BORON AIR EMISSIONS IN GLAZED TILE MANUFACTURING PROCESSES WITH TOTAL WASTEWATER REUSE

J. E. Enrique, E. Monfort; F. Ferrando; M.ª F. Gazulla

Instituto de Tecnología Cerámica (ITC)
Asociación de Investigación de las Industrias Cerámicas (AICE)
Universitat Jaume I. Castellón. Spain.

1. INTRODUCTION

Previous studies conducted by the Instituto de Tecnología Cerámica[1], [2] have demonstrated the feasibility of reusing the arising industrial wastewater as a raw material in the same production process, while showing that the controlled application of these recycling systems did not produce any significant changes in process variables or final product quality.

This solution has found widespread implementation in recent years in the Spanish ceramic tile industry and has allowed wastewater effluents and water consumption to be significantly reduced.

In these recycling systems, wastewater is assumed to be eliminated by evaporation in the spray dryer, while the suspended or dissolved materials present, especially the boron compounds, are assumed to become incorporated in the finished product.

A previous study[3] addressed the possible environmental impact of this measure in the body preparation stage. The objective of the present work was therefore to draw up overall boron balances in glazed tile manufacturing processes with total wastewater reuse.

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[1]. BLASCO, A.; GINÉS, F.; JARQUE, J.C.; MONFORT, E. *Adición de fangos reciclados a composiciones de pavimentos y revestimientos cerámicos (I)*. Técnica Cerámica, 195, 470-483, 1991.

[2]. BLASCO, A.; GINÉS, F.; JARQUE, J. C.; MONFORT, E. *Adición de fangos reciclados a composiciones de pavimentos y revestimientos cerámicos (y II)*. Técnica Cerámica, 196, 578-585, 1991.

[3]. ENRIQUE, J.E.; MONFORT, E.; FERRANDO, F.; NEGR,. *Elimination of boron from wastewater produced in the ceramic industry*. 7th Mediterranean Chemical Engineering Congress. Barcelona. 1996.

These balances were prepared by taking into account all the material streams (solids, liquids and gases), especially focusing on the gas streams.

2. EXPERIMENTAL

The study was carried out in a single-fire, glazed wall tile manufacturing facility, at which wastewater, sludge and unfired scrap are reused in the same production process by incorporation in the body composition.

Sampling was performed during two weeks of normal production. The experimental values were obtained as follows:

- In the gas streams, the boron found in the gas phase and in the solid phase was analysed, taking samples from representative gases. The samples of particulates from the exhaust gases were obtained by isokinetically collecting samples of suspended particles[4].

- Boron analysis in the liquid samples was carried out by the azomethine-H colorimetric method[5]. This was done potentiometrically in the solid samples after previously preparing an alkaline fusion followed by acid digestion.

Using the values obtained in the different chemical analyses and drawing up a material balance of the process allowed computing the mass flows of the boron compounds in all the streams.

The values of the mass flows have been expressed as milligrams boron/kg processed tile body raw material.

Table 1 details the experimentally and computationally determined resulting boron mass flows, based on the above calculation.

Stream	B (mg / kg body)
Waste reused in body preparation (wastewater + sludges + glaze rests + unfired scrap)	225
Spray-dried powder and unglazed green bodies	224.7
Gas emissions in the spray dryer	0.3
Glaze raw materials	740
Unfired glazed bodies	739.7
Fired glazed bodies	739.1
Spray dryer emissions	0.6

Table 1. *Boron mass flows in the different streams.*

[4]. P. MAZZALI. *L'inquinamento atmosferico*. Bologna: Ed. Pitagora, 1989.
[5]. LÓPEZ, F. J.; GIMÉNEZ, E.; HERNÁNDEZ, F. *Analytical study on the determination of boron in environmental water samples*. Fresenius J. Anal. Chem., 346, 984-987, 1993.

3. CONCLUSIONS

- In the most significant gas emissions - involving spray dryers and tile kilns - a total mass flow of boron compounds was determined of around 0.1% of the total boron compound feed into the process.

- The results show that in this process most of the boron compounds are incorporated in the finished product, and are immobilised there.

- From an economic and environmental point of view, the implementation of a recycling system, in which the arising wastewater and unfired waste in glazed ceramic tile manufacture are reused in the same production process, represents the best available technology for treating these waste streams.