ALL ON EDGE

Development of Objective Test Methods for Furniture Edges and Rims

Workpackage C „Long-term Prognosis methods“

Agenda

- Short introduction
- Overview and explanation of methods used
- Material overview
- Results
- Summary

3. WP-C: Long-term prognosis methods (Leader: IHD)

- **Tasks:**
  - Task-C1: Definition, preparation and providing of different coating/glue materials and furniture edges (IHD/ITD)
  - Task-C2: Investigations on aging behavior of coatings and glues under the influence of temperature and humidity (IHD)
  - Task-C3: Methodological investigations on long-term prognosis (IHD/ITD)
  - Task-C4: Comparative tests of the developed long-term methods (IHD/ITD)
  - Task-C5: Round Robin Tests of optimized long-term methods (IHD/ITD)
  - Task-C6: Final description of suitable long-term methods (IHD/ITD)

3. Task-C2: Investigations on aging behavior of coatings and glues under the influence of temperature and humidity (IHD)

- Long-term storages of coating constructions, **edge materials and glues to characterize the influence of incident light, different temperatures as well as constant temperature with different humidity**
- For determination of aging effects very sensitive methods are necessary which are available at IHD and will be used after defined times of described aging factors:
  - **Microhardness** to detect the influences on brittleness by aging of coatings and glues
  - **FTIR** for the determination of changes in the chemical structure of glues and coatings
  - Determination of **surface energy** of coatings, glues as well as edge materials in unused and aged state to predict the general adhesion behavior and to determine changes in the expectable adhesion induced by aging
    - ➢ For details on the used methods, please see the presentation from the 2nd User Committee Meeting

Material overview

ADHESIVES

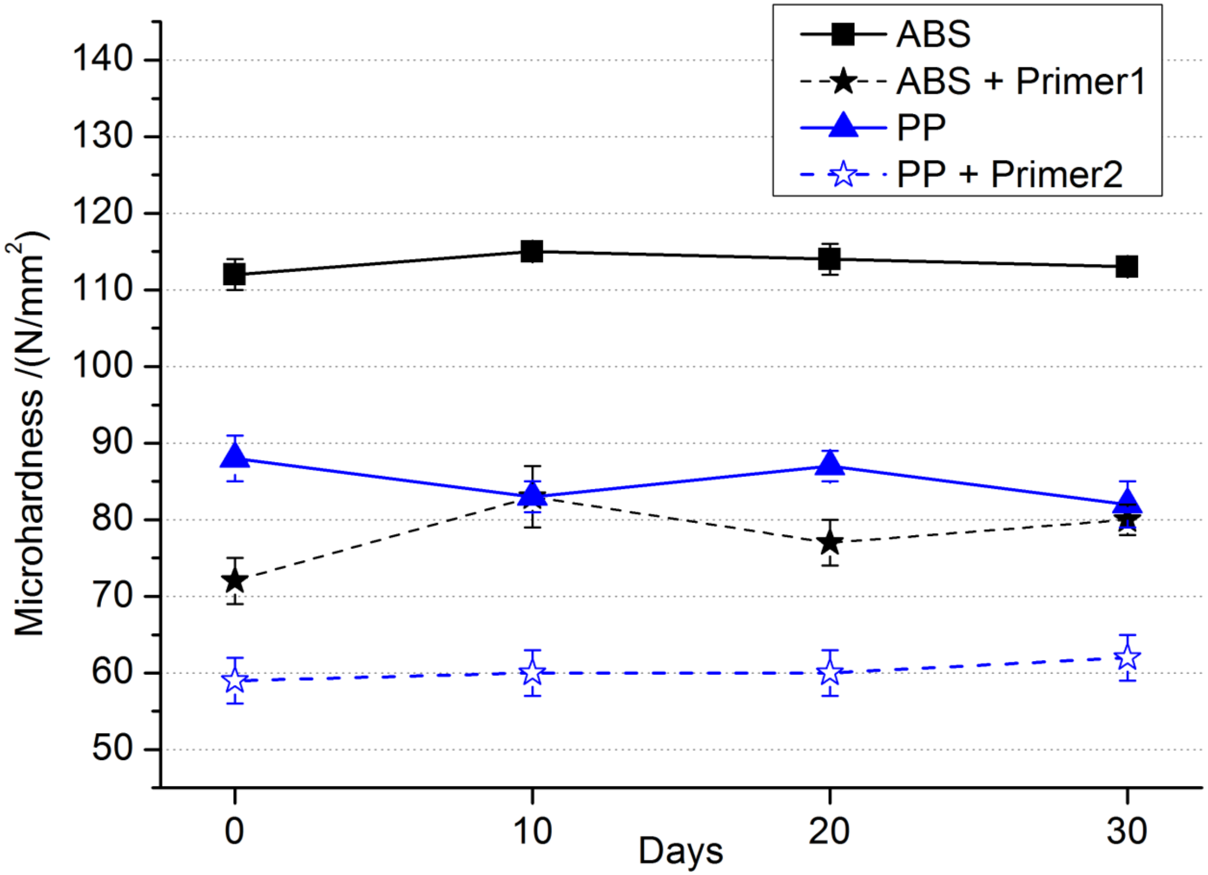
- PVAc dispersion
- PU dispersion (without added hardener)
- 2 EVA hotmelts
- PUR hotmelt
- PO hotmelt (polyolefin)

