METAL LEVELS IN THE PM_{10} FRACTION IN CHANNELLED SOURCES OF THE CERAMIC INDUSTRY

I. Celades[(1)], E. Monfort[(1)], X. Querol[(2)], V. Sanfélix[(1)], A. Escrig[(1)]

[(1)] Instituto de Tecnología Cerámica (ITC).
Asociación de Investigación de las Industrias Cerámicas (AICE).
Universitat Jaume I. Castellón. Spain
[(2)] Instituto Ciencias de la Tierra "Jaume Almera", CSIC, Barcelona. Spain

1. INTRODUCTION

The ceramic district in Castellón province is characterised by a high concentration of companies that manufacture ceramic tiles and related products. This has a significant impact on environmental air quality in this area. Recent studies on this issue have detected that the PM_{10} fraction concentrations (particles with an aerodynamic diameter below 10 μm) and the concentrations of certain metals constitute the most critical environmental parameters in the area.

In this sense, it has been observed that the concentrations of certain metals in the PM10 fraction (Li, Sc, Co, Zn, As, Se, Rb, Zr, Cd, Cs, Ce, Tl, and Pb) are higher in the ceramic area than in urban areas of Spain, and that the levels of some of these metals are even higher in the studied area than in other industrial areas (Querol et al., 2007; Minguillón et al., 2007). In order to remedy this situation, an Air Quality Improvement Plan (http://www.cma.gva.es) has been drawn up.

The present study has been undertaken with a view to finding technically and economically feasible solutions: the PM_{10} fractions of the particulate matter released via the main channelled sources of the ceramic industry (spray drying, pressing, glazing, and firing) have been quantified and their chemical composition has been studied.

Detailed knowledge of the emissions produced in the ceramic tile manufacturing process and of the efficiencies attained by currently implemented cleaning systems is fundamental in order to be able to identify the origin of the emitted particles and their formation process, to evaluate the possibilities of implementing at-source abatement measures and/or to detect the need of putting in place additional treatment systems.

2. METHODOLOTY

In order to achieve the objectives of this study, a methodology of obtaining the PM10 fraction in the main ceramic process stages with a PM10 cut-off cyclone has been developed, and an analytical method has been fine-tuned for subsequent chemical characterisation of these emitted fractions from the studied sources.

In a first study phase, the wastes obtained in the emission cleaning systems installed in the studied process stages were chemically characterised: in the case of the ceramic tile manufacturing industry, these are mainly bag filters. This first approach was based on the consideration that the filtration temperature in these process stages was similar to the emission temperature, so that the fine fraction of these wastes would be likely to have a chemical composition similar to that found in the fine fraction of air emissions. Although not included in this work because of space constraints, the validity of this assumption has been verified. In the firing stage, owing to the low degree of implementation of BATs, isokinetic samplings

were carried out of the PM10 fraction of the streams emitted by the industrial stacks.

3. RESULTS AND CONCLUSIONS

Figures 1 and 2 display the chemical profiles obtained in the characterisation of the PM10 fraction in the different ceramic tile manufacturing process stages.

The results obtained indicate that, in this process, heavy metal emissions essentially occur in the glazing and firing stages. Therefore, in order to reduce these emissions, corrective measures must focus on these two process stages.

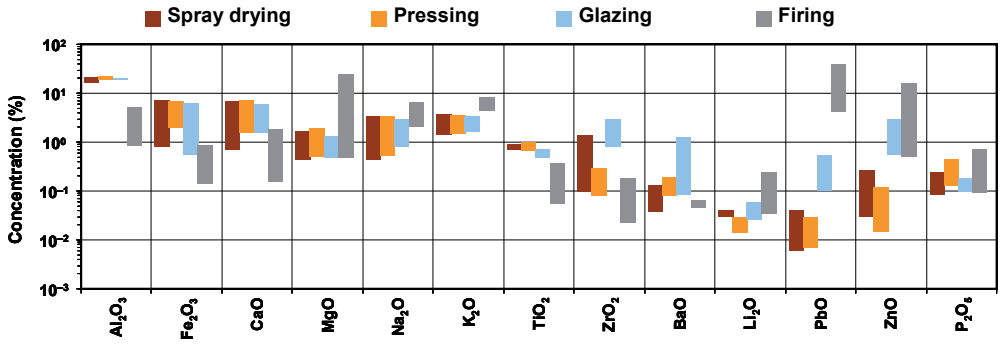

Figure 1. Concentration profiles of the major constituents.

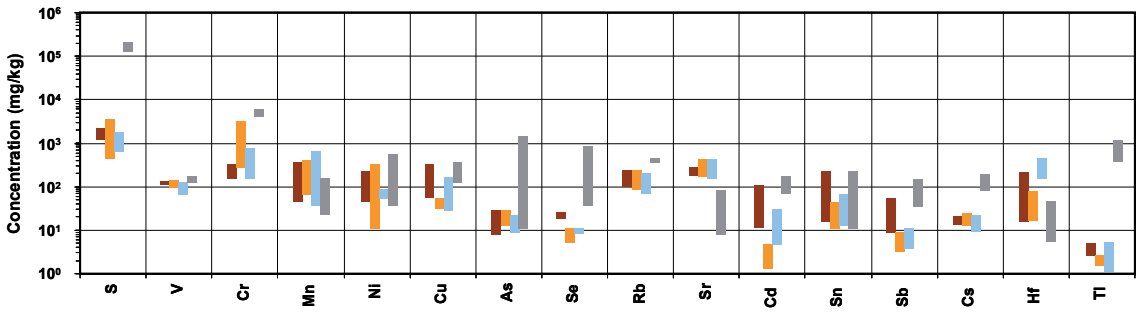

Figure 2. Concentration profiles of the trace elements.

ACKNOWLEDGEMENTS

The present study was funded by the Ministry of Education and Science in the programme of the National Plan for Scientific Research, Development, and Technology Transfer (2004-2007), reference CGL2006-07956/CLI.

REFERENCES

[1] Querol, X.; Minguillón, M.C.; Alastuey, A.; Monfort, E.; Mantilla, E.; Sanz, M.J.; Sanz, F.; Roig, A.; Renau, A.; Felis, C.; Miró, J.V.; Artiñano, B. Impact of the implementation of

PM abatement technology on the ambient air levels of metals in a highly industrialised area. Atmos. Environ., 41, 1026-1040, 2007.

[2] Minguillón, M.C.; Querol, X.; Alastuey, A.; Monfort, E.; Miró, J.V. PM sources in a highly industrialised area in the process of implementing PM abatement technology. Quantification and evolution. J. Environ. Monit., 9(11), 1071-1081, 2007.

[3] http://www.cma.gva.es/cidam/emedio/atmosfera/index.htm

(Retrieved: 17 September 2009).