SALZGITTER MANNESMANN FORSCHUNG

Ein Unternehmen der Salzgitter Gruppe

JoinTec

Flügge

Paderborn, den 25. Mai 2010

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- Leaking pipe joints
  - Possible failure causes
    - **Shrinking of the adhesive**
    - **Water pressure / load case**

Test procedure to open the joints

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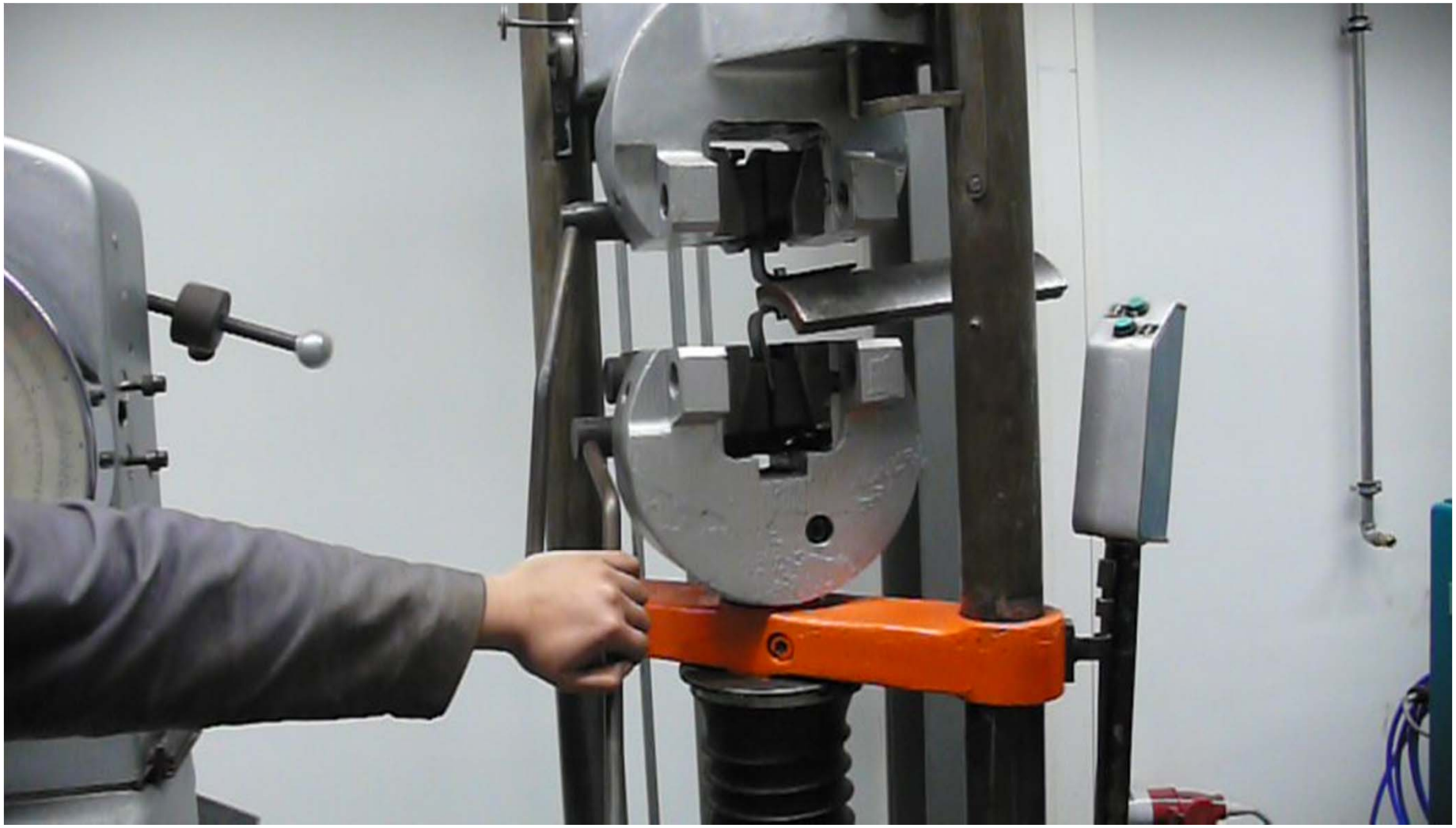

