

## Porcelain tile surface modification with isocyanate coupling agent: interactions between EVA modified mortar and silane improving adherence

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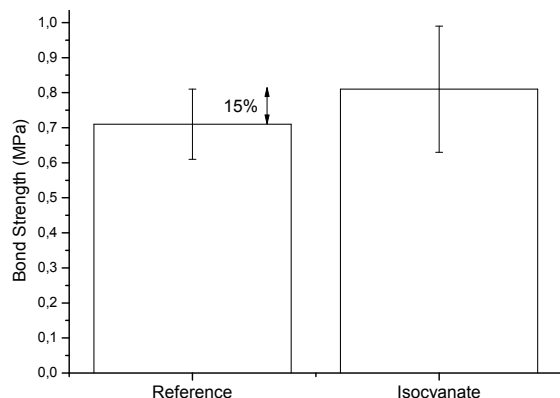
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**Abstract** – Adhesion between tiles and mortars are of paramount importance to the overall stability of ceramic tile systems. From the chemical perspective, weak forces are expected to occur preferably at the tiles and polymer modified Portland cement mortar interfaces. Thus, the main goal of this study was to chemically modify the ceramic tile surface through isocyanate organosilanes aiming to improve adhesion with EVA modified mortars. The bond strength results have given strong evidence of the improvement on adherence at the tile-polymer modified mortar interface reflecting, among other factors, the development of urethane linkages between silane and EVA polymer.

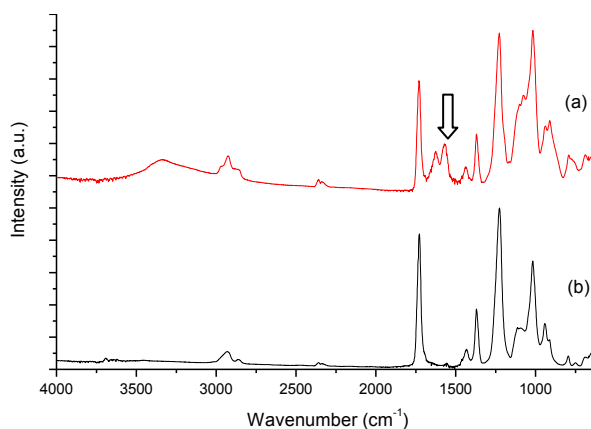
Adhesion between tiles and mortars are of paramount importance to the overall stability of ceramic tile systems. Latex modified Portland cement mortars based on poly(ethylene-co-vinyl acetate), EVA, is the standard product in the market for ceramic tile installation. However, based on chemical features of EVA and ceramic tiles, predominantly the weak forces such as van der Waals forces and hydrophilic interactions are expected to be developed at the tile-polymer modified mortar interface. On the other hand, surface modification is generally performed to modify its properties such as enhancing the interface adhesion between inorganic and organic materials. In this sense, silane coupling agents have been used for generating a hybrid layer onto substrates. Consequently, the aim of this research was to promote a novel chemical functionalization of ceramic tiles surfaces by modifying with isocyanate-trialkoxysilane coupling agent in order to enhance the interfacial adhesion with polymer modified mortar. Also, in order to investigate chemical interactions between organosilane and EVA that may contribute to the enhanced interfacial resistance, films derived from EVA and isocyanate-trialkoxysilanes were synthesized via aqueous routes.

Porcelain tile surfaces were prepared with isocyanate silane derivative (3-Isocyanate-propyl-triethoxysilane) for evaluating their relative compatibility with the EVA mortar. The silane was supplied by Sigma-Aldrich. Tile without any chemical modification (as supplied) was used as reference. Pull-off tests were conducted to assess the effect on adhesion properties between tile and poly(ethylene-co-vinyl acetate) modified mortar. Films of EVA and EVA mixed with organosilane were prepared at temperature of  $(25 \pm 1)^\circ\text{C}$  and Fourier Transformed Infrared Spectroscopy (FTIR), using Attenuated Total Reflectance method, was used to characterize the presence of specific chemical groups in the EVA and EVA/organosilanes films.

The bond strength results have given strong evidence of the improvement on adherence at the tile-polymer modified mortar interface (Figure 1). EVA films evaluation (Figure 2) have shown the reaction of isocyanate groups with EVA polymer forming urethane linkages. The presence of urethane groups has been proven by FTIR measurements due the presence of characteristic peak centered at  $1570\text{cm}^{-1}$  that corresponds to the amide region of carbamate. Also the absence of the typical signal related to the asymmetric stretch of the  $-\text{N}=\text{C}=\text{O}$  group, centered at  $2277\text{cm}^{-1}$  indicates that the functional silane group have reacted [1].



**Figure 1:** Bond strength results from (a) reference and (b) porcelain tile modified with isocyanate coupling agent.



**Figure 2:** FTIR spectra from a) EVA and (b) EVA + isocyanate.