Akzo Nobel
Functional Chemicals GmbH
Liebigstraße 7
07973 Greiz

Technical Information

August 31, 2015

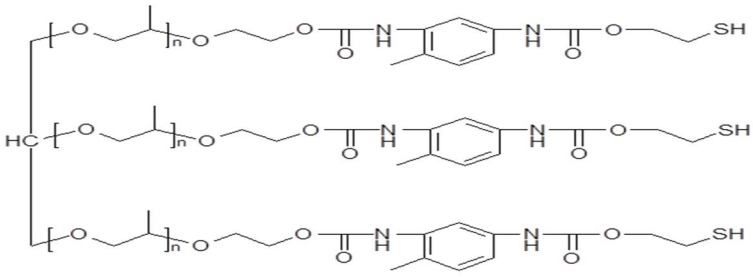
In June 2015, Akzo Nobel got noticed about Insulating Glass (IG-) sealants, using a new kind of “modified mercaptan (SH-) functionalized polymer” (following mentioned as “new Russian polymer”) curable with “Manganese (IV)-dioxide”. Producer of that kind of “modified mercaptan (SH-) functionalized polymer” is a Russian polymer producer based in Kazan, Republic of Tatarstan. The mentioned kind of IG-sealant gets actually promoted by a Turkish sealant producer with production sites multipresent in Turkey and Eastern Europe.

The mentioned Turkish IG-sealant, based on “new Russian polymer” gets promoted in its Technical Data Sheet and in technical communications as an IG-sealant based on “liquid polysulfide polymer” or even “modified liquid polysulfide polymer” the same chemical and physical performance as the well accepted liquid Polysulfide Polymer, like Thioplast G.

Akzo Nobel defines that as an active misinformation of the market.

To demonstrate the physical and chemical differences, AkzoNobel did a full chemical and physical analysis of different IG-sealant batches based on the “new Russian polymer”.

On polymer-chemical basis, the IG-sealant based on mentioned “modified mercaptan (SH-) functionalized polymer”, got characterized as “Mercapto end-capped Polyether / TDI* prepolymer” very likely to the following polymer structure



That polymer structure is chemically likely to a Polyether based Polyurethane, what is commonly used in low budget 1-part construction sealant and far from the polymer backbone of a liquid Polysulfide Polymer, well known under the product label “Thioplast G”.

The sulfur content of the “new Russian polymer”, one of the relevant parameters for the excellent low temperature flexibility and low Argon permeability, got analyzed to only 1.46%. That is significantly below the sulfur content of Thioplast G having in average 38 % sulfur in its polymer backbone.

Re our test results, all tested IG-sealants based on the “new Russian polymer” are in terms of their chemical and physical performance not to compare with a “Thioplast G” based IG-sealant. The following abridgement out of our full test report will demonstrate that.

*TDI: Toluene-di-isocyanate

Chemical composition of the sealant:

Major part of the IG-sealant formulation beside the already mentioned “modified mercaptan (SH-) functionalized polymer” are $CaCO_3$-fillers. **“**Di-Butyl-Phthalate (DBP)” is used as plasticizer. DBP is suspected to be teratogenic to animals and human beings. Chlorinated plasticizer is additionally found in IG-sealant formulations used in Eastern Europe markets. All tested sealant batches are based on a solvent like 2-Butoxyethyl acetate and Dimethylformamide (DMF), what is thought as well to cause birth defects. Based on that result, all tested IG-sealants based on the “new Russian polymer” are solvent based. Solvents will definitely reduce the adsorption capacity of the molecular sieves used in IG-units. There is a high risk for “Fogging” between the two glass plates. Additionally the PIB-based primary seal might be dissolved by the volatile solvent during the service life of the IG-unit.

Shore A-hardness and physical performance

All tested IG-sealants, based on the “new Russian polymer” reach only low Shore A-hardness after curing at 23°C / 50% r.H. Approx. 10 Shore A digits below to IG-sealants, certified acc. the ISO EN 1279, have been found. Additionally the tensile strength (sealant strength) of all tested IG-sealants based on the “new Russian polymer” is only approx. 50% of the tensile strength known from IG-sealants, certified acc. the ISO EN 1279 and based on Thioplast G.