Appearance of fracture of pipe bonds with defects

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Appearance of fracture of pipe bonds without failure

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Leaking pipe joints

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- **No adhesion between adhesive and pipe surface**
- **Water damage on the surface**
- **Mostly no adhesion on the pipe side but on the sleeve side**

Failure analysis of leaky pipe joints

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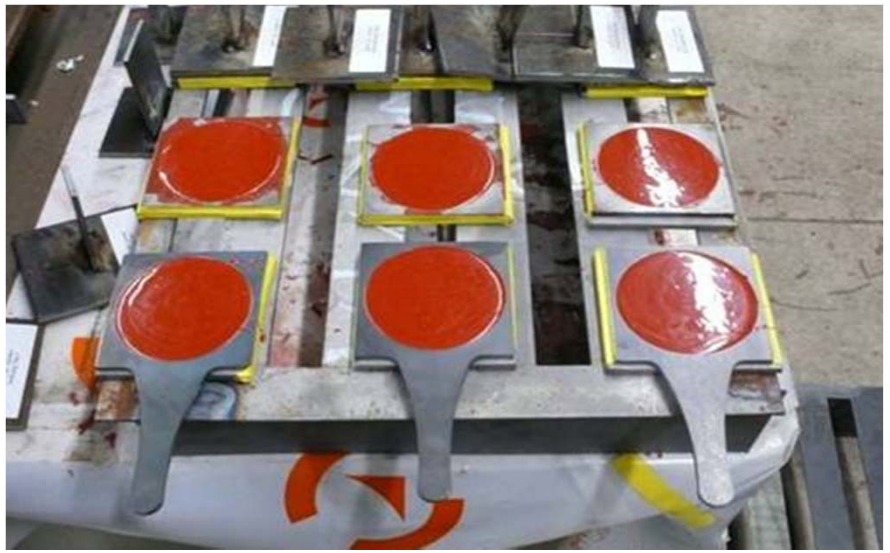
Possible explanations for the phenomena of no adhesion at the pipeline sided bond line are:

- **Adhesive shrinkage**
- **Handling issues through rotation**
- **Possible crack at the bond line**

Unfortunately the tests do not show some shrinkage either a crack, probably because of the adhesive quantity. New tests are coming with some other preparation.



Failure analysis of leaky pipe joints

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Crack check

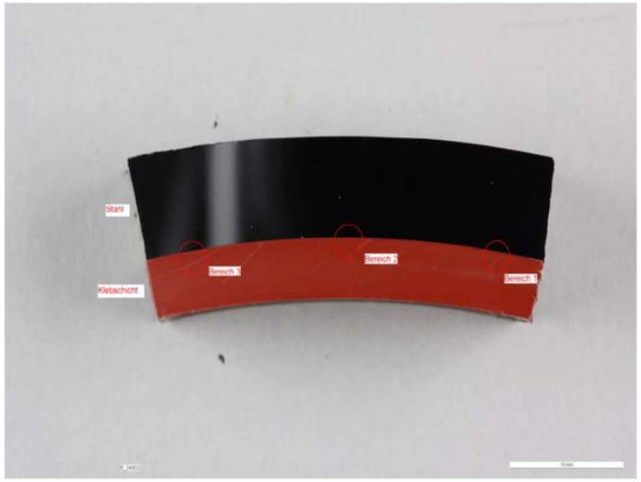


Bild 1
B_249532
Übersicht

Makro

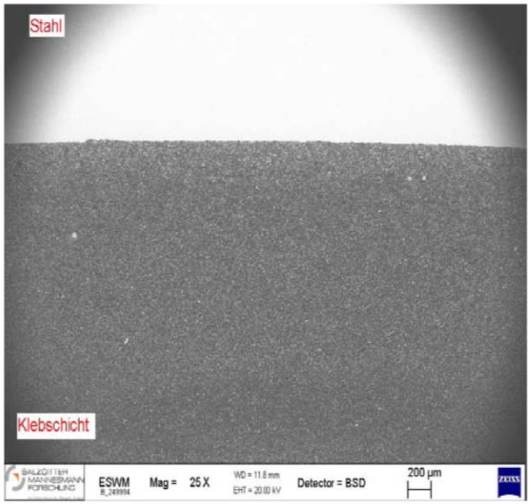


Bild 2
B_249994
Bereich 1

Keine Poren oder Risse in der Klebschicht erkennbar.