EDGE MATERIALS

- ABS (with and without primer)
- PP (with and without primer)

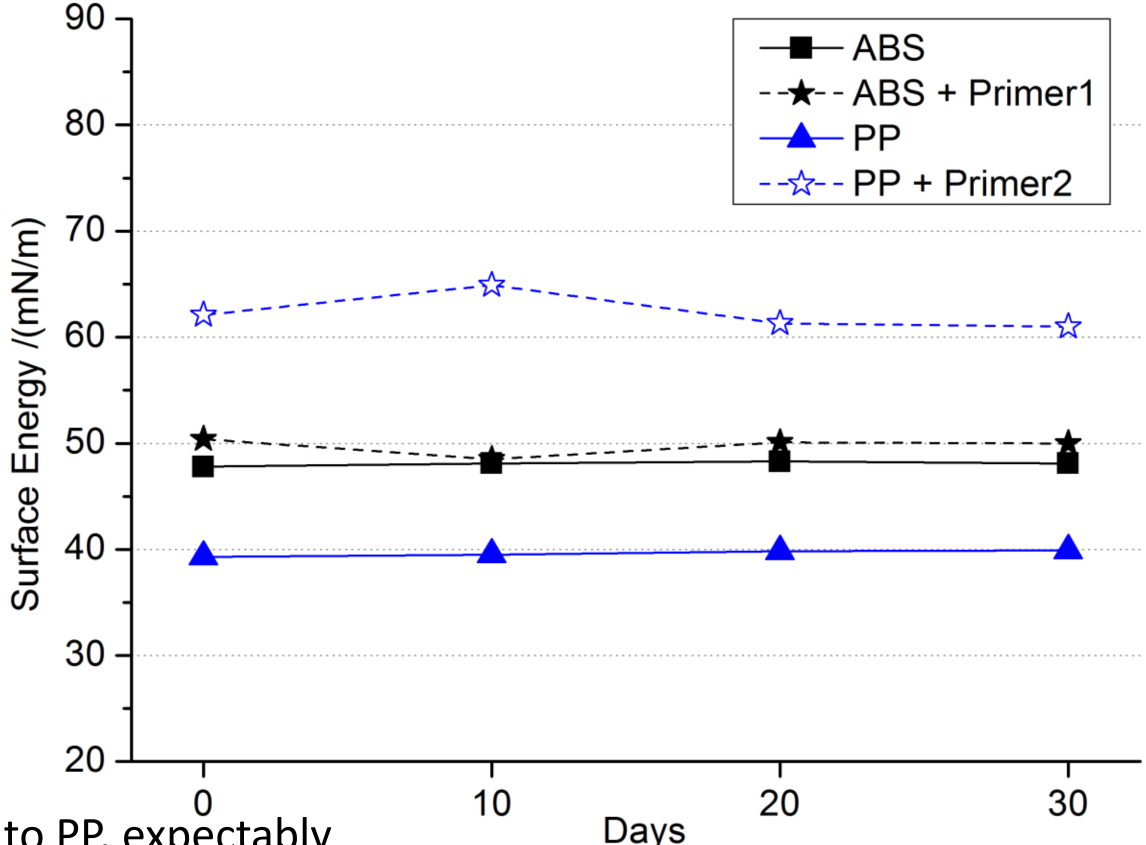
- Aging was done by the following procedure:
  - Artificial aging inside an climate chamber (without light) with the following cyclic regime for 30 d: 12 h 50 °C/50 % r. h.; 12 h 50 °C/90 % r. h.
  - Evaluation and sampling each 10 days
- As reference one produced sample was stored under defined conditions at 23 °C/ 50 % r. h.