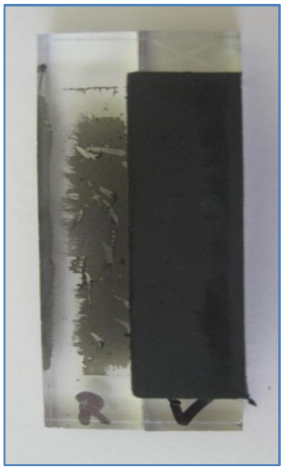
After curing, a significant plastic tensile strength/elongation characteristic has been found on all “new Russian polymer” based IG-sealants. According the present understanding of an appropriate IG-sealant, all tested IG-sealants batches based on “new Russian polymer” are unsuited to use as a structural, “Secondary Seal” in IG-applications. All tested IG-sealants are too “soft” after complete curing.

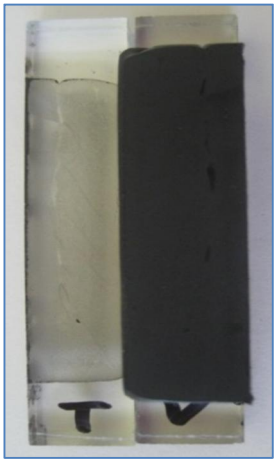
Based on our test results and because of the weak and low modulus sealing, it is very likely that IG-units based on the “new Russian polymer” will get leaky and will fail within their service time.

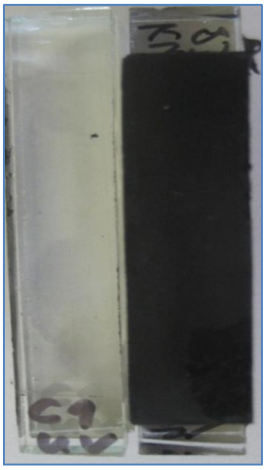
Artificial weathering (UV-Water ageing acc. EN ISO 1279-4)

(Test conditions: Water and UV/VIS/IR radiation acc. to DIN 53387)

AkzoNobel noticed on all cured IG-sealant batches based on the “new Russian polymer” a complete loss of adhesion to glass after 96h artificial weathering in water / UV/VIS/IR acc. to EN ISO 1279-4.



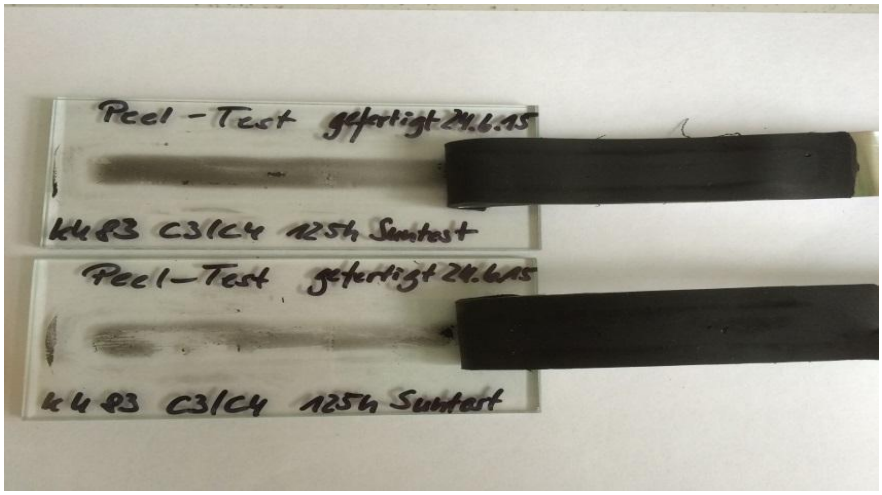




,

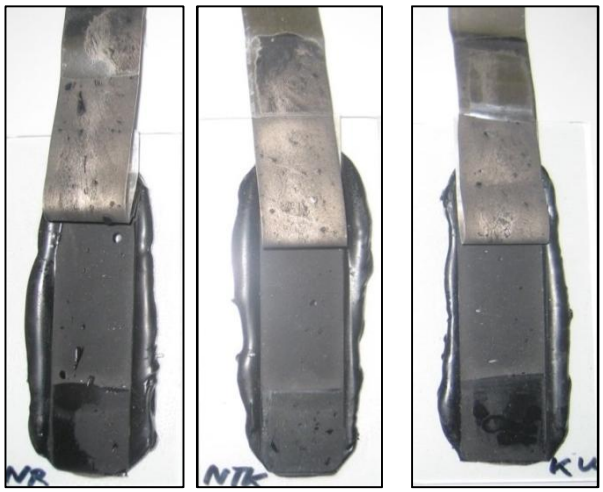
Because of that poor adhesion performance (100% adhesion loss) after artificial weathering, the test has to be stated as not to be passed acc. to the EN ISO 1279-4.