Compo 25: 1

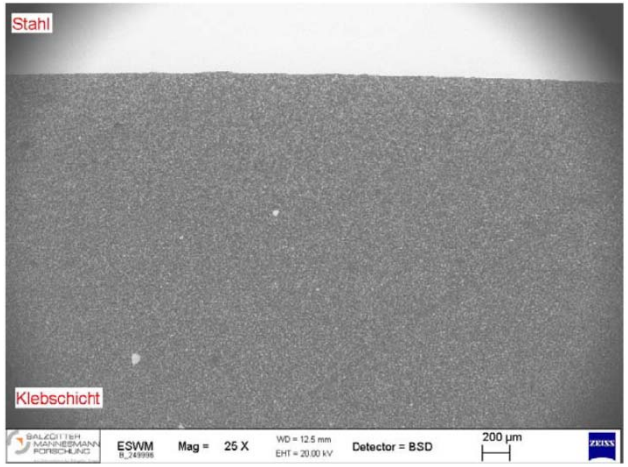


Bild 5
B_249996
Bereich 3

Keine Poren oder Risse in der Klebschicht erkennbar.

Compo 25: 1

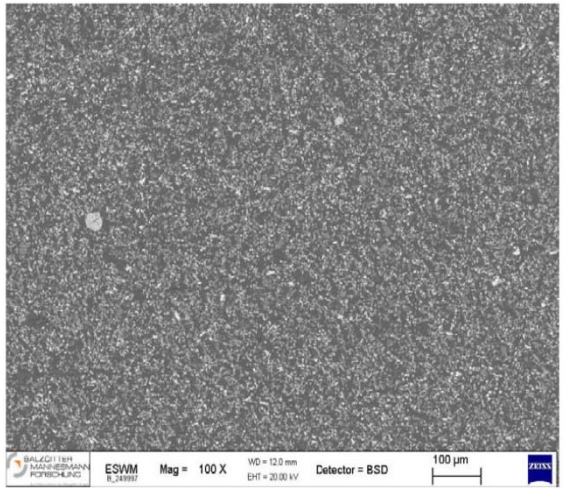
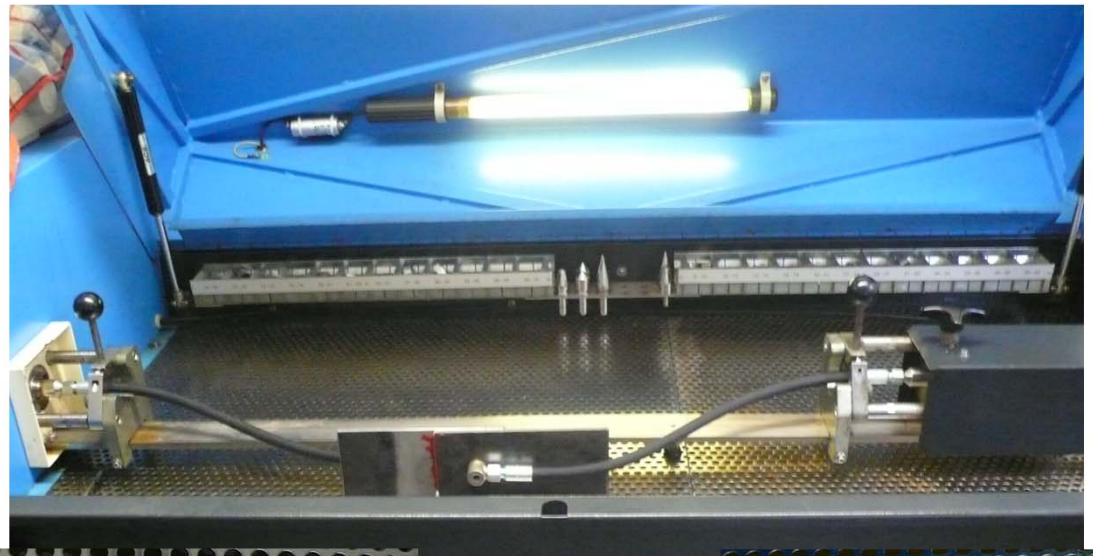


