

23rd International Enamel Congress

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New coatings for the functionalization of enamelled surfaces

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New coatings for the functionalization of enamelled surfaces



Enamel is an extremely heat and abrasion resistant coating, able to protect steel and increasing its performances.

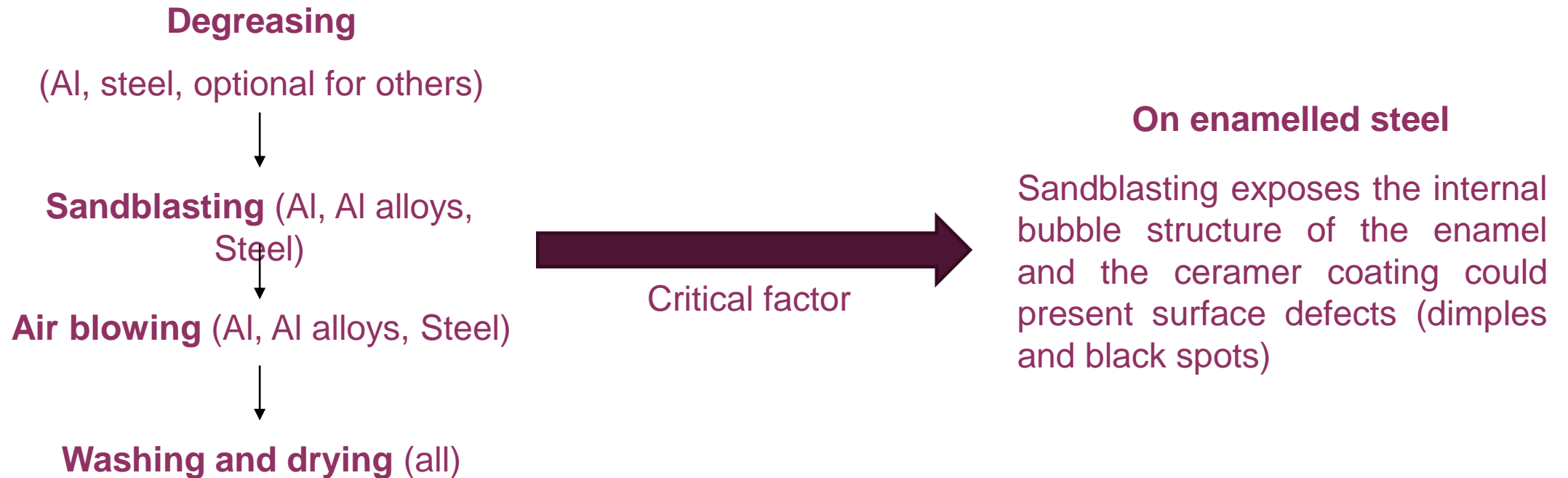
Enamel is a material particularly suitable for food contact but don't have an anti-stick feature.

Ceramer coating can give an anti-sticking behaviour, joining with a good scratch and thermo resistance.

Ceramers are hybrid materials made of inorganic structures interconnected with silica based polymers, with properties of ceramics (thermal resistance, chemical resistance, anti-scratch behaviour, stiffness) and polymers (elasticity, hydrophobicity).

The product can be applied on different metallic substrates (aluminium and aluminium alloy, steel, brass, ..). The substrates generally need a pre-treatment to create a certain roughness on their surface to ensure coating adhesion.

Substrate pre-treatment



Hard ground coated enamelled steel

A viable way to overcome the problem is the application of a specific hard ground.

This enamel guarantees a rough slightly porous surface, but able to favour the ceramer adhesion to the enamel.

