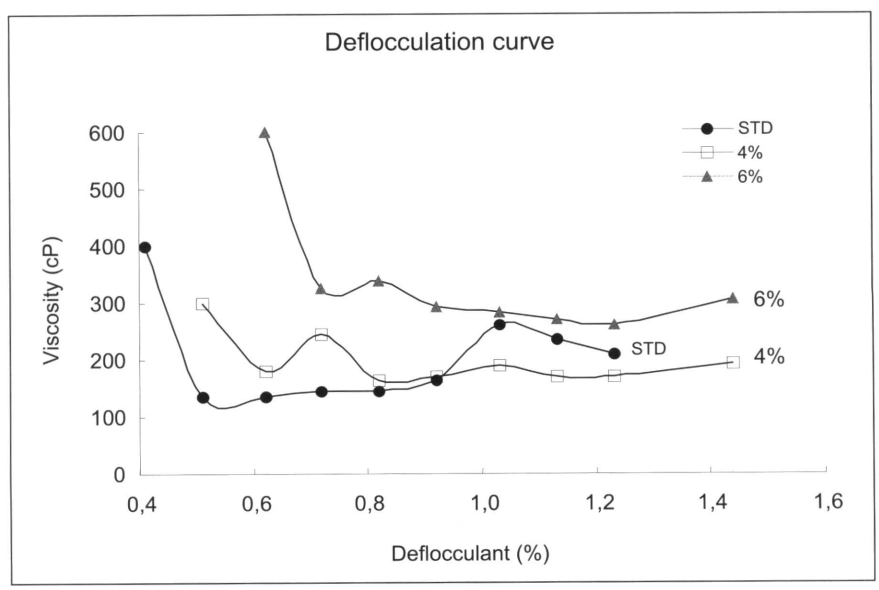


RESULTS OBTAINED IN THE INDUSTRIAL KILN (TUNNEL).



DEFLOCCULATION CURVE.

Deflocculant	Viscosity (cP)		
(%)	STD	4%	6%
0.41	400	-	-
0.51	136	300	-
0.62	135	180	600
0.72	144	245	325
0.82	146	166	340
0.92	165	170	295
1.03	260	190	285
1.13	235	170	270
1.23	210	170	260
1.44	-	195	305



DISCUSSION OF RESULTS

- The solid waste was found to contain a high percentage of MgO from the abrasives used in polishing.
- A reduction was observed of compaction with the rise in the quantity of solid waste in the formulation.
- Firing shrinkage dropped in the laboratory kiln and the material behaved as an inert material, however firing shrinkage rose in the industrial cycle when the waste proportion was raised.
- Water absorption rose in the two situations probably as a function of the reduction in bulk density of the formulations.
- Thermal expansion tended to rise under the two conditions (industrial and laboratory)
- The deflocculation curves indicate that the difficulties started at a 4% waste solids content.

CONCLUSIONS

The results obtained indicate the possibility of using the solid waste from porcelain tile polishing in twice-fire processes, though the linear shrinkage of the end product needs to be reduced.

In the deflocculation curves the difficulty can be observed that will be encountered under industrial conditions, involving a rise in the slip viscosity, limiting use to 4%.

An industrial trial will be conducted to confirm the laboratory results, in which all the process parameters will be controlled, especially the deflocculant quantity.