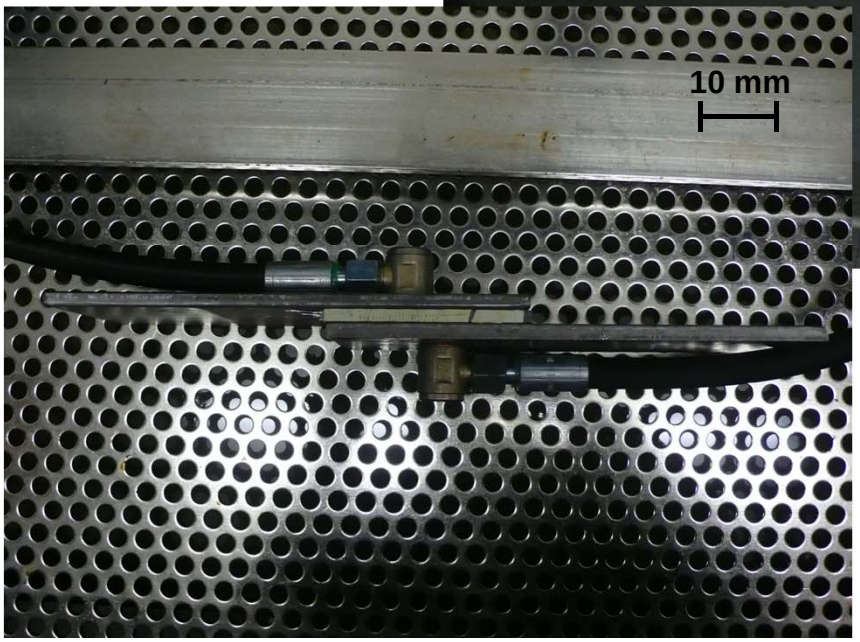
Bild 4
B_249997
Detail 2

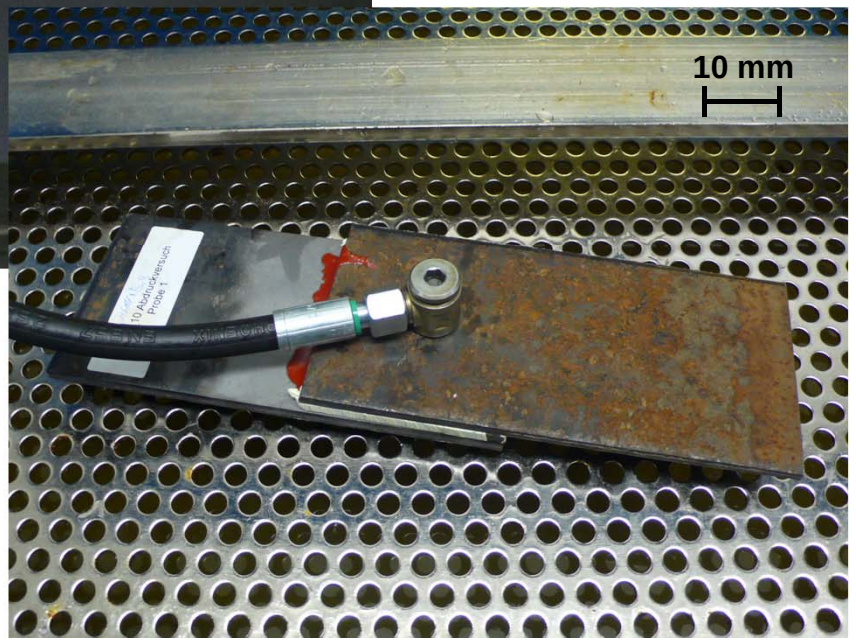
Darstellung der Klebschicht

100: 1

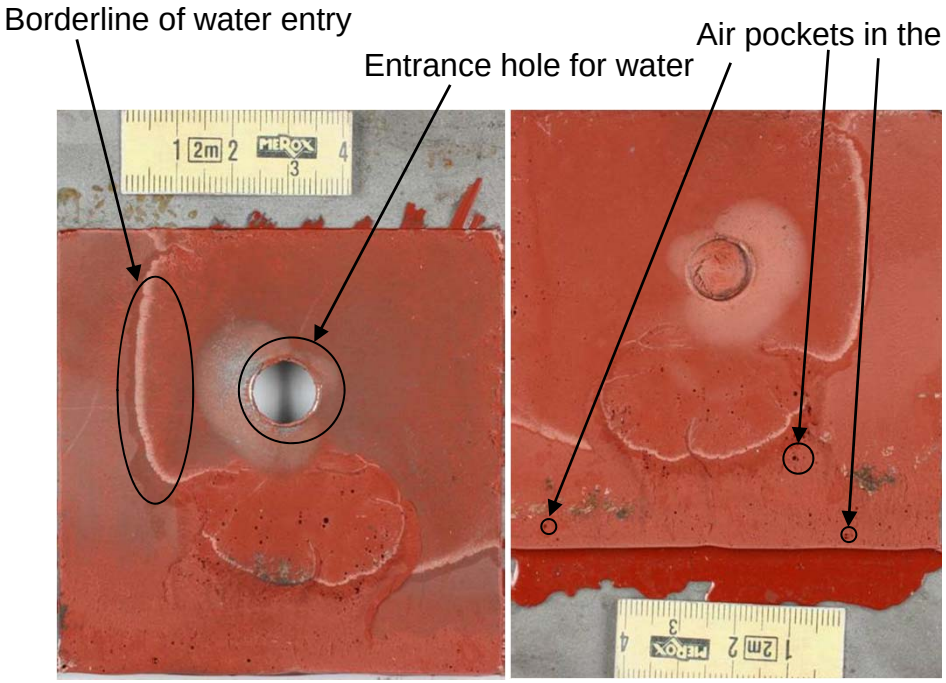
Failure caused by pressure: Test setup







Failure caused by pressure



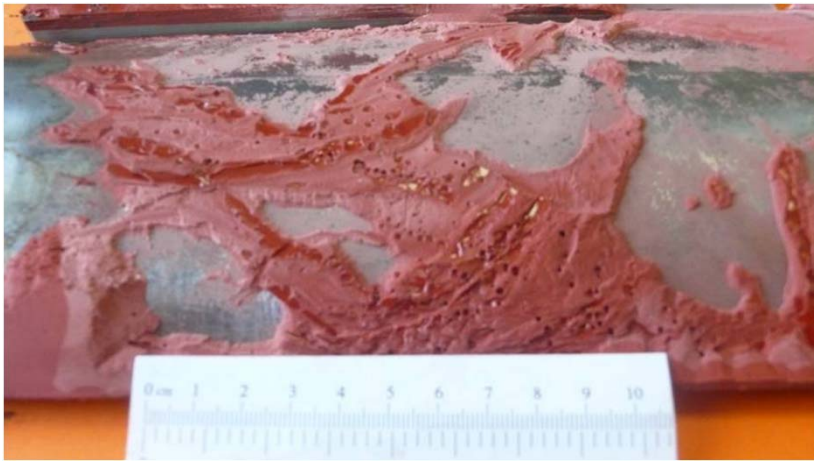
test 1: leak at 180 bar

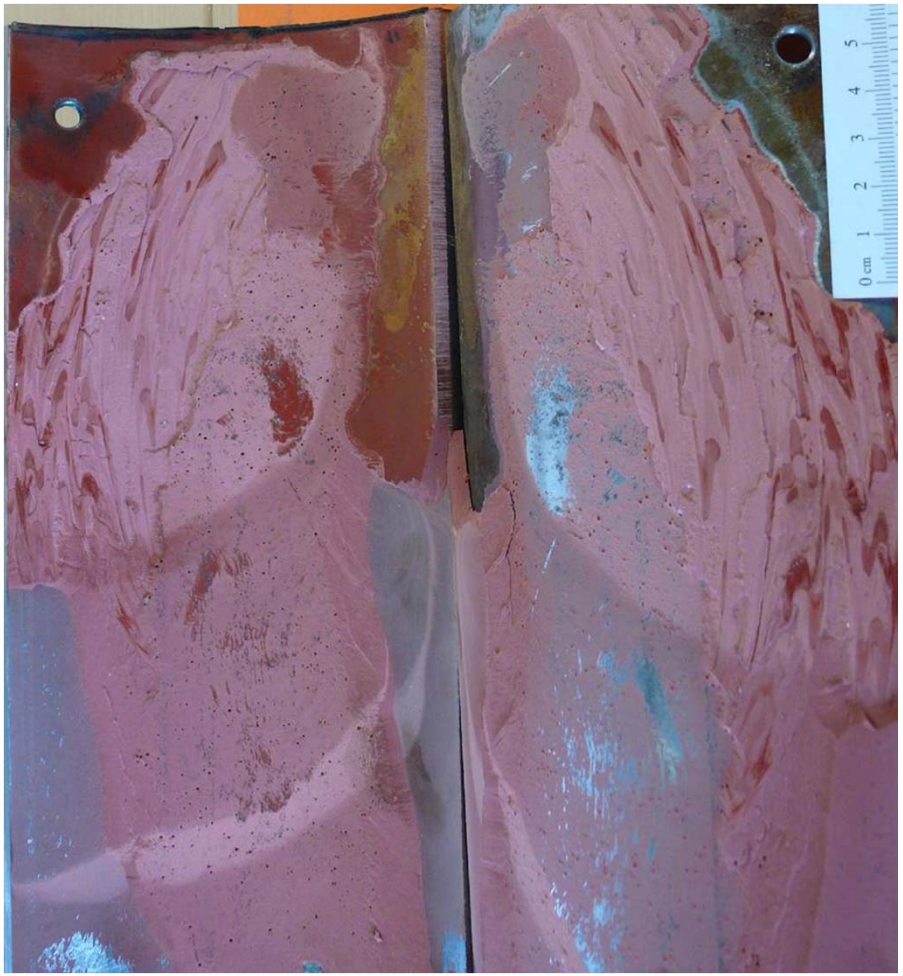
