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Long Abstract

Organically Modified Silicates (Ormosils) as Adhesives for Siliceous Surfaces†

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1 INTRODUCTION

Adhesion to glass surfaces still may be a problem under "heavy duty" conditions such as temperature and moisture or both. In many cases the problem may be overcome by use of adhesion promoters such as reactive silanes. These silanes remove water films from the glass surface by chemical reaction, are able to form chemical bonds to the glass surface and, in addition to this, can have an affinity to the sealing material to be used. A decay of adhesion strength between glass and a seal under wet conditions is

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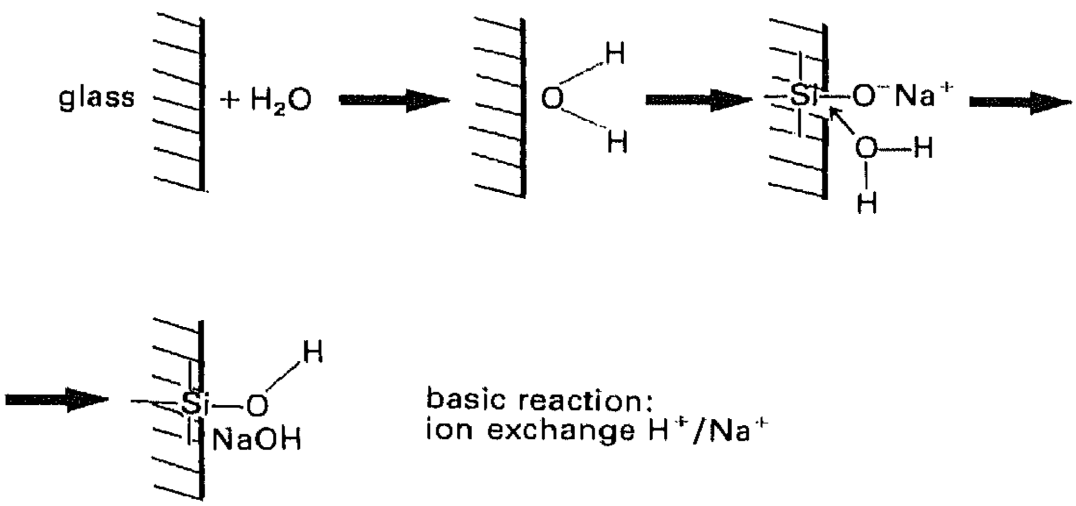
caused by the following effect:



The formation of NaOH leads to an alkaline media interface between seal and glass surface which causes a network degradation of the glass and a subsequent loss of adhesion. The magnitude of the effect depends strongly on the chemical durability of the glass substrate used. Especially, if hot sealing procedures have to be used, serious difficulties due to wetting problems during the sealing procedure and due to a water film remaining on the glass surface can appear.

A special hot sealing material was developed which was proved to be able to overcome most of the described problems:

a) The material should be "glass-like". Therefore, a silica based polymer with a $\equiv$Si—O—Si$\equiv$ backbone was chosen.

b) The material should be thermoplastic. That means the network connectivity of a pure inorganic (non-thermoplastic) polymer had to be reduced. Therefore, C_6H_5—Si—C_6H_5 groups were introduced. It was well known that these groups can cause thermoplasticity.

c) Residual groups like $\equiv$Si—OR or $\equiv$Si—OH should remain in the polymer in order to form reactive bonds to the glass surface.

d) Flexibility and photocurability should be obtained for reasons of application improvement. Therefore, a second type of

