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Ingenieure und Sachverständige

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Durability of Sarnafil T polymeric roofing membrane

Summary report

In addition to Expertise No. 70006 dated 02 July 2009 concerning the durability of polymeric roofing membranes types Sarnafil TS and Sarnafil TG (study of four roofs 14 to 20 years old, plus 139 additional roofs investigated by Sika field survey including internal production monitoring data)

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Durability of Sarnafil T polymeric roofing membrane

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Summary report

of Expertise 70006 dated 02.07.2009

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Commissioned by Sika Services AG and Sika Technology AG (hereafter called Sika) on 02.12.2008 and 30.01.2009

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1. General remarks, task description

Sika produces and sells polymeric waterproofing membranes, some of which are based on flexible polyolefin (FPO). The product line of this membrane type based on flexible polyolefin is called **Sarnafil T**.

Sarnafil T membranes have been in use now for 20 years. They are mainly used for waterproofing flat roofs.

In our Expertise No. 3460 dated 17 Dec. 1999 we reported the results of various studies on polymeric roofing membranes of the product groups **Sarnafil TS** and **Sarnafil TG** for roofs aged 3 to 10 years.

In our expertise No. 4708 dated 10 Nov. 2004 we reported the results of investigations on these roofing membranes at the age of 9 to 15 years.

Four of the membranes investigated in 1999 and 2004 are now re-examined in 2009. Sika instructed us on 02.12.2008 and 30.01.2009 to conduct investigations on the roofing membranes of these four roofs.

The findings gathered on site and the results of laboratory studies are to be assessed under consideration of the results of tests conducted by Sika (internal production monitoring data and data of additional roofs) and the results of the studies conducted in 1999 and 2004 in regard to the following aspects:

- Condition and properties of the polymeric roofing membrane in place on the roofs of the buildings in comparison with the results of internal monitoring, the results of our tests on specimens taken during this year's production (specimens from 2009), and the results of our studies conducted in 1999 and 2004.
- Comparison to project data collected by Sika.
- Estimation of the long-term stability and durability of polymeric roofing membranes **Sarnafil TS** and **Sarnafil TG**.
- Examination of the repair capabilities in the course of time by checking the welding seams of new polymeric roofing membranes on exposed membranes.

*This summary report has been compiled as a supplement to Expertise 70006 dated 02. July 2009 on the durability of polymeric roofing membranes **Sarnafil TS** and **Sarnafil TG**. For details please consult the full expertise.*

2. Methodology and procedure

2.1 Methodology

By using accelerated ageing tests in short-term investigations, changes of material properties can be measured in the laboratory and described.

In addition to conducting short-term tests, the reliable prediction of service life and life span also requires the study of long-term data collected from roof investigations. The longer the observation period and the larger the number of investigated roofs is, the more reliable the data obtained through field investigation is for predicting service life.

2.2 Procedure

The expertise described here is based on a field study of roofing membranes on 139 roofs covered with **Sarnafil TS** and/or **Sarnafil TG**. Four roofs of different age were examined and evaluated by our institute. The roofs monitored by Sika are taken into consideration for the overall evaluation.

Thus, more than 200 samples (Fig. 1) of roofing membrane type **Sarnafil T**, at ages distributed over 20 years were collected and examined.

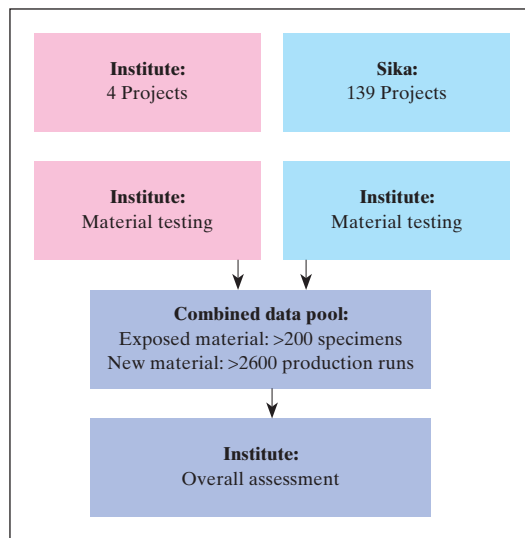


Fig. 1: Expertise data structure

The roof assessment and testing of material samples of the four roofs we examined was conducted independently of the Sika surveys and according to following criteria:

- **Roof assessments:** General condition of the roof, roof assembly, flashings, welded seams, structural aspects.