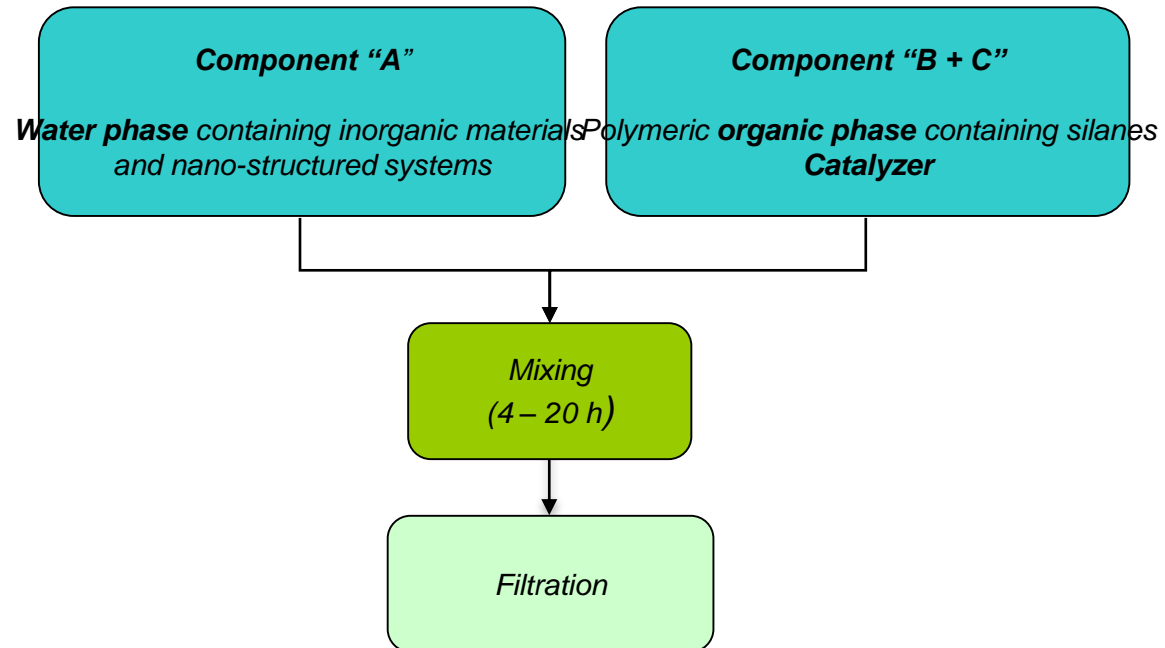
The developed formula is for wet spray application in 2c/2f on fired enamel. It's necessary to apply just 30 – 40 μm of hard ground enamel on coated enamel, dry and fire at the common enamel firing temperatures.



