SILIFE. PRODUCTION OF QUARTZ POWDERS WITH REDUCED CRYSTALLINE SILICA TOXICITY

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1. ABSTRACT

The inhalation of crystalline silica produces the well-known pathological reaction called silicosis. Many industrial sectors use quartz and/or quartz-containing raw materials in their processes. Consequently, the occupational environments of these companies may contain appreciable quantities of this pollutant. However, quartz cannot be replaced in most cases.

Numerous studies suggest that the toxicity of quartz is conditioned by the surface chemistry of the quartz particles and, in particular, by the density and abundance of silanol groups. The effectiveness of the addition of substances like nano-alumina, aluminium lactate, and organosilanes to block these groups was studied in the SILICOAT project, in which it was shown that the toxicity of the RCS contained in the wet-processed raw materials of the traditional ceramic industries can be virtually nullified. This effect was obtained by adding an additive to the ceramic compositions, which coats the quartz surface so that it is no longer toxic. This technology was found to be technically and economically feasible for traditional

From these results, a new LIFE project (SILIFE) has been approved by the EU and started in order to extrapolate these good results to other industrial sectors which use quartz in their dry processes. The main objective of this new project consists of producing commercial quartz powders that show very little or no RCS toxicity. To do this, a pilot plant for treatment of commercial quartz powders will be designed. The treated quartz produced in this plant will be verified by means of industrial trials performed by several end users from different industrial sectors.

2. INTRODUCTION

Respirable Crystalline Silica (RCS), for example in the form of quartz, is known to produce the irreversible and potentially lethal pathological disease called silicosis. Furthermore, the International Agency for Research on Cancer (IARC) classified RCS in the form of quartz and cristobalite from occupational sources as carcinogenic for humans (category 1).

Crystalline silica – quartz, in particular – is one of the most widely used industrial raw materials. In terms of exposure, RCS is probably the most concerning hazardous chemical: more than 4 millions of European workers are believed to be potentially exposed to RCS at their workplaces.

3. BACKGROUND. SILICOAT PROJECT

The SILICOAT project aimed to develop and implement cost-effective RCS-coating technologies based on stable, covalent saturation of reactive quartz surface silanol groups in ceramic processes to inhibit quartz-specific toxic effects (figure 1). This technology was found to be technically and economically feasible for traditional ceramics.

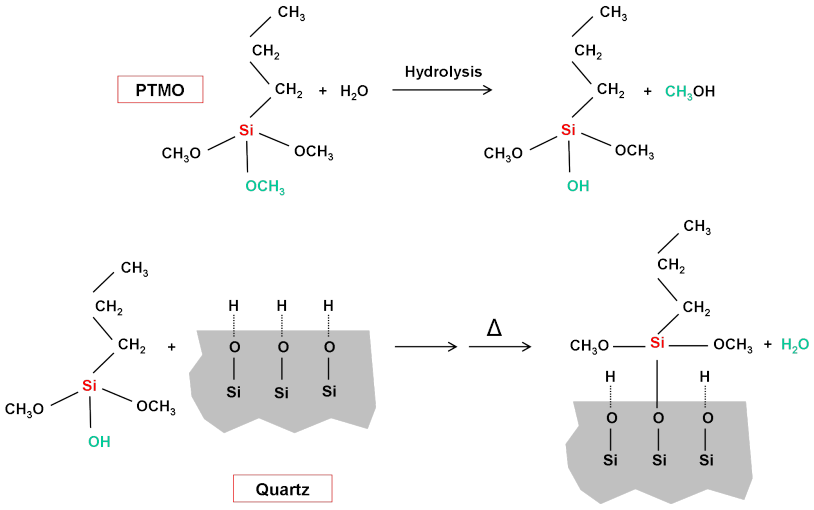

Figure 1. *Hydrolysis of PTMO and coating reaction with reactive silanol groups on the quartz surface.*

4. SILIFE PROJECT

4.1. OBJECTIVES

Although the coating technology developed was demonstrated for traditional ceramics, it was not applied elsewhere. Furthermore, the project also evidenced that the coating technology should optimally be introduced upstream, when the quartz powders are produced.

Taking into account the above, the aim of the SILIFE project is to produce commercial quartz powders that exhibit very little or no RCS toxicity, with the following main goals:

- Design of a pilot plant for the treatment of commercial quartz powders.
- Demonstration that the treated powders exhibit much less toxicity than the untreated quartz.
- Performance of a critical assessment of the treatment to ensure technical and economic feasibility.
- Verification that the treated powders have full product quality by means of industrial trials in end-user factories belonging to other industrial sectors than ceramics.
- Informing the stakeholders of the results in order to encourage them to embrace the technology.

4.2. CONSORTIUM

The project consortium includes eleven beneficiaries, seven of which are industrial partners from different sectors. Apart from one quartz processor and one silanes producer, the remaining five are end users of quartz from different industrial sectors. They will test the coated quartz in their respective processes.

Coordinator: ITC-Universidad Jaume I

Technological beneficiaries:

- ITC-Universidad Jaume I
- Fraunhofer-ITEM
- Centro Ceramico di Bologna (CCB)
- Spanish Technology Platform on Industrial Safety (PESI)

Industrial beneficiaries:

- ABCR Laboratorios S.L. (Silanes producer)
- Bulk Cargo Logistics S.A. (Quartz processor)

End-user beneficiaries:

- Elastomers Union S.r.l. (Elastomers producer)
- ESMALGLASS S.A.U. (Frits and glazes producer)
- Fundiciones FUMBARRI-DURANGO S.A. (Steel foundry)
- ITACA S.A.U. (Inorganic pigments producer)
- MAPEI S.P.A. (Adhesives producer)

5. ACKNOWLEDGEMENTS

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