- **Material samples:** Thickness, tensile strength, elongation at break, low-temperature foldability, peel strength and shearing tensile strength of site-welded seams and seams of new membranes on exposed membranes as well as microscopic investigation of the membrane surface. These properties are essential for predicting the durability of polymeric waterproofing membranes.

By merging the data determined by us with the data collected by Sika surveys, the long-term stability and durability of polymeric waterproofing membranes **Sarnafil TS** and **Sarnafil TG** can be predicted, supported by a broad base of data and using the methodology described in section 2.1.

3. Results

3.1 Roof assessments

All four examined roofs were found to be in good general condition (Pictures 2 and 3). Thus, in particular the edge securement and the flashings at penetrations such as skylights (Picture 4) were intact.

Even at flashings with corrosive run-off traces from the metal construction above (Picture 5) there was no damage of the polymeric membrane.

All seams checked with a seam tester were tight. All sampling locations (Picture 6) could be patched without problem, by welding according to the standard methods described in the installation guidelines.

Compared with our studies conducted in 1999 and 2004, we detected no changes to the technical or visual condition of the roofing.



Fig. 2: Overall view of roof, project Brunner in Flawil (Switzerland)



Fig. 3: Overall view of roof, project Tries in Ehingen (Germany)



Fig. 4: Flashing at skylight, roof of Brunner building in Flawil (Switzerland)



Fig. 5: Curb flashing detail, Mahle building in Fellbach (Germany)



Fig. 6: Sampling on the roof, Tries building in Ehingen (Germany)

3.2 Mechanical properties

To summarize the characteristics of various polymeric waterproofing membranes in uniform terms, one can express the change of properties over time in relation to the properties of new material. This method was used in our expertise.

Mechanical properties of new material show a range of values, due to certain technical aspects of production and measuring. This distribution of values can be quantified using standard deviation methods. For the graphic display we chose a confidence interval of 99%. Of 100 measured values of new material, 99 are within the range of distribution. If the values measured on a sample from an exposed roof lie within this confidence interval, the material properties have not changed significantly in comparison with the new condition.

Sarnafil TS

Material investigations of **Sarnafil TS** showed that the values of the mechanical properties elongation at break and tensile strength even after up to 18 years of natural exposure lie within the described distribution range for new material. Hence there is no significant change of properties. Fig. 7 and Fig. 8 are representative examples displaying the tensile strength of the **Sarnafil TS** specimens.

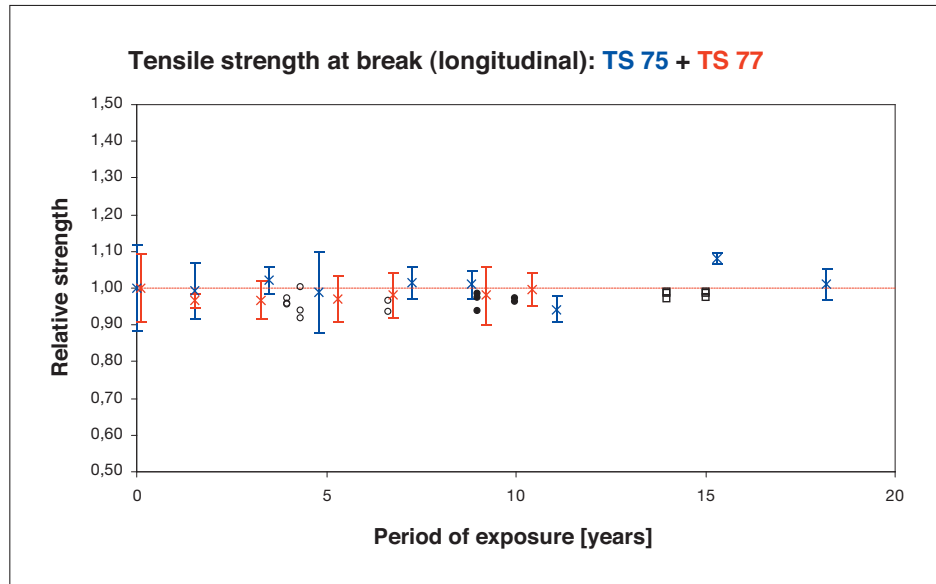


Fig. 7: Tensile strength at break (longitudinal) of Sarnafil TS after exposure

- Values measured in 1999 by Institut für Bautenschutz, Baustoffe und Bauphysik
- Values measured in 2004 by Institut für Bautenschutz, Baustoffe und Bauphysik
- Values measured in 2009 by Institut für Bautenschutz, Baustoffe und Bauphysik
- X Values measured by Sika with scatter range (139 roofs)