On Glass-Aluminum peel samples, 100% adhesion loss to glass was noticed after 125h artificial weathering (water / UV/VIS/IR) acc. EN ISO 1279-4.



Adhesion – Peel Test at substrate Glass / Aluminum (24h 23°C + 24h 100% r.H.)

Inacceptable adhesion behavior (100% adhesion loss) to Aluminum was found on cured IG-sealant based on “new Russian polymer” after ageing at high humidity (conditions: 24h 23°C + 24h 100% r.H.



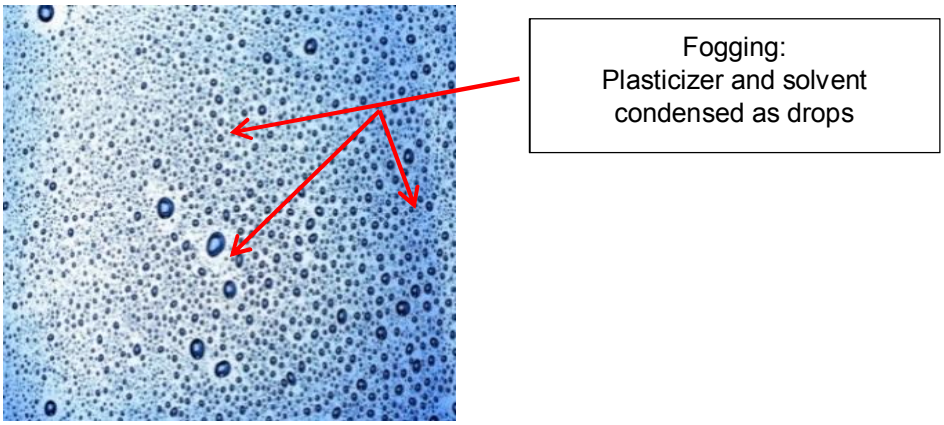
,

Acc. our testing and because of the poor adhesion characteristic, IG-sealants based on the “new Russian polymer” are not able to fulfill the criteria of a properly working structural “Secondary IG-Sealant”.

High temperature behavior: Volatile Ingredients - “Fogging“

Test conditions: similar to EN ISO 1279-6, ageing for 4 h @ 90 °C)]:

After ageing 4 h @ 90 °C, what is quite realistic in real IG-units exposed to sun, on all IG-sealant based on “new Russian polymer”, approx. 2.4% of organic volatiles have been found. Volatiles are mainly based on plasticizer (Di-Butyl-Phthalate) and solvent like 2-Butoxyethyl acetate (picture below).

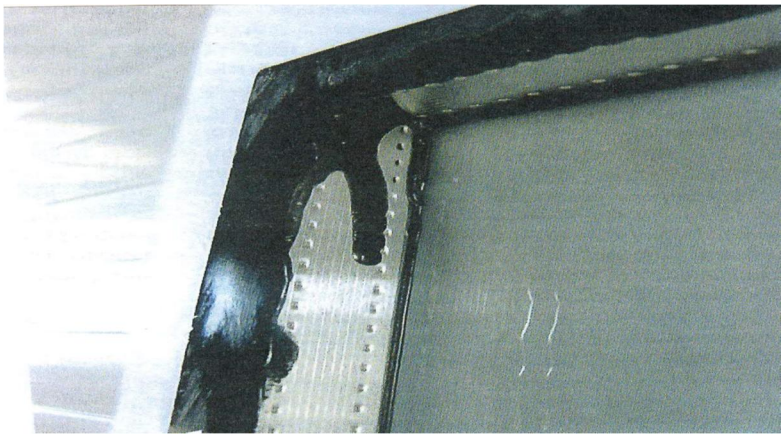


Because of dramatic high volatile and fogging behavior of the cured IG-sealant, the use of the “new Russian polymer” in IG-sealant applications is definitely unsuited. In comparison to that, the volatiles of IG-sealants based on a liquid Polysulfide Polymer, like Thioplast G, are in the range of 0.5% only and mainly based on water out of the IG-sealant formulation (fillers, polymer).