Microhardness of edge materials depending on aging



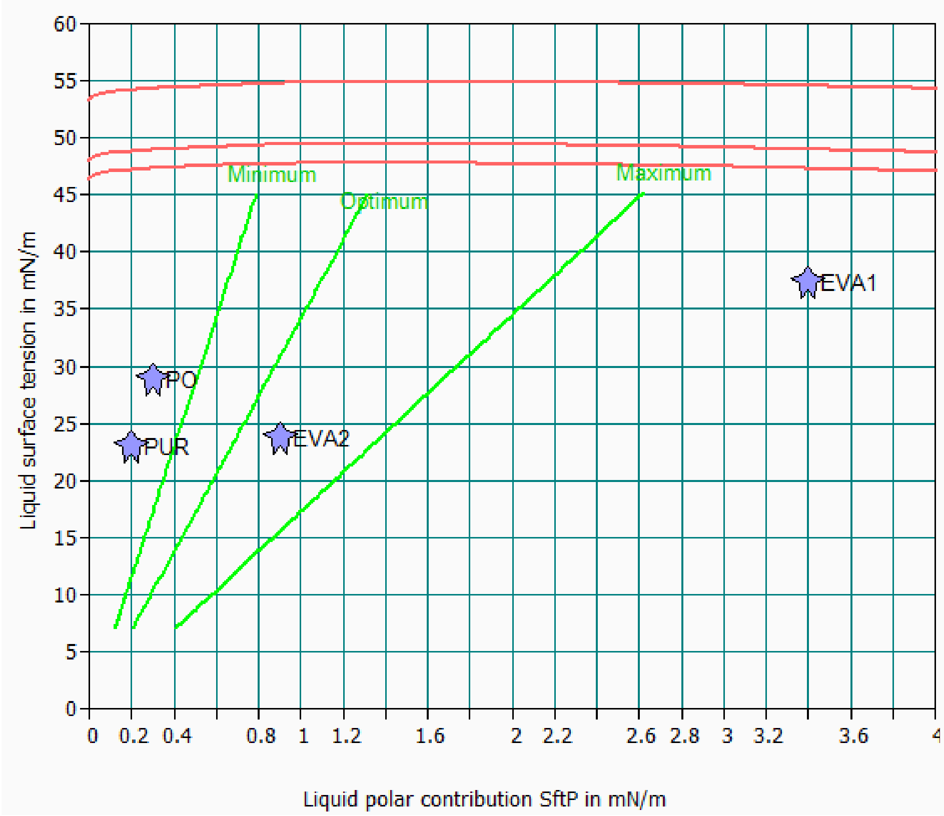
- ABS is much harder than PP due its aromatic structure, expectably
- Prime of edge materials decreases hardness in any case
- Aging has no significant effect on edge materials or primers

Total surface energy (SE) of edge materials depending on aging

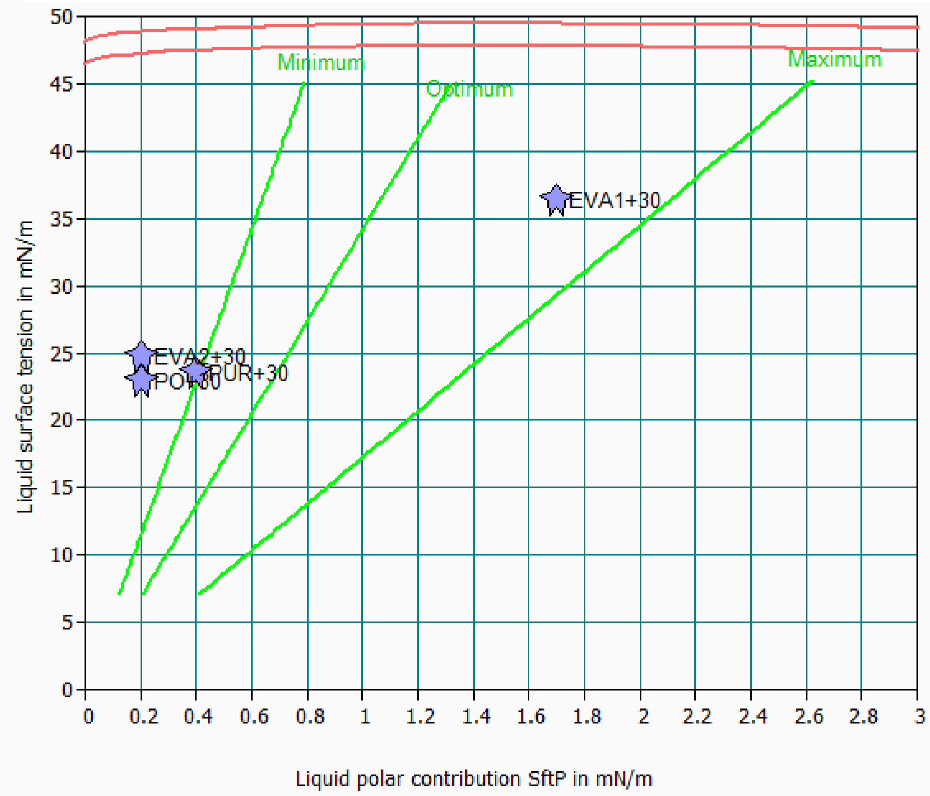


- ABS has a higher SE comparing to PP, expectably
- Primer 1 raises SE of ABS slightly, whereas Primer 2 enhances SE of PP strongly
- Primers increase the polar part of both materials
- Aging has no significant effect on edge materials or primers
- SEs higher than 35-40 mN/m are usually uncritical for wetting with liquids

