DRY INDUSTRIAL TECHNOLOGY FOR REDUCING QUARTZ TOXICITY

E. Monfort[(1)], A. López-Lilao[(1)], MJ. Ibáñez[(1)], G. Bonvicini[(2)], O. Creutzenberg[(3)], C. Ziemann[(3)]

[(1)] Instituto de Tecnología Cerámica, Universitat Jaume I, Castellón (España)

[(2)] Centro Ceramico di Bologna (CCB), Bolonia (Italia)

[(3)] Fraunhofer Institute for Toxicology and Experimental Medicine (ITEM), Hannover (Alemania)

ABSTRACT

The inclusion of "work involving exposure to respirable crystalline silica dust generated by a work process" in Annex I of Directive 2004/37/EC, which regulates worker exposure to carcinogenic agents, requires companies where this pollutant is present to take extra precautions to protect worker health. Replacing quartz is usually unfeasible.

Two research projects were conducted in which technologies were developed that allow crystalline silica particle toxicity to be reduced by coating the particle surface with organosilanes. In the first project (SILICOAT), the effectiveness of adding these coating agents in wet production processes for traditional ceramics was verified. In the second project (SILIFE), a dry coating process was developed that enables quartz powders with low or zero toxicity to be obtained, ready for use as raw material in industrial processes without wet production stages, such as those of frits, glazes, and ceramic pigments. The technology developed in the SILIFE project is protected by European patent application reference EP19382177.4, date of application 11/03/2019. In every case, coating the quartz particles was verified to lower crystalline silica toxicity, and the technical feasibility of the treatment was confirmed by industrial trials.

1. INTRODUCTION

In the SILIFE project, a dry coating process with organosilanes was developed that yields quartz powders with low or zero toxicity, ready for use as raw material in industrial processes in which there are initially no wet production stages, such as frit, glaze, and ceramic pigment production.

2. PROCEDURE UDES

2.1. MATERIALS SELECTION AND CHARACTERISATION

After the physico-chemical and toxicological characterisation of the quartzes used by different user companies, trials were carried out to select the most appropriate silanes in every case.

2.2. COATED QUARTZ PREPARATION PROCESS

Figure 3. *Prototype installed in the quartz processing plant*

A prototype was designed from a pilot mixer with the capacity to produce sufficient amounts of the different coated quartzes. The facility was installed in a quartz processing plant (Figure 3) and the necessary modifications were implemented to appropriately perform the task. Before start-up, the relevant measures were taken to assure safety during use and conformity to applicable legislation was accredited.

3. VALIDATION OF THE METHOD AND PERFORMANCE OF INDUSTRIAL TRIALS

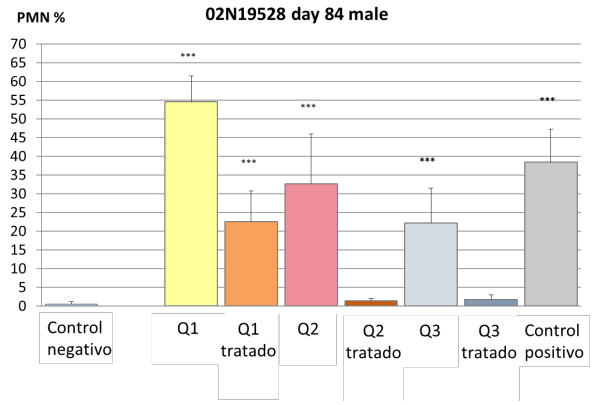

Figure 4. *Example of the decrease in toxicity achieved in several quartzes with the developed tratment*

The user companies were sent a first batch of quartz coated with the most promising silanes obtained in the laboratory and toxicity tests, to ascertain whether the treated quartzes were compatible with user processes and the resulting products met their quality standards.

Once the relevant adjustments had been implemented in each case, each company was supplied with the amount of coated quartz required for the industrial trials, in which the quartz customarily used was replaced with the coated quartz.

In the case of glazes prepared with the coated quartz, no problems in performance were observed during the process and the tiles made in the production lines exhibited no differences with the rest of production.

Figure 4. *Glazing process and appearance of the glazed surface of a tile produced during the trial.*

On dispersing the pigments prepared with the treated quartz in the coloured glaze formulations, occluded bubbles were observed to appear, which gave rise to pinholing and dimples in the fired glazed tile surface. This problem was solved by two actions:

- Selection of more hydrophilic silanes to facilitate wetting of the materials.
- Mixing by more vigorous methods (milling).

Figure 5. *Comparison of the appearance of the (dispersed) slips and surfaces obtained using pigments made with and without treated quartz.*

4. CONCLUSIONS

A technology was developed that enables quartz toxicity, owing to RCS, to be reduced or suppressed by coating the quartz particles with organosilanes, without using an aqueous medium, which can therefore be readily integrated into dry processes.

Industrial trials proved that the coated quartz can be used in glaze and ceramic pigment production.

The methodology developed can be adapted to the different production processes being studied.

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