Sarnafil TS

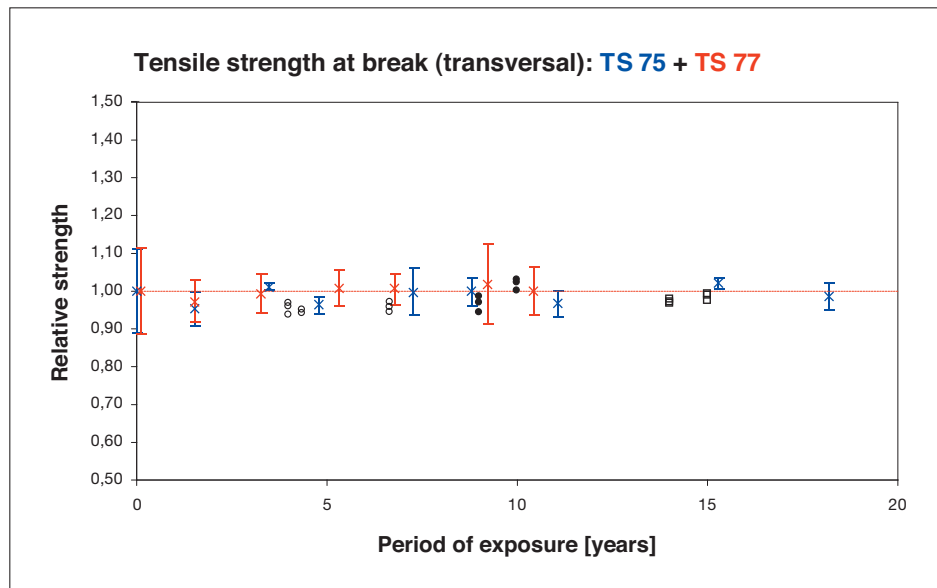


Fig. 8: Tensile strength at break (transversal) of Sarnafil TS after exposure

- Values measured in 1999 by Institut für Bautenschutz, Baustoffe und Bauphysik
- Values measured in 2004 by Institut für Bautenschutz, Baustoffe und Bauphysik
- Values measured in 2009 by Institut für Bautenschutz, Baustoffe und Bauphysik
- X Values measured by Sika with scatter range (139 roofs)

Sarnafil TG

Measured values of elongation at break for **Sarnafil TG** were similar to the results of **Sarnafil TS**; i.e. even after up to 20 years of exposure there was no significant change over time (Fig. 9 and Fig. 10: Elongation at break).

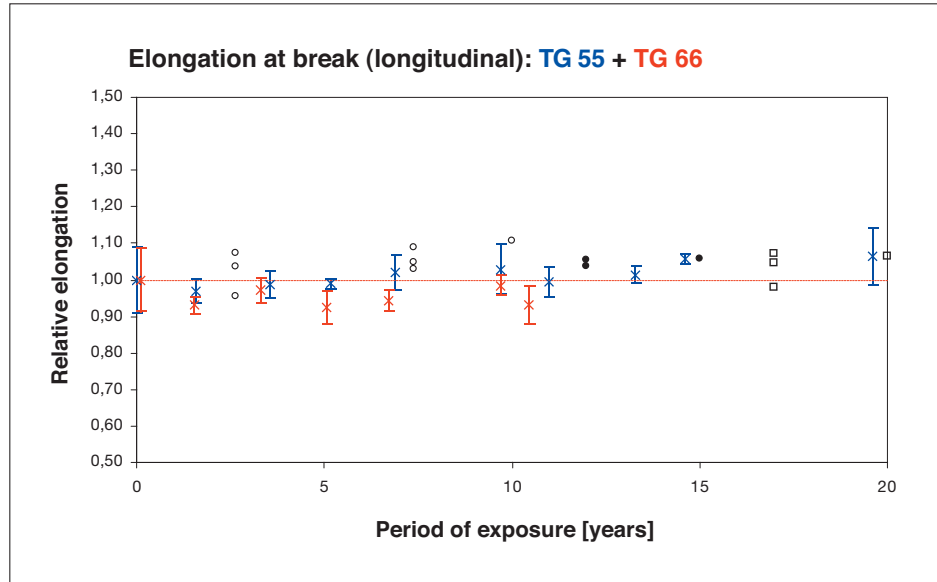


Fig. 9: Elongation at break (longitudinal) of Sarnafil TG after exposure

- Values measured in 1999 by Institut für Bautenschutz, Baustoffe und Bauphysik
- Values measured in 2004 by Institut für Bautenschutz, Baustoffe und Bauphysik
- Values measured in 2009 by Institut für Bautenschutz, Baustoffe und Bauphysik
- X Values measured by Sika with scatter range (139 roofs)