Comparison of adhesion prediction of several hotmelts on ABS without primer before and after aging

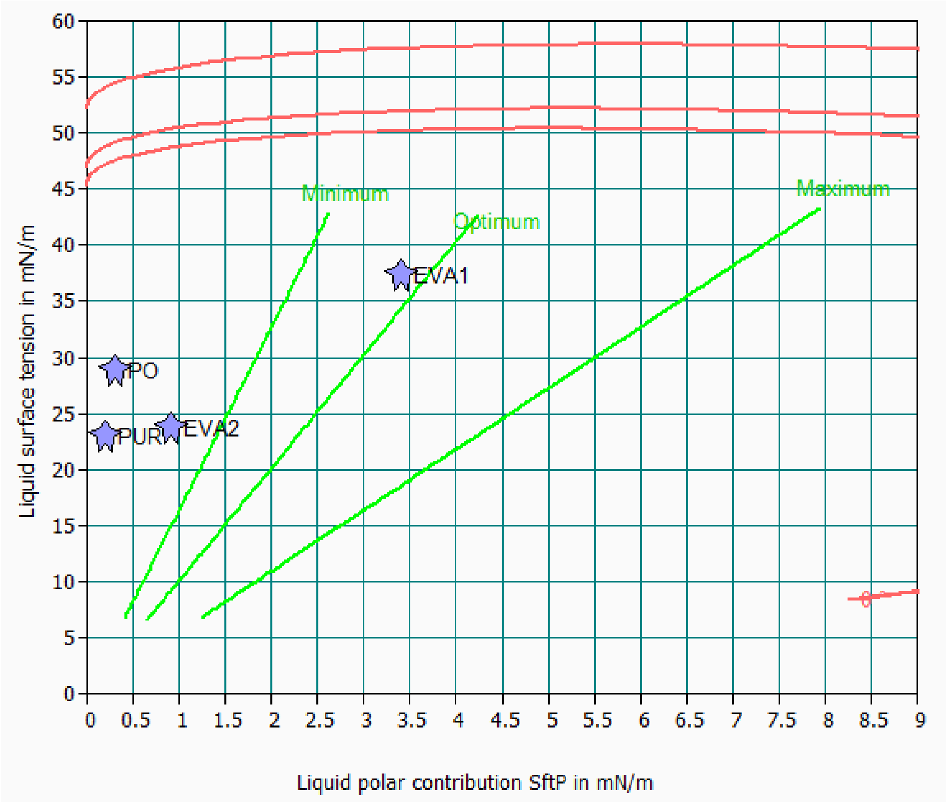


Without Aging

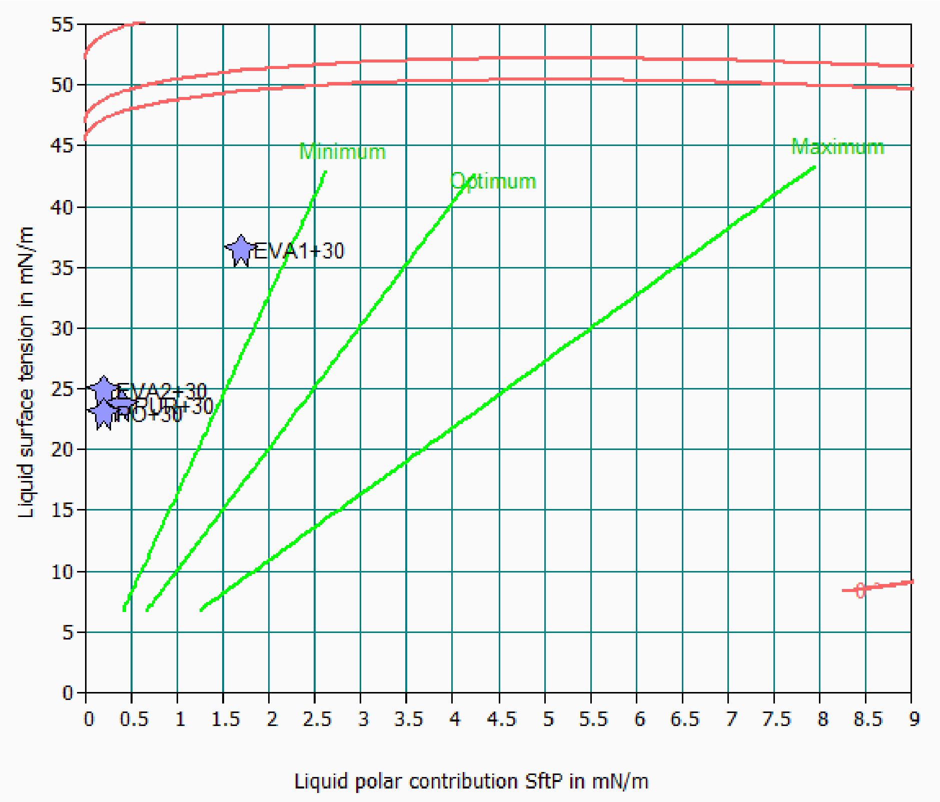


+30 days aging

Comparison of adhesion prediction of several hotmelts on ABS with primer before and after aging



