EFFECT OF CHEMICAL FUNCTIONALIZATION OF PORCELAIN TILES BY AMINOSILANE IN THE INTERFACIAL ADHESION BETWEEN TILE AND EVA-MODIFIED MORTAR

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1. INTRODUCTION

Adhesion between tiles and mortars is crucial to the stability of ceramic tile systems. From the chemical point of view, weak forces, such as van der Waals forces, are expected to be developed preferably at the interface tiles/mortar. Aminosilane incorporation in glass tile surface has improved adherence between tile and poly(ethylene-co-vinyl acetate), EVA, modified mortar, also changing the mode of rupture from interfacial to a combined mode interfacial-cohesive at mortar. The enhancement on stability and interface adhesion was achieved by the development of hydrophilic, hydrophobic and even covalent bonds, besides the weak van der Waals forces. In this sense, the main goal of this work was to promote chemical functionalization of porcelain tiles surfaces by modifying with aminosilane coupling agent in order to enhance the interface adhesion between tile and polymer modified mortar. It is the first attempt of use the same successful system approved for glass tiles in porcelain tiles.

2. EXPERIMENTAL PROCEDURE

Commercial porcelain tiles surfaces were prepared with silane derivative bearing amino (-NH_2) functionality. Porcelain tile without any chemical modification (as supplied) was used as reference, as well as, the previous results of modified and unmodified glass tile. Cement:sand ratio of 1:1.7 was used to prepare the mortar and water/cement ratio was 0.60 and the EVA/cement ratio was 10%. Pull-off assays were performed following the procedures described in the Brazilian Standard NBR 14084/04 test method.

3. RESULTS AND DISCUSSION

The results have shown that the expected enhancing of interfacial adherence was not attained. The improvement of about 50% previously observed for glass tiles were not replicated for porcelain tiles. The overall result was a reduction of almost 20% in bond strength values when comparing modified (0.59 MPa) and unmodified porcelain (0.72 MPa) tiles. About the rupture mode, considering the presence of the modification layer, newer rupture modes are possible for the system: adhesive between tile/silane layer, cohesive in the silane layer and adhesive at silane layer/mortar. One explanation for the observed behaviour is based on the compositional differences between porcelain and glass tiles. Glass tiles are completely amorphous and with silica structure. Both aspects are considered the best features for silane reaction and they are not observed for porcelain tiles (70% amorphous with quartz and mullite, as crystalline phases). Also, Fourier transformed infrared spectroscopy (FTIR) was used to evaluate the chemical groups at the adhesive rupture surface (from mortar side) (not shown). Among the vibration bands associated with cement and polymer, some of the observed peaks are related to the aminosilane (1169 cm^{-1}, 790 cm^{-1}, 773 cm^{-1}, and 691 cm^{-1}). In this sense, it is believed that the rupture has mostly occurred in the adhesive mode at the interface tile/silane layer or in the cohesive mode at the silane layer (Figure 1).

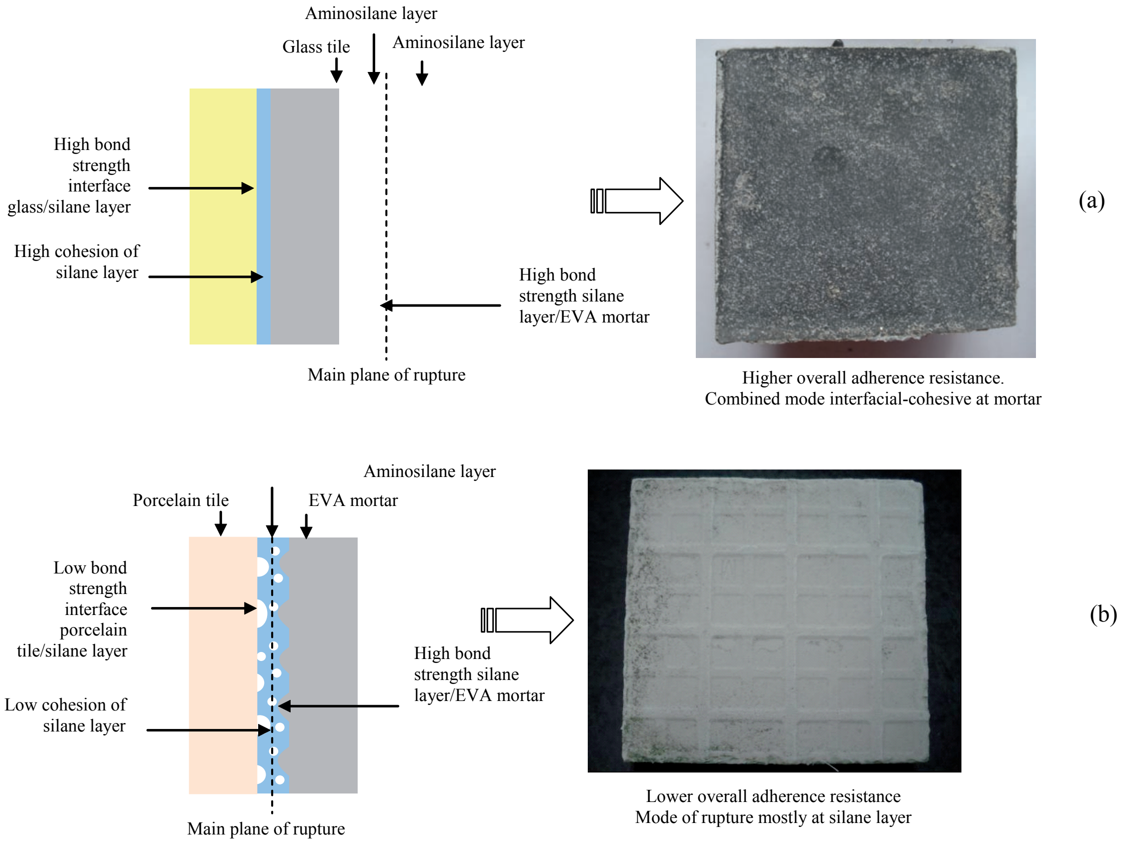

Figure 1. Rupture modes for (a) aminosilane modified glass tile and (b) aminosilane porcelain tile.

4. CONCLUSIONS

Based on the results, it is confirmed that the dissimilar bond strength behaviour for glass and porcelain tiles systems is a consequence of the composition of the tiles that promotes weaker adherence of the silane coating onto the surface, also reducing the cohesive strength of the silane layer.

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