Sarnafil TG

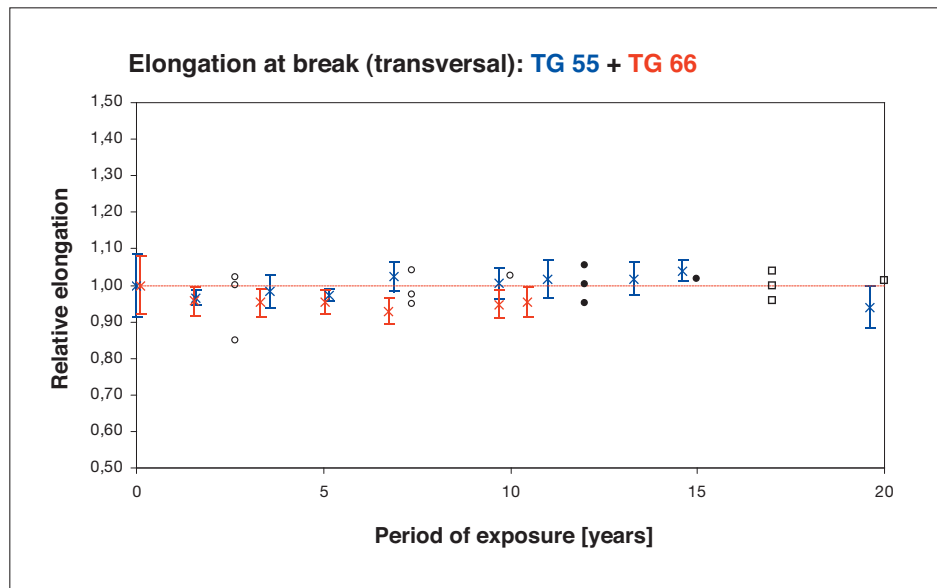


Fig. 10: Elongation at break (transversal) of Sarnafil TG after exposure

- Values measured in 1999 by Institut für Bautenschutz, Baustoffe und Bauphysik
- Values measured in 2004 by Institut für Bautenschutz, Baustoffe und Bauphysik
- Values measured in 2009 by Institut für Bautenschutz, Baustoffe und Bauphysik
- X Values measured by Sika with scatter range (139 roofs)

The tensile strength of **Sarnafil TG** showed a decrease of 15% after 12 years. However, this decrease is significantly decelerating thereafter.

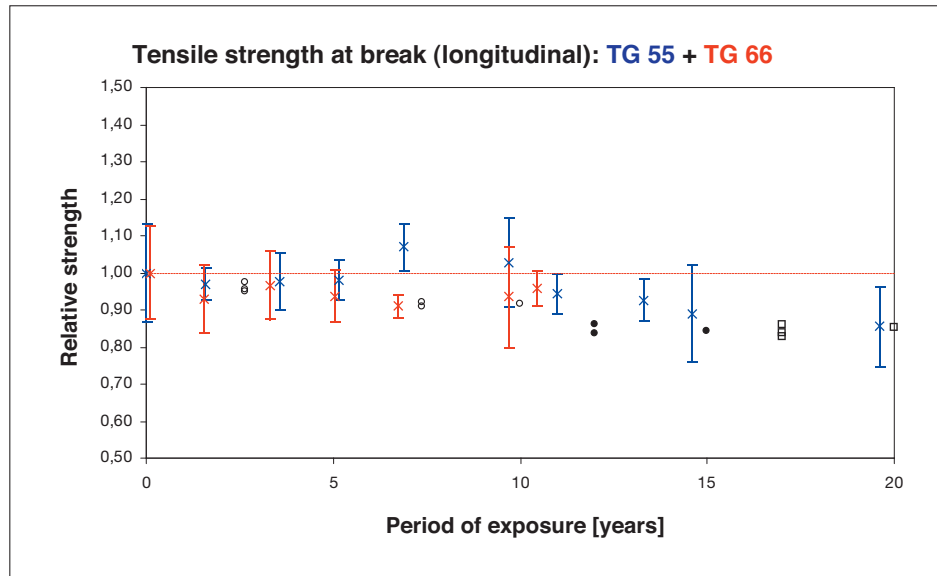


Fig. 11: Tensile strength at break (longitudinal) of Sarnafil TG after exposure
 ○ Values measured in 1999 by Institut für Bautenschutz, Baustoffe und Bauphysik
 ● Values measured in 2004 by Institut für Bautenschutz, Baustoffe und Bauphysik
 □ Values measured in 2009 by Institut für Bautenschutz, Baustoffe und Bauphysik
 X Values measured by Sika with scatter range (139 roofs)

