POSTER ABSTRACT
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Laser thermal processing and vitrification of enamels coatings manufactured by thermal spraying

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Abstract

During the last decade, the use of vitreous enamel for industrial applications has grown due to their excellent technical properties such as shock-resistant, abrasion-resistant, scratch-resistant, dirt-repellent, hygienic surface and non-flammable. Thus, enameled steels are displacing other solutions from the market as organic coated steels, galvanized steels, stainless steels or aluminum panels in many industrial applications including silos/tanks for storage and offshore applications. Thermal treatment of around 800 ºC (usual thermal process in furnace) is compulsory with traditional enamel coatings, having significant impact on steel properties and leading to use more costly manufacturing methods or substrates, for applications in which the mechanical properties of the structure are of high relevance.

In this work, laser thermal processing was applied to sinter and vitrify the enamel ceramic coatings manufactured by thermal spraying. The main advantages of the laser treatment compared to a conventional oven treatment are its higher process speed of about 3 mm/s related to bigger parts, lower thermal impact and its savings in terms of energy cost of the process. Laser post-processing represents a saving in both production time and operational cost for the industry.

The laser treatment was done using a laser optical system with a galvo-scanner, in which the beam was moved resulting in a line, to distribute the energy on the ceramic surface. The temperature on the surface of the material was closed-loop controlled using a thermographic camera and a PI-controller, thus achieving a homogeneous heat treatment. Different laser parameters that affected the sintering and vitrification process were studied: scanning frequency of the line, processing speed and the laser power, which in this case was controlled in reference of a set-point around the desired target temperature. The microstructure and topography of the thermally sprayed coatings before and after laser treatment were investigated.

The laser-treated enamel ceramic coatings were characterized by smooth glossy surfaces with an average roughness R_a below 1 μm. Dense coating layers with 200 μm-thicknesses containing closed porosity (“bubble structure”), similarly to those obtained during conventional oven enameling methods, could be achieved. The laser vitrification process is still under development, and future work will be focused on the achievement of similar results using thinner enamel ceramic layers.

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