Acc. to EN ISO 1279-6, the volatiles or fogging of IG-sealants is limited to max 0.7%. Even due to that, all tested IG-sealants based on “new Russian polymer” won´t pass the EN ISO 1279-6.

Because of high content of volatiles, the risk of solving the PIB-based Primary Seal in an IG-unit is very likely (picture below). It is highly to expect that IG-units sealed with IG-sealant based on the “new Russian polymer” will get leaky because of dissolving the PIB based “Primary Seal” and will fail within their service time.

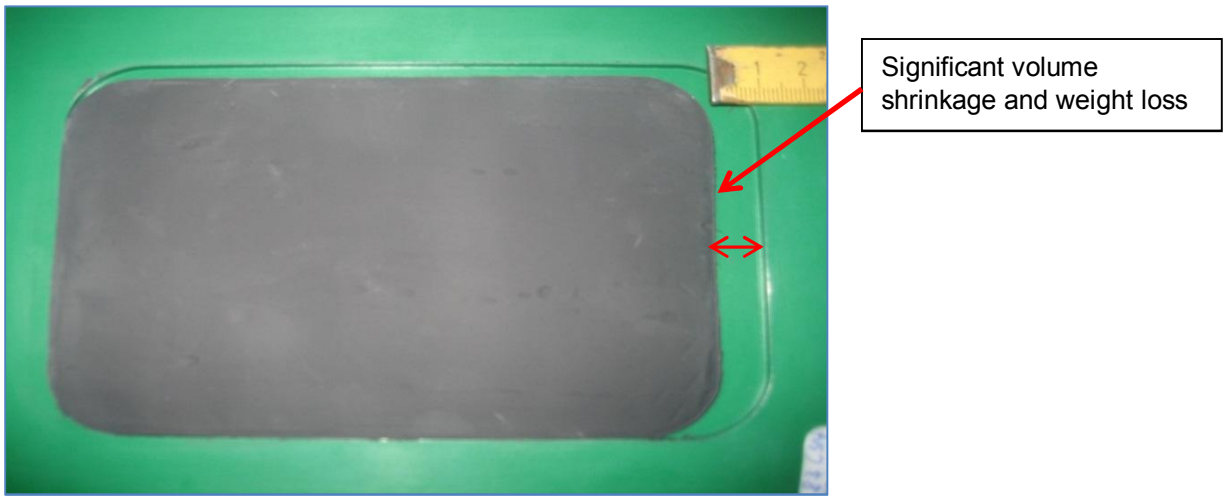
,



Volume Shrinkage

All tested IG-sealants based on “new Russian polymer” are solvent based. After ageing (28d @60°C) we noticed on all cured IG-sealants based on “modified mercaptan (SH-) functionalized polymer” a significant weight loss of 9.5 wt% and in parallel a high shrinkage in volume of about 7.3%. IG-sealants based on liquid Polysulfide polymers, like Thioplast G, are stable in volume and weight (Shrinkage <0.3%).

Extreme shrinkage of the tested IG-sealants based on “new Russian polymer” leads to significant stress and tension on the sealant /glass- and sealant/spacer flanks. Consequence is finally adhesion loss of the cured IG-sealant to glass or spacer followed by the malfunction of the IG-unit. IG-units will definitely fail within their service time.

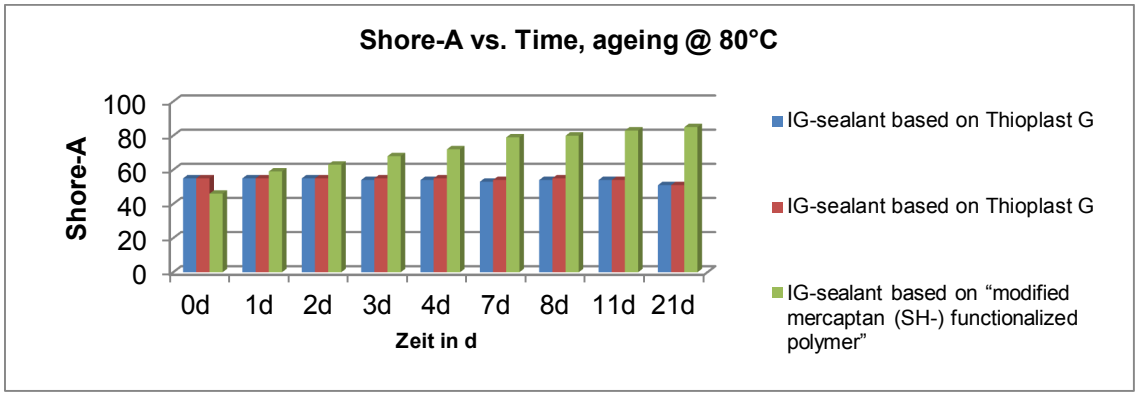


High temperature behavior: Increase of Shore A hardness / Polymer cracking (De-polymerisation)

