FORSCHUNGSINITIATIVE ZukunftBAU

Fraunhofer ICT

ABSTRACT of the research project SWD-10.8.18.7-17.15

Title

Deactivatable adhesives for the recycling of thermal insulation composite systems

Occasion / Initial situation

In the field of building materials recycling, expanded polystyrene (EPS) accounted for approx. 42,000 tonnes in 2012, with a significant increase expected in the coming decades. So far, composite thermal insulation systems cannot be separated according to type during dismantling, so that EPS with adhering mineral residue can only be used for thermal recycling.

Subject of the research project

The aim of the project was to develop a soluble adhesive which can be activated by microwave radiation in order to enable pure recycling.

A 2K polyurethane was chosen as the adhesive base because it is chemically compatible with polystyrene. The irradiating microwave energy is to be converted directly into heat by commercial microwave absorbers in the adhesive seam, whereby energetic materials in the form of blowing agents and/or oxidizers are brought to react in order to damage the adhesive matrix thermally and mechanically.

Various polyols and polyisocyanates have been studied for their adhesive strength to ensure performance throughout the product life cycle. Microwave absorbers and blowing agents were investigated for their thermal and dielectric properties and compatibility with polyurethane must be ensured.

In the project a thermoplastic adhesive with low cross-linking could be identified as adhesive base, which can be activated for microwaves by means of pearl graphite. Physically acting blowing agents based on Expancel microspheres showed particularly high expansion rates during the activation of the adhesive.

With EPS-EPS and EPS-OSB glued together over a large area with dimensions of 1.0 x 0.5 m, an application on a recycling yard in a microwave array could be demonstrated. The samples could be dissolved without force after approx. 3 minutes, whereby only a few residues remained on the EPS.

The lifecycle analysis showed that the soluble adhesive has a significantly better environmental balance than commercial organic adhesives. Despite the recycling of 80 % of the recycled EPS, no ecological benefit can be proven compared to mineral adhesive mortars.

The soluble adhesive can compete economically with organic systems in use, as care has been taken to use basic chemicals that are available in large tonnages.

Conclusion

In this project, a soluble adhesive could be developed which can be activated by microwave radiation in order to remove EPS plates from the masonry. By using a microwave array to remove the adhesive, an exemplary stationary application on a recycling yard could be demonstrated. The lifecycle analysis shows that the soluble adhesive offers an ecological advantage over commercial organic adhesives, but not over mineral adhesives. Therefore a transfer of the results to mineral adhesives would be recommended.

Translated with www.DeepL.com/Translator

Key data

Short title:	WDVS-Deaktiv
Researcher/ Project leader:	M.Sc. Stefan Sims (Project leader, Fraunhofer ICT)
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Total costs:	200.018,07 €
Federal grant:	140.013,00 €
Project duration:	24 Monate

Images

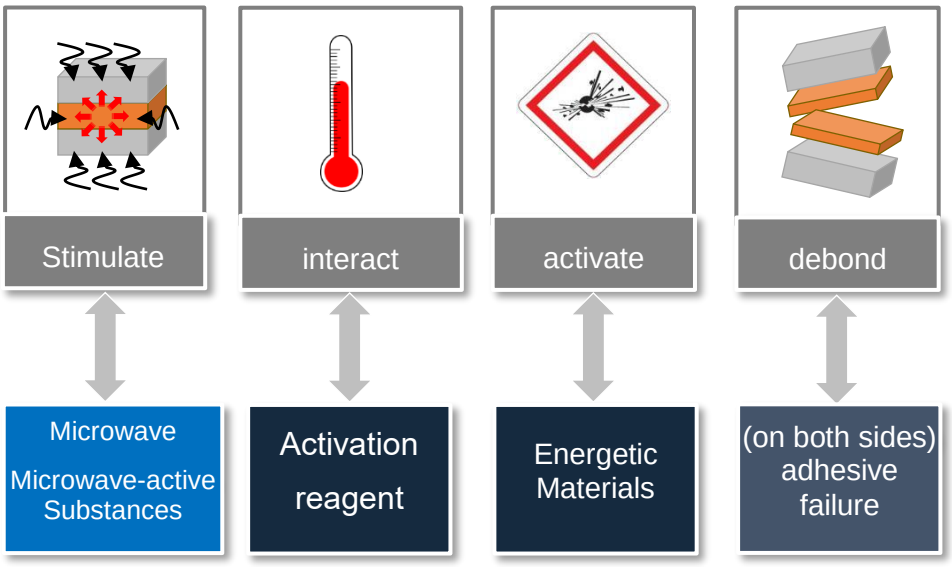

Figure 1: Basic principle of the soluble adhesive

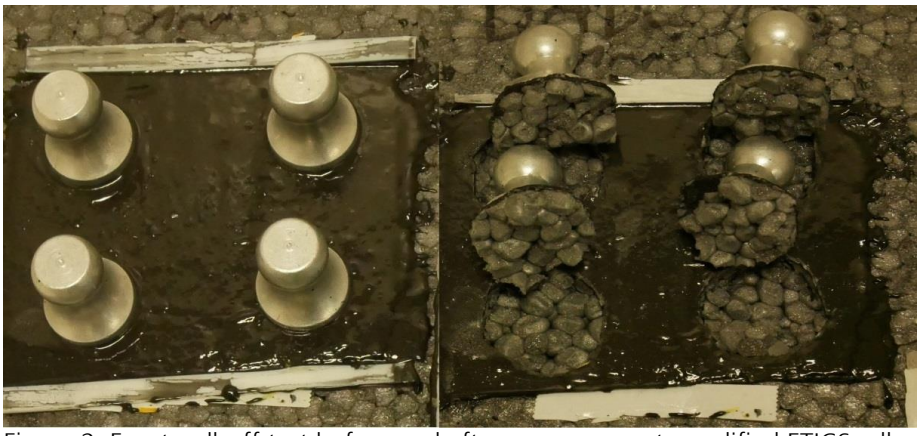

Figure 2: Front pull-off test before and after measurement, modified ETICS adhesive on EPS at 2 mm test layer thickness