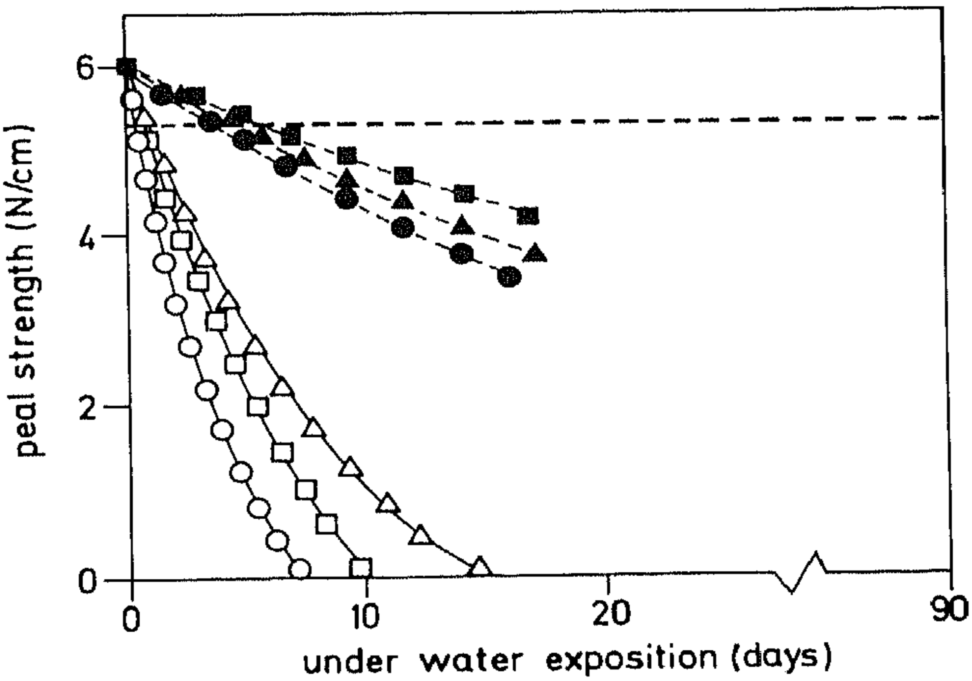


FIGURE 1 Peel strength decay curves of 1 cm Al-strips sealed on glass
polyamide: untreated: △△△
treated: ▲▲▲
vinylacetate/vinylchloride copolymer:
untreated: ○○○
treated: ●●●
Surlyn: untreated: □□□
treated: ■■■
$(C_6H_5)_2SiO/TiO_2/CH_2{=}CH(CH_3)SiO$ based copolymer:---
Treatment: Glass surfaces treated with an epoxy silane as adhesion promoter.

network by vinyl polymerization was introduced into the polymer by use of $CH_3{-}Si{-}CH{=}CH_2$ groupings.

As a result, a three-component system using sol-gel techniques was synthesized from $Si(OC_2H_5)_4$, $(C_2H_5O)_2Si(CH_3)CH{=}CH_2$ and $(C_6H_5)_2Si(OH)_2$ or $Ti(OC_2H_5)_4$ as starting compounds.[1,2,3] By proper choice of composition, hydrolysis and condensation and thermal or photocuring, hot melts can be obtained with sealing temperatures between 80 and 160°C as desired. Figure 1 shows the sealing strength (peel strength) of aluminum strips sealed to a glass surface in comparison to other polymers with and without using an adhesion promoter. Figure 2 shows the IR-controlled thermal curing. The OH-group content has to be adjusted for an optimal sealing strength.

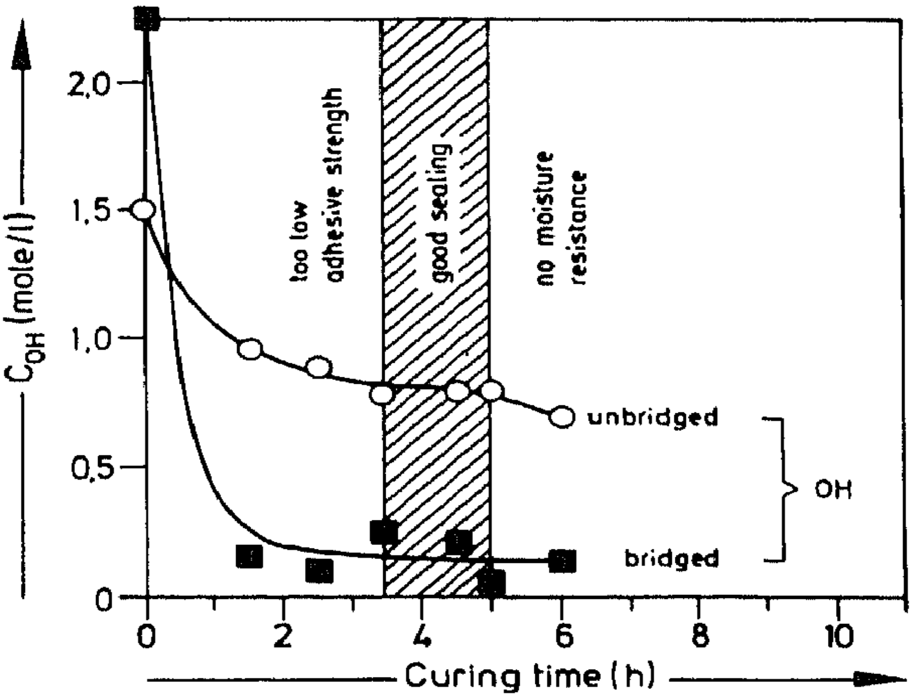


FIGURE 2 SiOH group concentrations for the system based on $(C_6H_5)_2SiO/SiO_2/CH_2{=}CH(CH_3)SiO$ as received from IR measure units; the hatched area represents the range of high peel strength and high moisture resistance according to Figure 1.

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