Without Aging

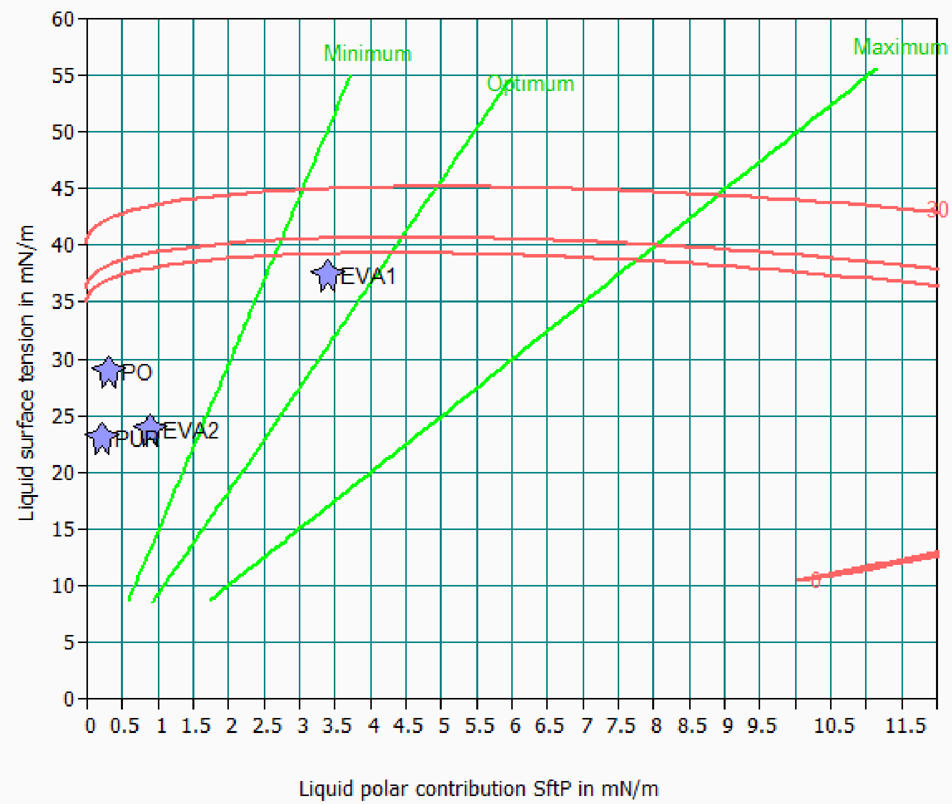


+30 days aging

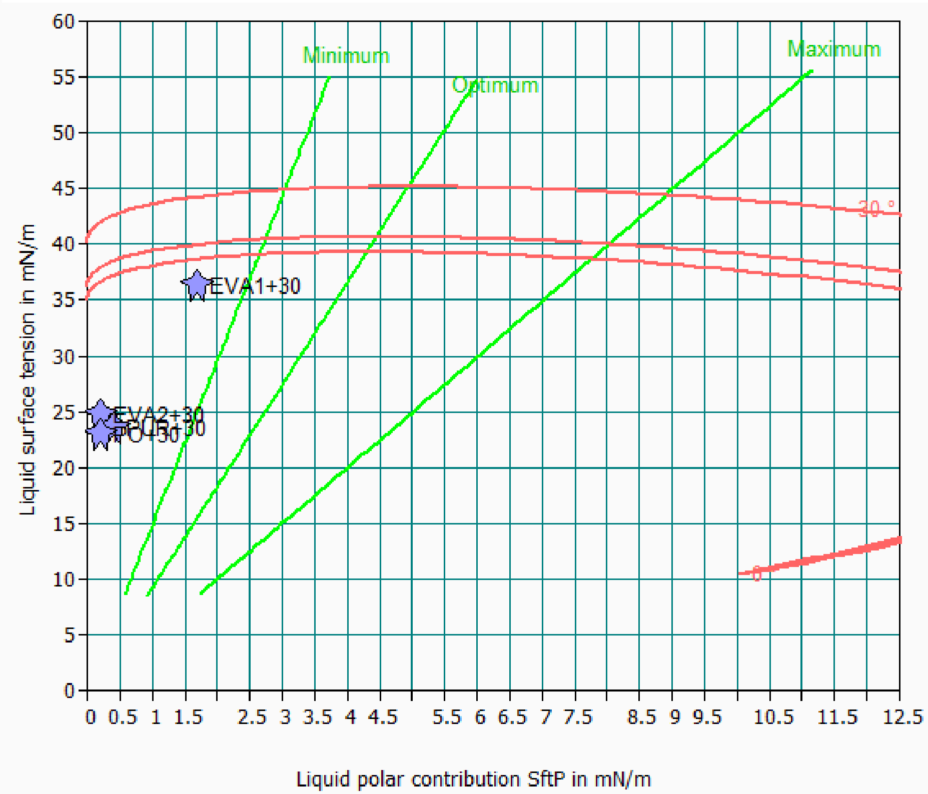
cornet

IHD TRÄGERVEREIN e. V. | OGÓLNOPOLSKA IZBA GOSPODARCZA PRODUCENTÓW MEBLI | IHD SCIENCE BY EXPERTS

Comparison of adhesion prediction of several hotmelts on PP without primer before and after aging