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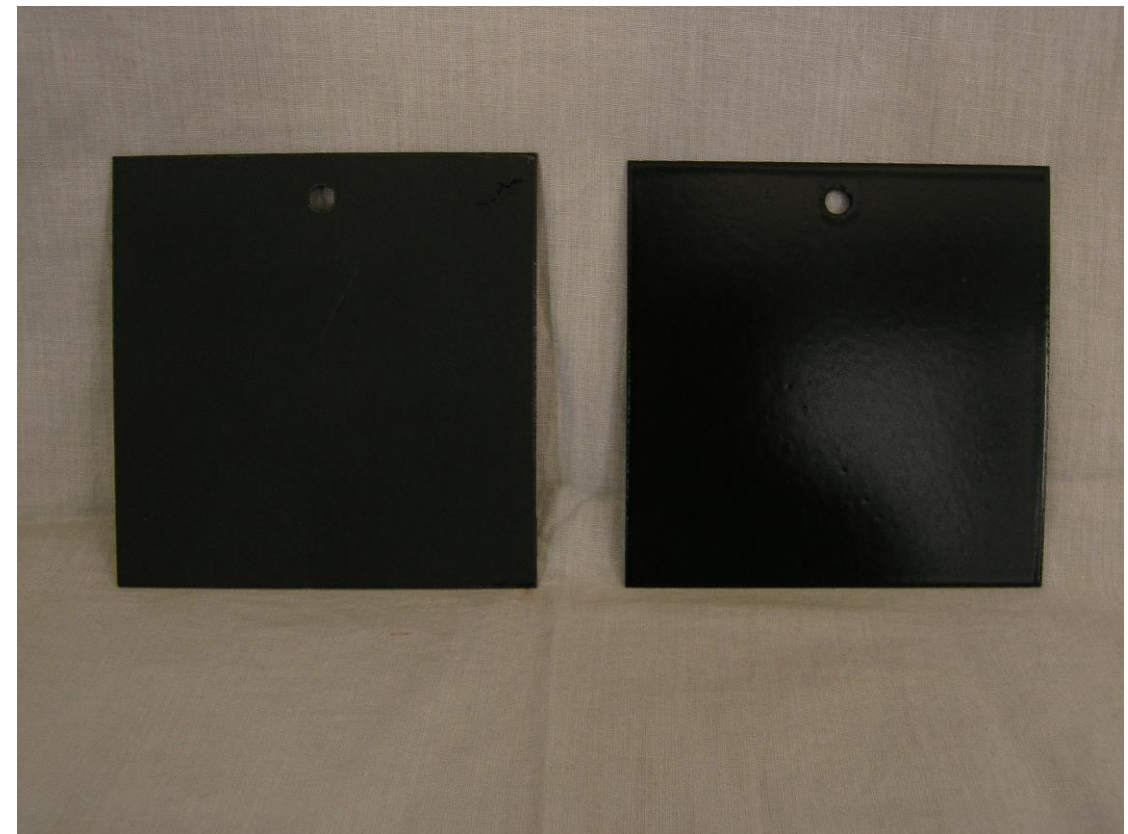
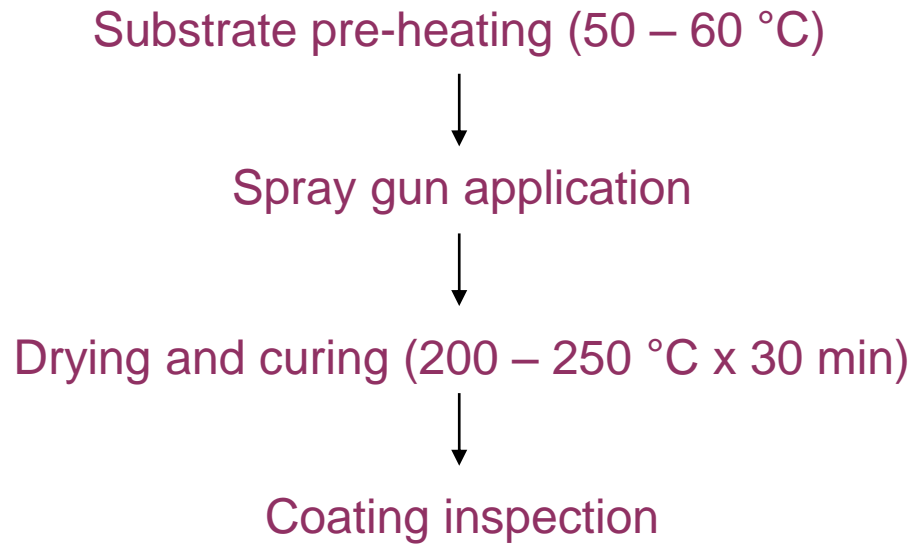
Ceramer formulation



