GLASS TILE CRACKS AND DELAMINATION: MICROSTRUCTURAL EVALUATION OF FAILURE CAUSES

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1. INTRODUCTION

Glass tiles provide a refined finish and a sophisticated look, though there is a high cost associated with the material and installation. Failure of glass tile systems was observed with the occurrence of delamination of tiling and cracking of pieces. For the glass tiles involved in this pathology, the colour is a result of a paint baked onto their back and the mode of rupture detected was cohesive in the tile, mostly close to this paint layer. The main goal of this work was to evaluate the causes of glass tile system detachment using scanning electron microscopy. The use of this microstructural technique is not usual for this kind of investigation, which is usually based on macrostructural observations and tests. However, it can provide some important information regarding the problem being studied.

2. EXPERIMENTAL PROCEDURE

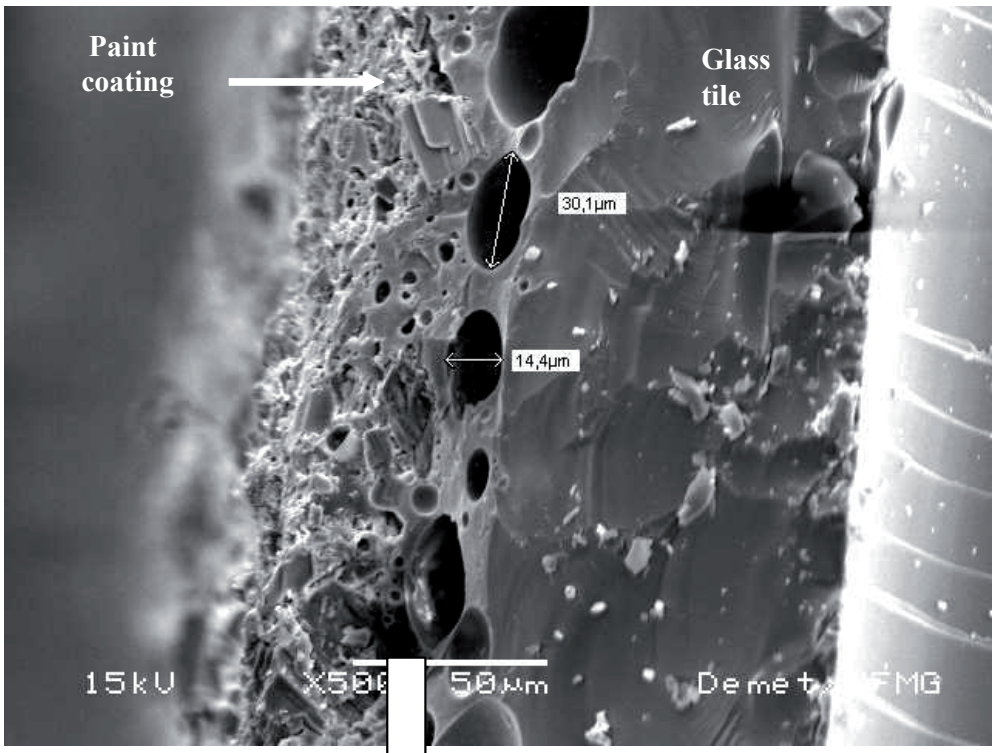
SEM images were taken from glass tiles and fractured surfaces of tile system with a JSM 6360LV, Jeol/Noran, microscope coupled to an Energy Dispersive Spectrometer (EDS) for semi-quantitative chemical analysis. Before examination, samples were coated with a thin gold film by sputtering at low deposition rate, cooling of substrate and maximum distance between target and sample in order to avoid sample damage. Images of secondary electrons (SE) and backscattered electrons (BSE) were obtained using an accelerating voltage of 15 kV.

3. RESULTS AND DISCUSSION

SEM images revealed that the paint film of the tiles involved in the detachments presented high porosity with both closed pores and interconnected pores. The paint layer thickness was between 40 and 80 μm and the pore size ranged from 3 to 30 μm (figure 1a). EDS coating analyses have shown Si, Ca and Mg as major constituents (figure 1b). In addition, the images obtained from glass tile systems with the mortar adhered on the back have indicated the presence of cement hydration products inside the interconnected porosity (figure 2).