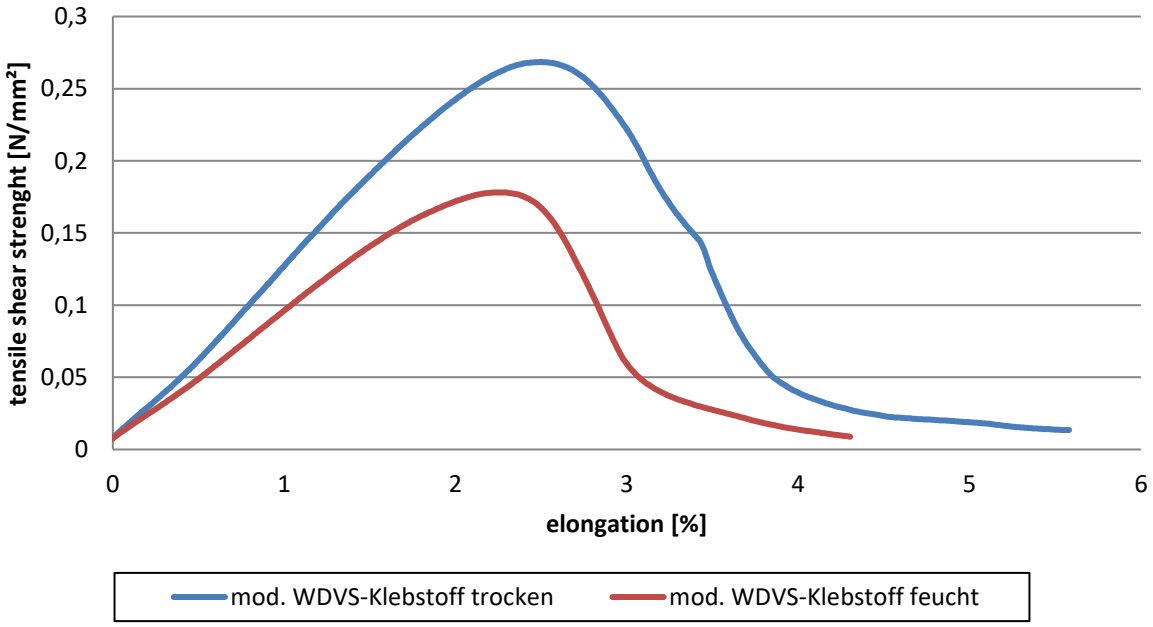

Figure 3: Tensile shear strength mod. ETICS adhesive on polystyrene, dry and moist stored, adhesive layer thickness 250 µm

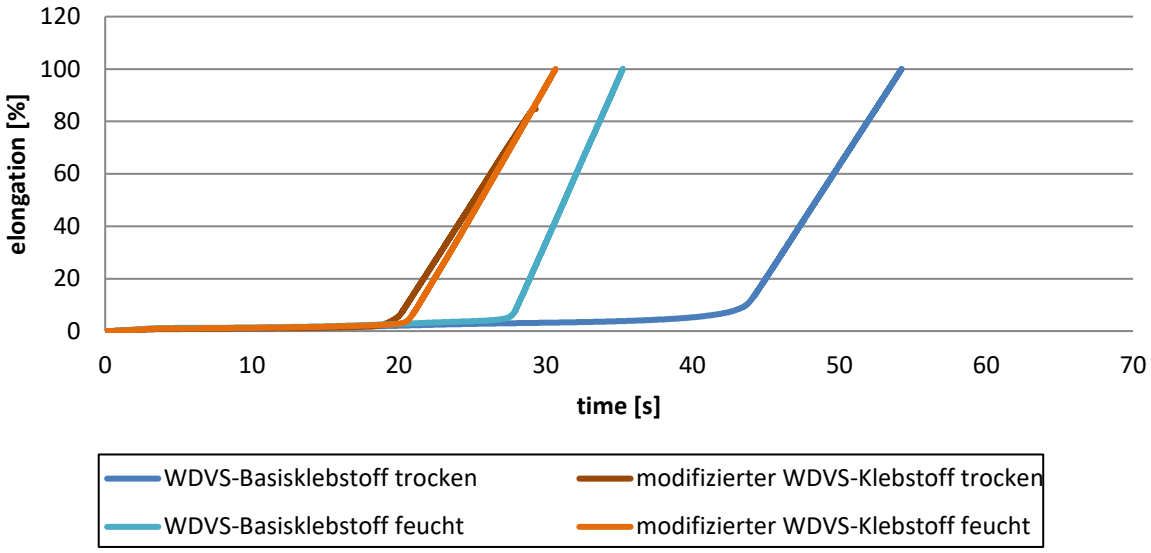

Figure 4: Microwave tensile test ETICS adhesive stored dry and wet on polystyrene at 10 N tensile force and 500 W at 2.45 GHz

Fig. 5: Decapped EPS plate after microwave irradiation in MAC-RTM at a surface temperature of the adhesive of 80 °C

Figure 6: ETICS on OSB after thermal activation of the adhesive