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Application

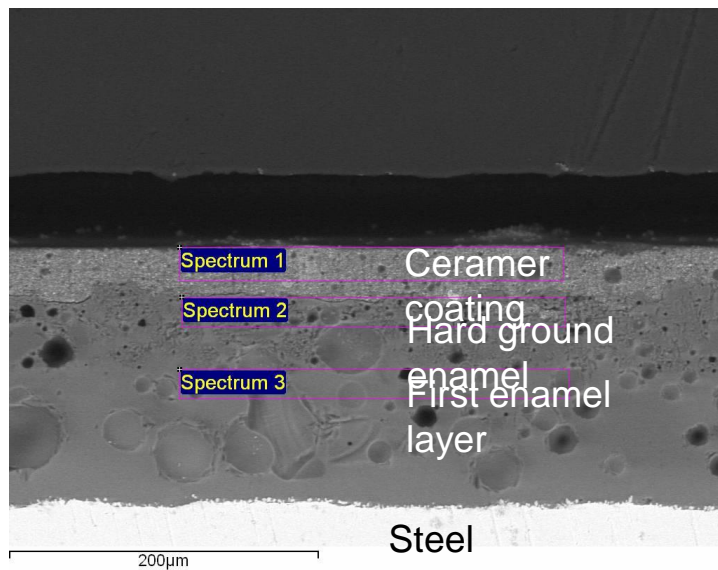


Ceramer coating on the right and the uncoated substrate on the left

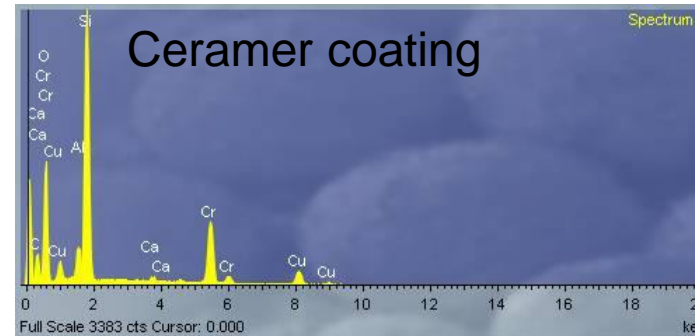
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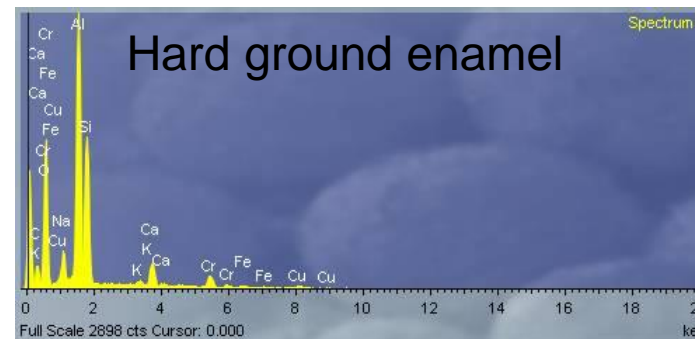
Morphological characterization



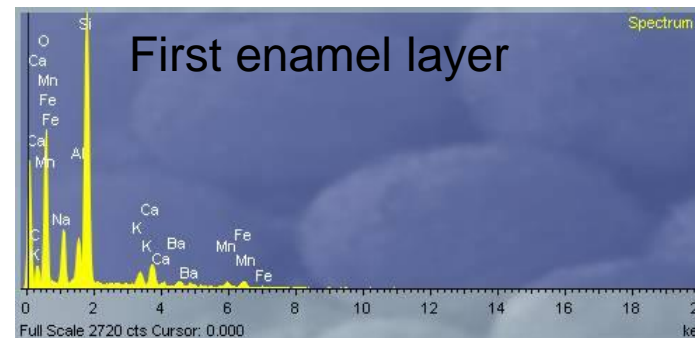
Backscattered FESEM Ceramer coating image



Cu and Cr and Si are well evident. The first are pigment elements, Si peak is due to the high presence of this element in the formulation.



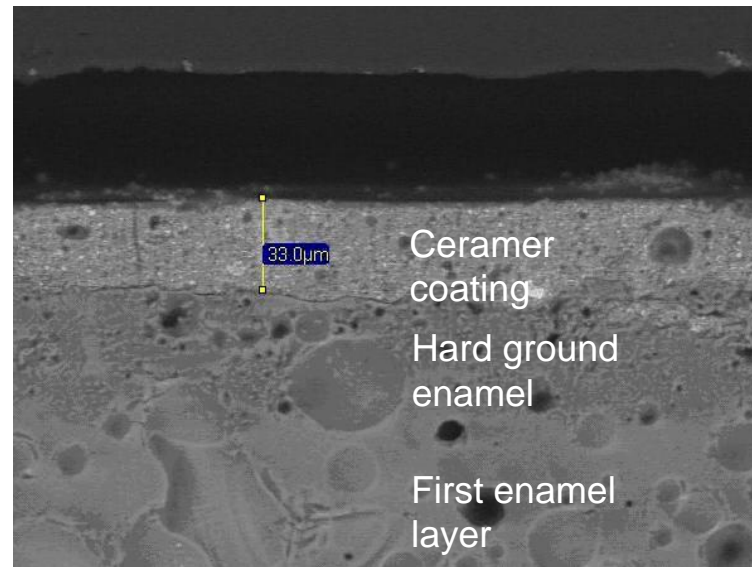
Si and Al are present in the hard materials used for the preparation of the enamel.



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Morphological characterization



From the SEM images, the thickness ceramer coating was measured. Also the image shows the good adhesion between the hard ground and the ceramer coating.