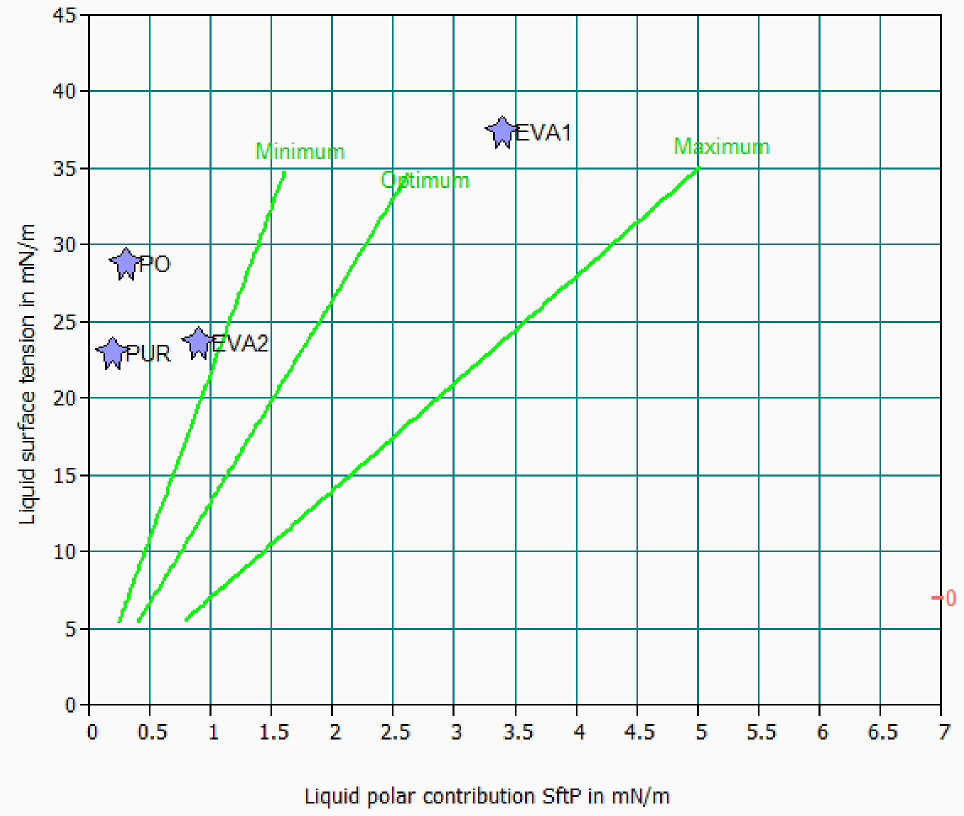


Without Aging

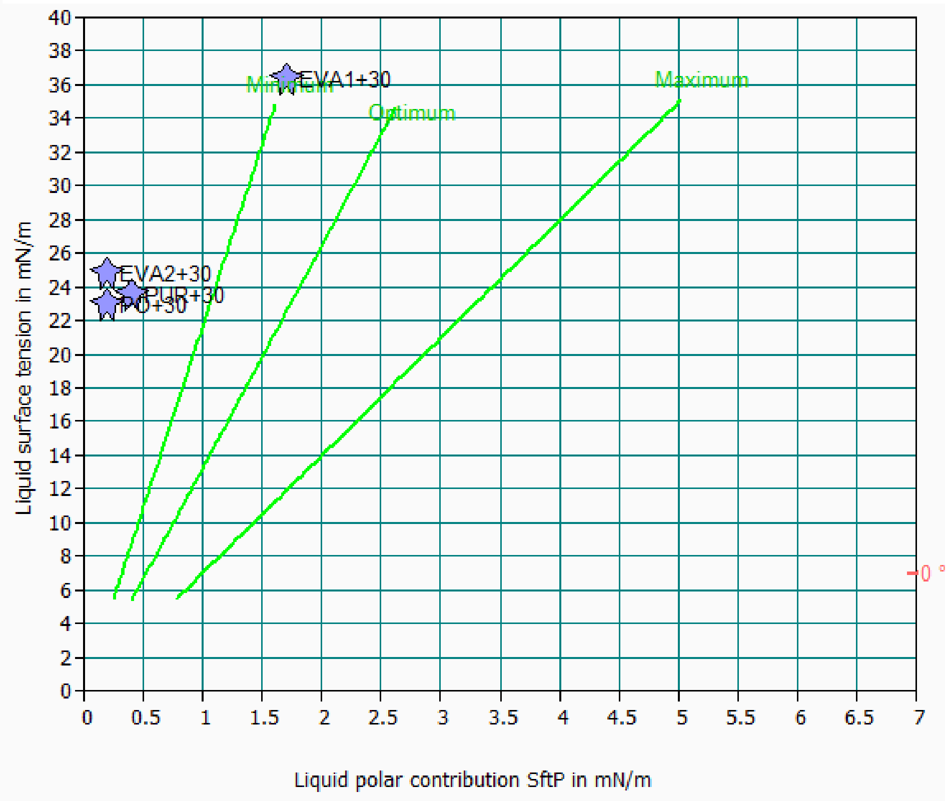


+30 days aging

Comparison of adhesion prediction of several hotmelts on PP with primer before and after aging



Without Aging



+30 days aging

Summary

- PP and ABS reveal no significant thermal- and humidity-induced aging behavior
- PP and ABS were coated with different primers
- Both primers decrease the microhardness of ABS and PP → advantageous
- Both primers raise the surface energy of the coated plastics and the polar part coincidently
- The overall SE values of both plastics (with and without primer) are high enough for a complete wetting of the surfaces by all adhesives investigated
- All hotmelts show a more or less intensive thermal- and humidity-induced aging behavior according to their chemical stability
- PUR hotmelt as the only reactive hotmelt undergoes a strong chemical changing resulting in strong decreasing polar part
  - Consequently, the adhesion behavior is strongly influenced by hardening/cross-linking
- The EVA hotmelt variants are the most suitable glues for application on the substrates investigated considering their SE values and the resulting adhesion prediction
