Effect of silica nanoparticles on shear strength of moisture curing silyl-modified polyether sealant

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Introduction

Silyl terminated polyether offers a low viscosity, The viscosity is relatively stable throughout a wide range of temperatures[1]. As a result, compounding is generally easy and straight-forward. The silane groups provide anon-isocyanate curing mechanism, good adhesion to various substrates[2]. The silyl reactive end-groups cure in the presence of moisture and an appropriate catalyst by means of an alkoxy reaction that is different than the conventional silicone cure mechanism[3]. The formulation has excellent adhesion to metals, plastics, wood and ceramics without the need for primers. These sealants are often touted as environmentally friendly, being free of solvents and isocyanates. Methanol is a product of the crosslinking reaction and is given off during cure.

Experimental

Mixed and stirred 33.5% by weight of a silyl terminated polyether polymer, 15% of plasticizer, 51% of filler, 0.2% of carbon black and different amounts of fumed silica (0%,0.3%,0.6%,0.9% by weight) to obtain a component A. Added 56.66% by weight of filler, 31.8% of plasticizer, 0.71% of anti oxidant, 0.71% of anti UV in to tank B and dehydrated for 2hr under the condition that the vacuum degree is greater than 0.098 MPa and the temperature is 100-110 DEG C, then cooled to below 40C, added 2% of amino silane, 0.2% of water and 1.5% of catalyst, mixed and stirred to obtain component B.

Result and Discussion

Tensile strength and elongation of the silyl terminated polyether sealant has shown in Fig.1. Shear strength and tensile elongation increased by increase nano-silica amount in the composition (A_0:0%, A_1:0.3%, A_2:0.6% and A_3:0.9% by weight). The sample containing nano-silica (0.9 wt%), provide shear strength (0.79 MPa to 0.98 MPa) and elongation (108% to 151%), were improved 24.05% and 39.81%, respectively, compared with the sample without nano-silica.

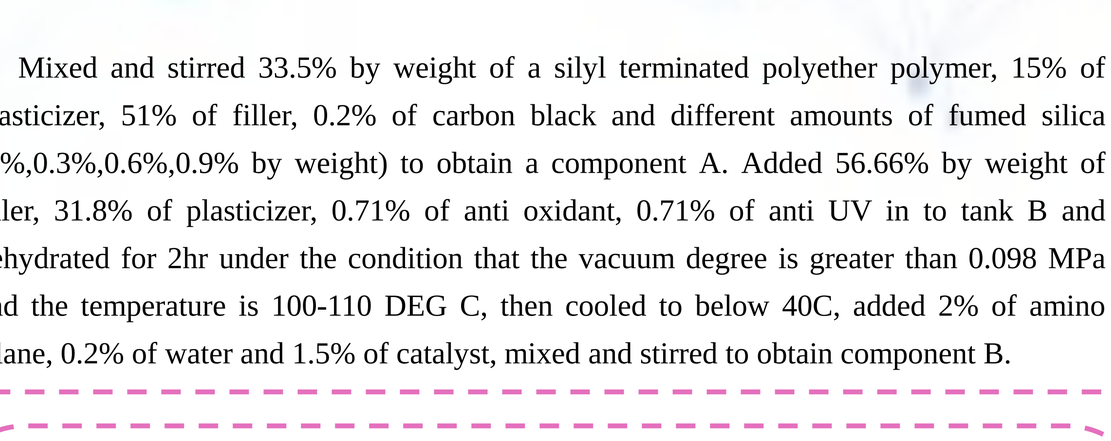

Figure 1. Shear strength and tensile elongation of silyl modified polyether sealant.

In Fig.2 shear strength characteristics of the investigated adhesives are shown after 7 days of curing. Increase of adhesive to various substrates (metal and glass) is gradually rising along with progression of the cure as well as development of bonding between the adhesive and substrate.

By considering the importance on the development of fast curing adhesive it is interesting to look on the change of adhesion strength within the bonded system as a function of reaction time.

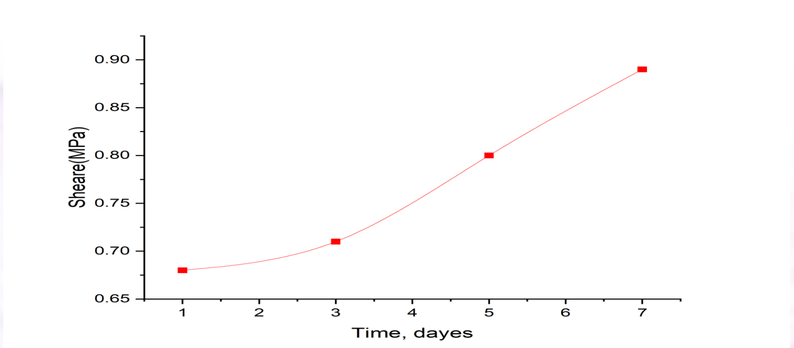

Figure 2. Shear strength of a sample containing nano-silica (0.3 wt%).

The shear strength increased during time an reach 0.89 MPa after 7 days at sample containing nano-silica (0.3 wt%). It is also mentioning that above 7 days of curing changes of adhesive strength to various substrates are comparatively small.

Conclusion

As the result showed, with the increase in the percentage of nano-silica in the adhesive structure, the adhesion strength has increased, which is completely in line with the expectation, because the presence of nano-silica in the adhesive structure and the establishment of hydrogen interactions with the adhesive matrix has caused this increase in properties.

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