PORCELAIN STONEWARE TILES: EFFECT OF WASTEWATER RECYCLING ON RHEOLOGICAL, THERMAL AND AESTHETIC PROPERTIES

F. Andreola, L. Barbieri, I. Lancellotti, T. Manfredini

Dipartimento di Ingegneria dei Materiali e dell'Ambiente, Facoltà di Ingegneria
Università di Modena e Reggio Emilia. Via Vignolese 905, 41100 - Módena- Italy
E-mail: andreola.fernandanora@unimo.it

1. INTRODUCTION

Porcelain stoneware is the fastest growing type of tile in the international ceramic market. Nowadays it is becoming more and more important in Italy; its production reached 42% (329.10^6 m^2) of total tile production in 2002 [1]. From a simple analysis of the tile quantities produced, broken down by typology, the last few years have shown a trend of porcelain stoneware production growth in respect of single firing products. Production of this tile in the last three years has increased by 71%. In contrast, in this same period the white body single firing products have displayed a decrease of 10%. This will involve a change in the current tendency of recycling different processing wastewaters in the single firing body toward another typology, which is able to absorb great volumes of wastewater.

Among the different ceramic floorings, porcelain stoneware is the only one that has very good mechanical and technical properties, showing a high degree of sintering and surface hardness, low porosity and high aesthetic characteristics. In the last few years, the applied research has provided different interesting results for enhancing aesthetic qualities. These characteristics make it difficult to reuse both the solid ceramic residues and the process wastewaters with a similar practice to that developed previously for the other typologies, making it necessary to find new solutions that can be applied to this kind of product.

In order to achieve sustainable development, the reduction of both the water discharged and water consumption is more important with respect to the fostering the cleaning process. The wastewaters from the production process (preparation of bodies and glazes, glazing and cooling processes, etc.) are collected in tanks where in some cases they are subjected to cleaning treatments with the separation of sludges which contain pollutant elements [2].

In order to recycle the wastewaters deriving from the different ceramic cycles inside a high quality body, such as porcelain stoneware, a systematic study needed to be performed in order to highlight possible changes in the operating parameters of the different processing stages. It is further necessary to verify that the usual characteristics of the finished products remain constants. The present work evaluates the possibility of recycling wastewater from different technological ceramic cycles in the porcelain stoneware body. These waters will be used for the preparation of the mixes in the wet-milling step of the ceramic cycle and it will be verified whether the use of these residues produces any changes in the rheological, thermal and aesthetic characteristics of the final products. Rheological measurements have been conducted in order to determine any eventual deviations of the rheological parameters (apparent viscosity, yield stress), which regulate the wet-grinding stage. Sintering has been controlled by water absorption and linear shrinkage measurements. The possible aesthetic modifications on the tiles caused by the recycling have been controlled by colorimetric tests both on the base bodies and on the bodies to which four commercial pigments (pink, blue, white and yellow) were added in industrial percentages.

2. CONCLUSIONS

From this work it can be concluded that rational recycling enables reusing wastewaters deriving from different ceramic production cycles in glazed and unglazed porcelainized stoneware bodies. This benefit is possible with a low

investment, by inserting into the flow sheet a homogenization tank with a decanter, which permits sedimentation of suspended solids. The preparation of slips using these waters does not change the parameters of the production cycle, leading to a final product with a quality and aesthetic characteristics similar to those required by the market and avoiding possible emission of the wastewater after treatment in sewers or in surface river courses.

	B	Pb	Cu	Cd	Fe	Al	Ca	Mg	Cl*	pH	C.S
WASTE	33.75	0.00	0.00	0.00	0.00	0.02	209.50	34.35	179.02	6.89	1.49
IND	2.29	0.00	0.00	0.00	0.00	0.00	128.70	31.46	126.20	8.21	1.25

* as chlorine

Table 1. Chemical analysis, pH and specific conductivity (mS/cm) of the waste and industrial waters.

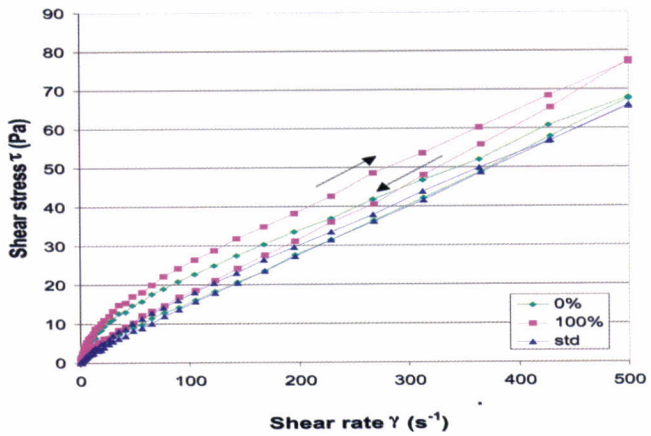

Figure 1. Flow curves for the suspensions prepared as a function of wastewater non-decanted percentage.

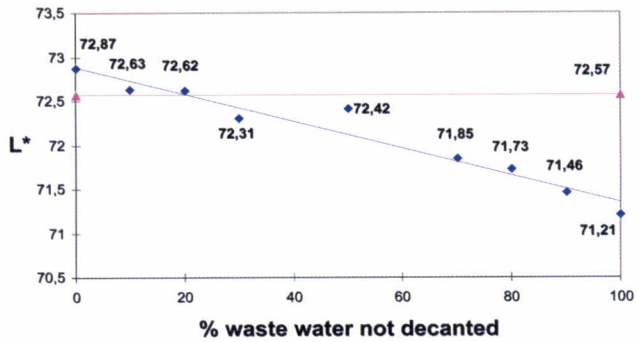

Figure 2. L parameter for a base body as a function of wastewater added.*

REFERENCES

[1] Italian National Statistic Study, Assopiastrelle, 2000.

[2] G.Busani. and G. Timellini, "Inquinamento idrico" (Water pollution), Chap. 3 in "Piastrelle Ceramiche & Ambiente" (Ceramic Tile & Environment) a cura di G.Busani. C. Palmonari. G. Timellini. EDICER, Sassuolo, 1995.