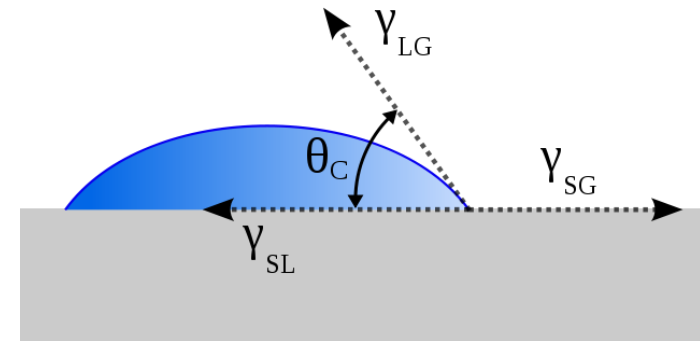
Backscattered FESEM Ceramer coating image

Heat resistance of anti-stick properties

Evaluation of anti-sticking properties by contact angle measurement

The coating was submitted to repeated thermal cycles at two different temperatures, 250 °C and 400 °C, and the angle contact was measured after every cycle.

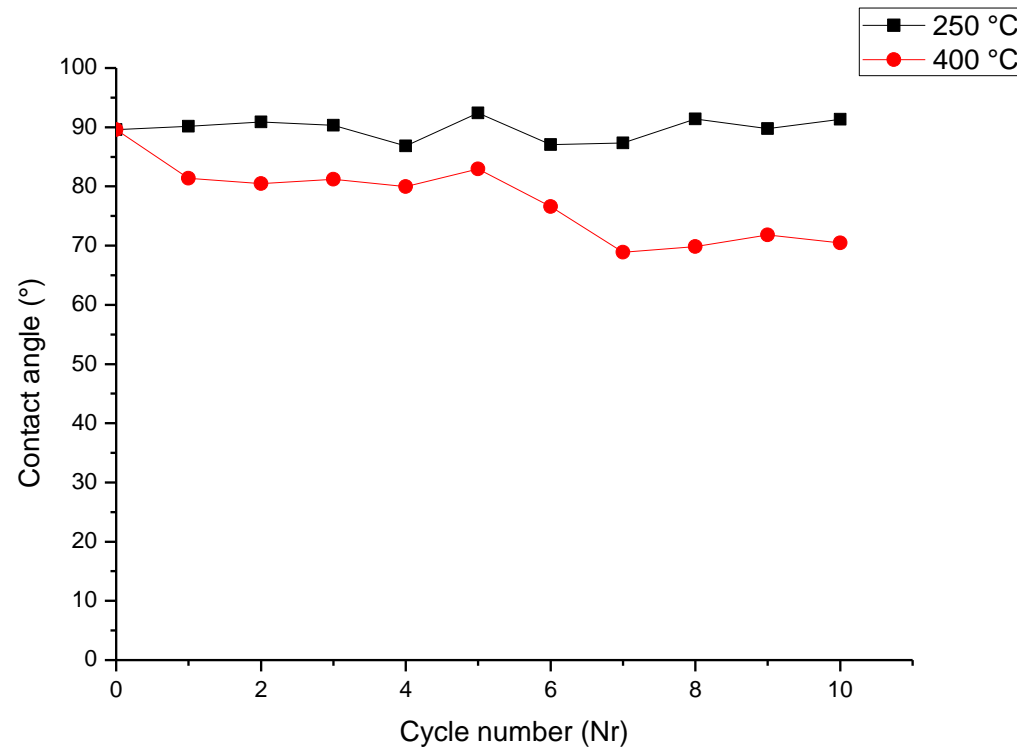
Contact angle = 89.6 ± 2.1



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Heat resistance of anti-stick properties



The coating was submitted to ten thermal cycles at 250 °C and 400 °C and the angle contact was measured after every cycle.

No change after 250 °C treatment
Little loss in hydrophobicity at 400 °C

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CONCLUSIONS

Ceramer applications possible on specific hard ground enamel

Main constrains

- non toxic, easy to clean coating for several applications

Main advantages

- anti-sticking performance
- thermo-resistance
- scratch and abrasion resistance

Future improvements

- color scale enlargement
- novel features (anti bacterial, stimuli responsive)