- <u>The SE analysis disregards effects such as penetration or chemical bonding</u>

New test regime for comparative investigations

- The applied test regime (12 h 50 °C/50 % r. h.; 12 h 50 °C/90 % r. h.) was selected according to an empirical value determined by aging tests of 3D furniture fronts with various kitchen manufactures .
- Modifications based on following hotmelt properties:
  - Step 1: Defining the upper temperature limit according to melting/softening point determined by DSC measurements:

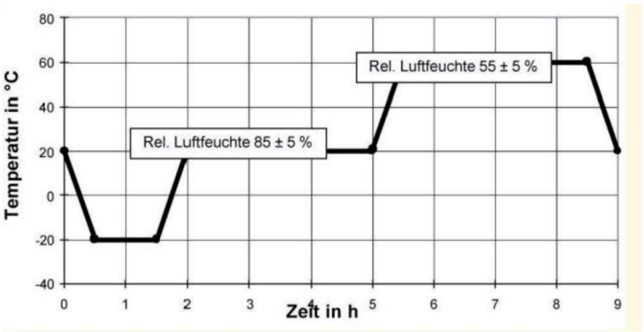
PUR	PO	EVA1	EVA2
57 °C*	153 °C	80 °C	**61 °C**

➢ Temperature should not be higher than 55 °C to prevent a structural weakening of glued parts

  - Step 2: Defining the upper humidity level: high humidity (e.g. 90 % r.h.) is more stressful for glues than dry conditions, because of a possible chemical attack by water and to force the swelling of possible substrates such as fiber- and particleboards.
  - Step 3: Defining the lower temperature limit concerning known transportation problems in containers: an additional step with low temperature (below 0 °C) to reinforce mechanical tensions (swelling, shrinking) between substrate, glue, and edge band which may result in delamination.