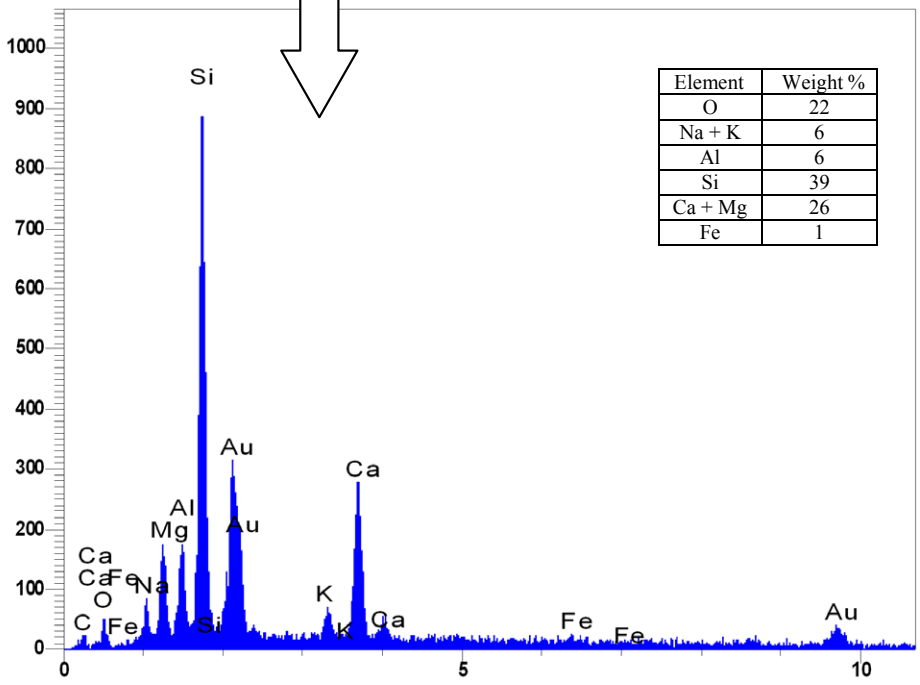
In view of the results, it may be considered that coating processing parameters are not well established. High content of materials that decompose at elevated temperatures releasing gases, firing time or coating viscosity favouring bubble entrapment, and bloating phenomena must be avoided by raw materials selection and the firing profile. Paint layer porosity, when considering the possibility of mechanical anchoring of mortar, is a positive property. On the other hand, high porosity considerably reduces the cohesive resistance of this layer, which favours the verified rupture mode.

a)



EDS from coating

b)



Element	Weight %
O	22
Na + K	6
Al	6
Si	39
Ca + Mg	26
Fe	1

Figure 1. (a) Glass tile cross-section showing coating features. (b) EDS from coating layer.

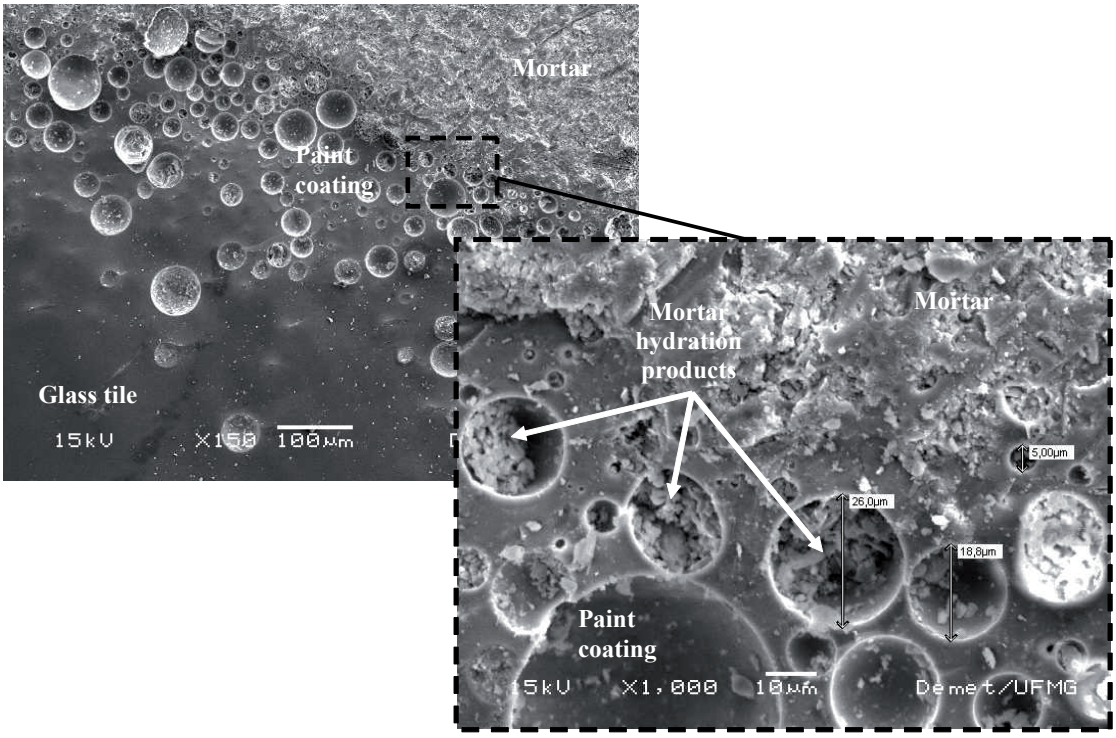


Figure 2. Hydration products inside the interconnected porosity of the paint coating.

4. CONCLUSIONS

SEM evaluation coupled with EDS spectra revealed that mortar filling of the interconnected pores of the surface coating may introduce and transfer stresses that exceed the resistance of the paint, resulting in the cracks and delamination observed.

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