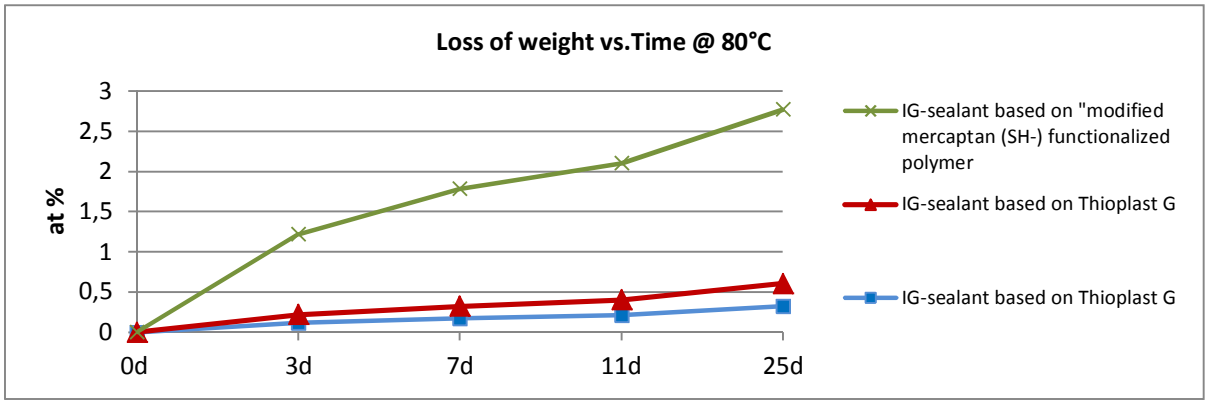
After ageing at 80 °C we notice a significant increase of the Shore A hardness at all tested IG-sealants based on the “new Russian polymer” because of the evaporation of the solvent and migration of the

,

plasticizer (fogging). Chemically incompatibility of the DBP-plasticizer with the “new Russian polymer” is very likely. At same temperature conditions, IG-sealants based on liquid Polysulfide polymers, like Thioplast G, are stable in Shore A and chemically compatible with the used plasticizer.



In parallel to the increasing of the Shore A hardness up to Shore D, a significant weight loss up to 3wt% has been noticed.

