# USE OF ULTRASONIC ATOMISATION TO MODIFY CERAMIC TILE SURFACE PROPERTIES

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## ABSTRACT

Ultrasonic atomising nozzles have traditionally been used for moistening. These types of nozzles are currently used in numerous applications, such as the following: solar cell manufacture, coatings for medical applications, microencapsulation, float glass coatings, etc.

The purpose of this study has been to identify the possible applications of ultrasonic atomising nozzles in ceramic tile manufacturing. To do this, a commercial ultrasonic atomising nozzle was used to build a prototype that allows different suspensions and solutions to be applied to ceramic tile surfaces.

After fine-tuning the prototype, tests were conducted with different types of materials, including nanometric materials (aluminium oxide and titanium oxide) and micrometric materials (glazes and ceramic raw materials), and soluble colours. The tests were carried out on unfired and fired tile bodies.

The results show the possible different applications of the prototype: 1. Application of coatings with photocatalytic activity. 2. Modification of gloss. 3. Modification of slip resistance. 4. Colouring of the surface using soluble salts.

## 1. INTRODUCTION

Ultrasonic atomising nozzles are currently used to obtain coatings for very different applications, such as: solar cell manufacture, coatings for medical applications, microencapsulation, float glass coatings, etc[1].

This type of nozzle is designed to generate vibrations of the amplitude required to produce the characteristic unstable capillary waves of ultrasonic atomisation. This system enables liquids, solutions and suspensions of materials of sizes below 40 μm to be sprayed.

Ultrasonic atomisation can be used in the manufacture of ceramic tiles for applying fine coatings to modify surface properties.

## 2. MANUFACTURING AND FINE-TUNING THE PROTOTYPE

This type of atomisation system requires low line speed, so it cannot be assembled on glazing lines with conventional transport systems. Because of this, the nozzle was mounted on a transport system designed by ITC technicians.

The prototype was built using a commercial ultrasonic atomising nozzle (figure 1), which has a suspension-proportioning system operated by a plunger. There are different proportioning systems, and this one was chosen for building the study prototype because it is possible to work with small quantities of sample.


*Figure 1. Close-up of the prototype.*

Figure 2 shows a general view of the prototype. The control system for the nozzle is marked with a C. The system allows parameters such as power source, atomiser power, and air power to be regulated.

Apart from the nozzle functioning variables, there are other variables that can be modified in designing the applications, such as nozzle height and line speed.

All the variables were adjusted to be able to perform applications on to 15-cm-wide tiles, the fixed variables being atomiser power at 10 W, and nozzle height at

1. BERGER, H.L. *Ultrasonic liquid atomization: theory and application.* New York: Partridge Hill, 1998.

18 cm. The other variables were modified within the following ranges: feed flow rate [5-70ml/min], air flow rate [30-65 l/min], and line speed [2-8 m/min].


*Figure 2. General view of the prototype.*

*Figure 3. Tiles before (below) and after (above) application of nanometric aluminium oxide.*

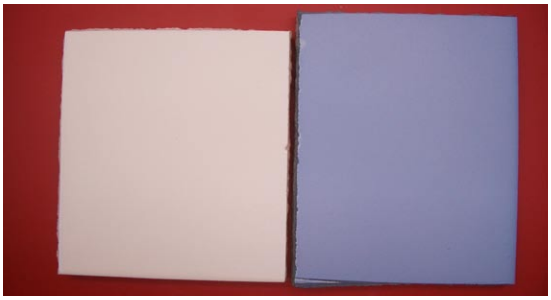

*Figure 4. Tiles before (left) and after (right) application of a soluble colour.*

## 3. DEMONSTRATION OF APPLICATIONS

Different materials were applied on to two types of substrates, a fired glazed tile and an unfired glazed tile. The application conditions required adjustment for each type of application.

The materials tested were:

- Suspensions of nanometric materials: titanium oxide and aluminium oxide.
- Soluble colours.
- Suspensions of ceramic glazes.
- Suspensions of ceramic raw materials.

The application of nanometric materials on unfired glazed tiles did not provide satisfactory results, because when the tiles were fired total integration of the material applied in to the glaze layer ensued. The best results were obtained with applications of nanometric materials on fired tiles, subsequently re-firing these at a low temperature, and with the application of soluble colours on to unfired tiles and then firing these at usual working temperatures.

## 4. CONCLUSIONS

A prototype has been developed, based on the ultrasonic atomisation technique, which allows the application of small quantities of solutions or suspensions on to the ceramic tile surface.

The technique is considered highly appropriate for modifying the surface properties of ceramic tiles using small quantities of material, which is especially interesting when the materials applied are expensive (nanometric materials). The use of this technique opens up a series of possibilities, the following of which deserve to be noted:

- Application of coatings with photocatalytic activity.
- Modification of gloss.
- Modification of slip resistance.
- Colouring of the surface using soluble salts.

The tests conducted have shown that to optimise the functioning of the equipment it is necessary to improve ceramic tile surface wetting.

This technique enables the application of new materials on to ceramic tiles to be considered for new functions, which makes it interesting to study the feasibility of applying new materials that are currently not used in ceramic tile manufacturing.

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