Other properties

For both **Sarnafil TG** and **Sarnafil TS** no change in material thickness due to exposure on the roof was found.

The «low-temperature foldability» test produced no cracks on almost all samples even at $-35\text{ }^{\circ}\text{C}$. Cracks were only found on the 14 years old samples. However, at test temperatures of $-30\text{ }^{\circ}\text{C}$ these samples passed the test without cracks. As a result, no cracks were found in spite of using an aggravated test temperature.

Even light microscope inspection at 30 times magnification, which again is a tightened inspection than prescribed by standards at new condition, showed no surface cracks.

All the tested welded seams tore outside the seam area as required by standards. There were no significant changes over time of exposure. Also the results of investigations into welding seams of new membranes onto exposed polymeric membranes from the roofs confirm the reparability even after 20 years.

4. Assessment of durability

Sarnafil TS

Our investigations of **Sarnafil TS** membranes show that the results of specimens from roofs 14 to 15 years old lie within the scatter range of results obtained by internal monitoring of new materials, in other words, within the normal scatter ranges encountered in production. As far as a comparison with specimens from this year's production (2009) was possible, the studies also show that no significant change in mechanical properties had occurred after 14 years and 15 years. All specimens passed the low-temperature foldability test at intensified test conditions of -30°C . With the exception of two specimens (14 years old specimens), no cracks were found even at testing conditions of -35°C . Thus our investigation results confirm the data collected by Sika for roofs up to 18 years old. The 1999 and 2004 durability assessments of **Sarnafil TS** are confirmed after an additional 5 years by the results of this investigation on 20 years old membranes.

There are now, about two decades of proven, positive experience for the durability of Sarnafil TS. While ensuring the standard conditions and used in compliance with the application and maintenance requirements, the results suggest that the polymeric roofing membranes Sarnafil TS will fulfill their waterproofing function for further decades.

Sarnafil TG

The roofs investigated with **Sarnafil TG** polymeric roofing membrane have been exposed for periods of 17 and 20 years. The properties tested here, for example elongation at break, showed results similar to those of **Sarnafil TS**, that is, no significant change over time could be detected.

Also the investigation of a new welding seam from new polymeric membrane onto exposed membrane from the roof showed the same results as with **Sarnafil TS**, respectively no failure of the seam.

A difference in the tensile strength was observed. The decrease of the tensile strength is time related. Considering the results from 2004, the last five years show a much slower reduction of tensile strength in comparison to the reduction during the first 7 or 10 years.

There are two ways to predict the service life of **Sarnafil TG**. Both are based on this time-dependent change of the tensile strength:

The German standard DIN 18531-2:2008-11 requires a value of at least 5 N/mm^2 for new materials. Model calculations show that it will take 55 to 100 years before the tensile strength drops to 5 N/mm^2 . The requirement for tensile strength of at least 5 N/mm^2 applies to new material. We consider a tensile strength requirement of 3 N/mm^2 reasonable and sufficient for calculating the service life of **Sarnafil TG**. Using the same considerations, this requirement of 3 N/mm^2 results to a period of more than 100 years. Therefore all the above mentioned data would indicate a service life of minimum 55 years respectively more than 100 years for **Sarnafil TG**.

Thus, the service life of **Sarnafil TG** corresponds to the service life assumed for constructions in general. The 1999 and 2004 durability assessments of **Sarnafil TG** are confirmed after an additional 5 years by the results of this investigation on 20 years old membranes.

The results of this long term study and the two decades of proven, positive experience for the durability of Sarnafil TG suggest, that while ensuring the standard conditions and used in compliance with the application and maintenance requirements, the polymeric roofing membranes Sarnafil TG will fulfill their waterproofing function for further decades.

Note

This summary report has been compiled as a supplement to Expertise No. 70006 dated 02.07.2009 on the durability of polymeric roofing membranes **Sarnafil TS** and **Sarnafil TG**. For details please consult the full expertise.

Expert



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