Next steps regarding long time comparative test (IHD/ITD)

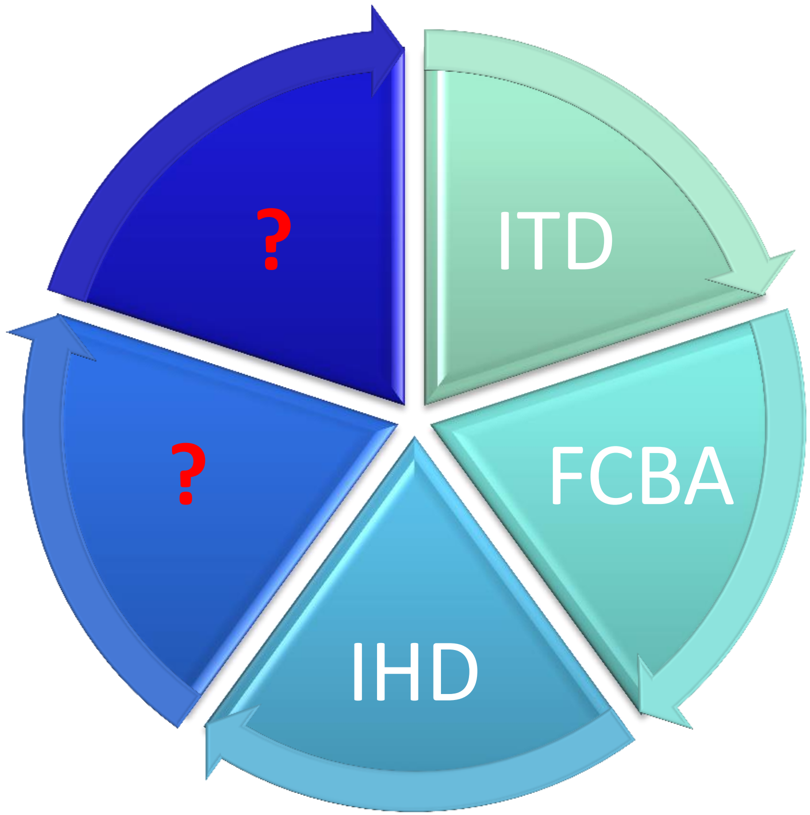
- Based on the results of previous investigations, the following cycle is proposed for a round robin test:
  - **Alternative 1:** ***pre-aging***: 14 days at: 12 h 50 °C / 90 % RH, 12 h 50 °C / 50 % RH (reference: 14 days at 23 °C and 50 % RH), ***followed by***:
  - ***changing climate test:*** acc. to AMK-MB 005 Test Module 3:
    - 0.5 h Cool down to -20 °C at cooling rate of 1.33 ± 0.1 K/min
    - 1 h Constant temperature of (-20 ± 2) °C
    - 0.5 h Heat up to 20 °C at a heating rate of 1.33 ± 0.1 K/min
    - 3 h Storage at (20 ± 2) °C and (85 ± 5) % RH
    - 0.5 h Heat up to 60 °C at a heating rate of 1.33 ± 0.1 K/min
    - 3 h Storage at (60 ± 2) °C and (55 ± 5) % RH
    - 0.5 h Cool down to 20 °C at a cooling rate of 1.33 ± 0.1 K/min

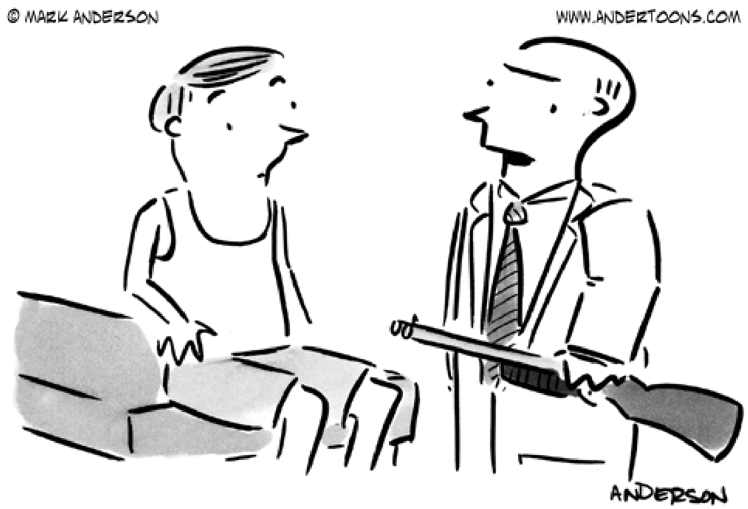


  - **Alternative 2:**
    - 55 °C / 90 % r. h. / **8** h
    - 55 °C / 30 % r. h. / **8** h
    - **-20** °C / **8** h
    - **heating/cooling rate: 1,33 ± 0,1 K/min, same as for AMK method**
    - duration: min. 28 days, evaluation **in the 1st week every day** and than each **7** days
  - **(For lacquered parts maybe with a pre-test on abrasion or layer thickness on rims? – momentarily not planned)**

Next steps regarding long time comparative test

- Who could take part in the RRT?





"I said you had three months to live, and I meant it."

Thank you!