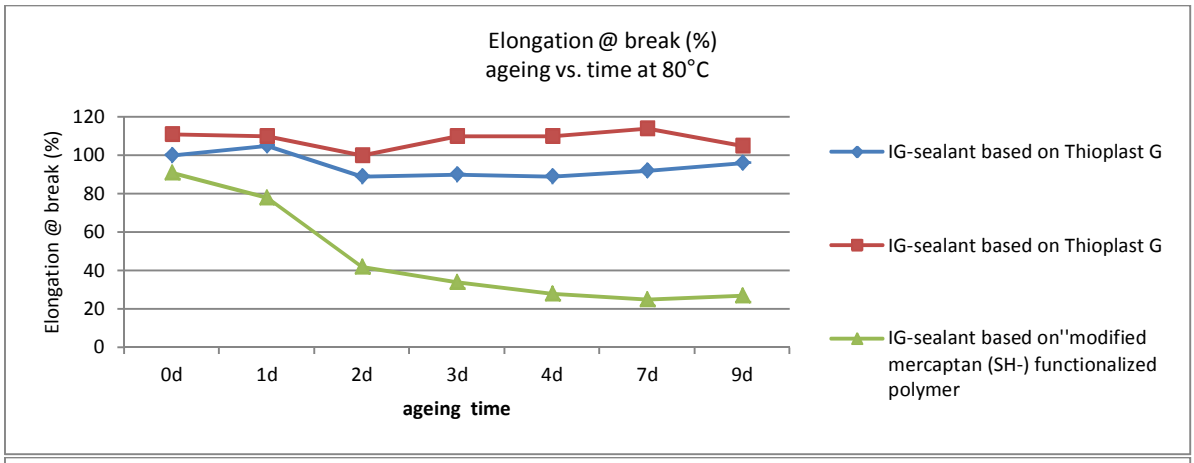


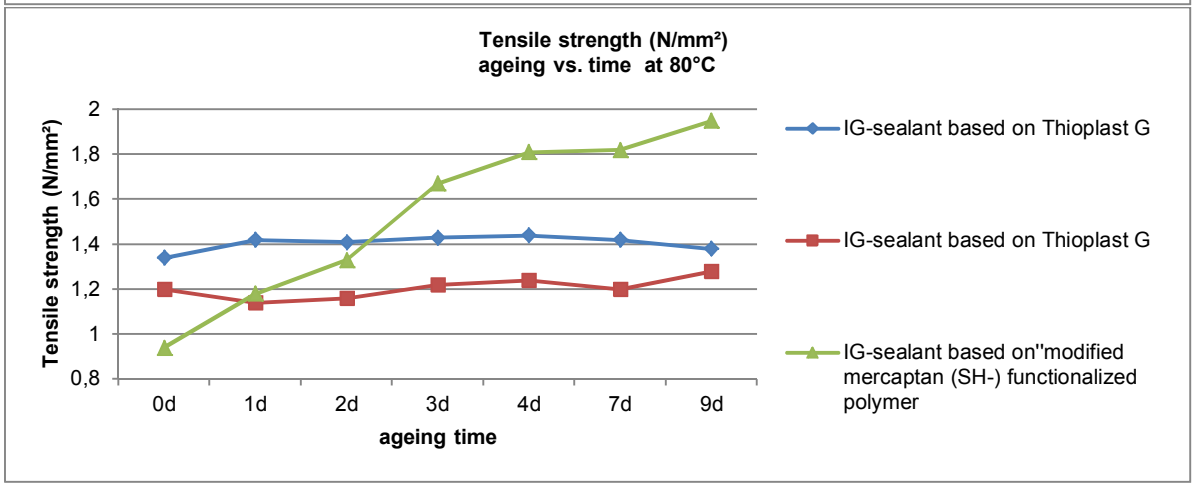
Additionally, a significant loss of elasticity and an increasing of the internal strength (tensile strength) has been found. In contrary, IG-sealants based on Thioplast G are stable in Shore A-hardness and their stress-strain characteristic even after ageing at 80°C.

One Reason for the significant increase of the Shore A hardness and reduced elasticity is the high content of volatiles. Other possibility is a thermal cross-linking via prior de-polymerisation of the polymer followed by forming Polyurea-structures.

Because of the loss of the elastic characteristic and increasing of the Shore A-hardness, IG-sealants based on the “new Russian polymer” are unable to fulfill the elastic seal performance requested by suited IG-sealants. In consequence IG-units will fail within their service time.

,





After 4d ageing at 100 °C, all tested IG-sealants based on the “new Russian polymer”, got chemically cracked. The sealant sample turns its physical behavior from a tack-free solid (Shore A ~40) to a tacky and pasty aspect. At that stage, Shore A is not any longer detectable and the cured IG-sealant got lost of all its physical behavior needed as IG-sealant. At same temperature conditions, IG-sealants based on liquid Polysulfide polymers, like Thioplast G, are stable in Shore A and won´t get tacky.

Because of the very poor temperature stability of IG-sealants based on “new Russian polymer”, it is very likely, that IG-unit sealed with IG-sealants based on that polymer will fail during their service time.

,

Closing remarks:

AkzoNobel is giving herewith a clear and strong warning notice to the market referring the use of such kind of IG-sealant based on “Mercapto-endcapped Polyether / TDI* prepolymer” or generally speaking “modified mercaptan (SH-) functionalized polymer”, because of its inacceptable performance in IG-sealants.

AkzoNobel will refuse all warranty claims in IG-applications using IG-sealants based on mentioned “Mercapto end-capped Polyether / TDI* prepolymer” or generally speaking “modified mercaptan (SH-) functionalized polymer” or even blends of that mentioned prepolymer in combination with Thioplast G.

Akzo Nobel Functional Chemicals GmbH, Dr. Volker Burkhardt, Technical Customer Support

,