test 2: no leak at 300 bar

Results:

- Damages forced by water are not the same compared to damages at pipes
- Pressure higher as 300 bar was possible
- No „scalpel effect“

Not cured areas





Bad mixture of the two components

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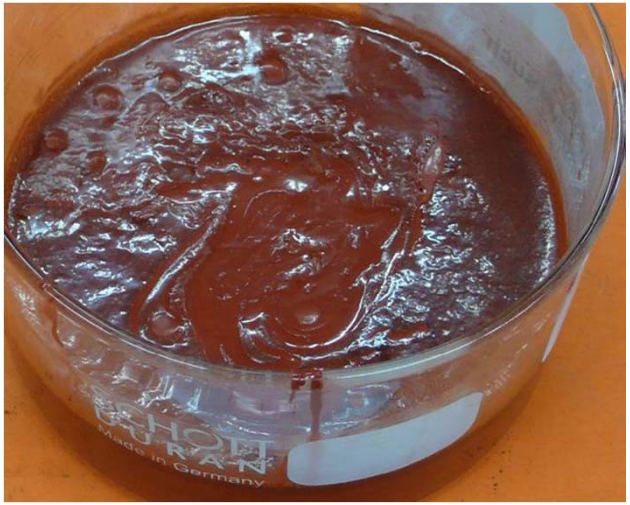
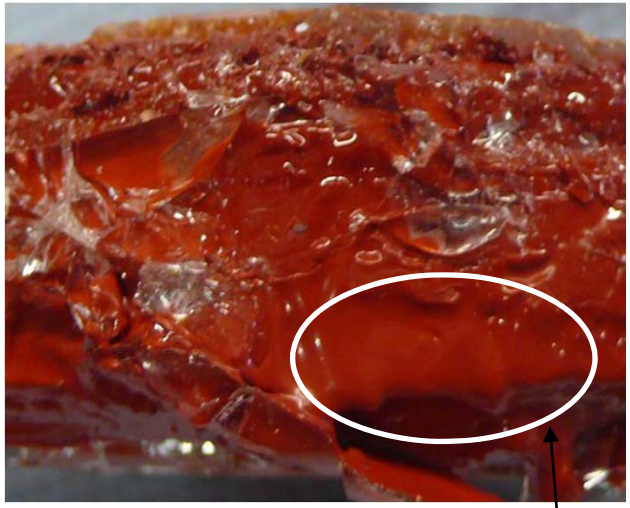


mixture after 1 day

mixture after 6 days

liquid Isocyanides



mixture after 2 weeks

liquid Polyol

Results:

- After 1 day: building of a hard surface
- After 6 day: liquid isocyanides is leaking out of the surface
- After 2 weeks:
  - Removing of the glass
  - Polyol next to the glass still liquid
  - Liquid isocyanides is crystalline