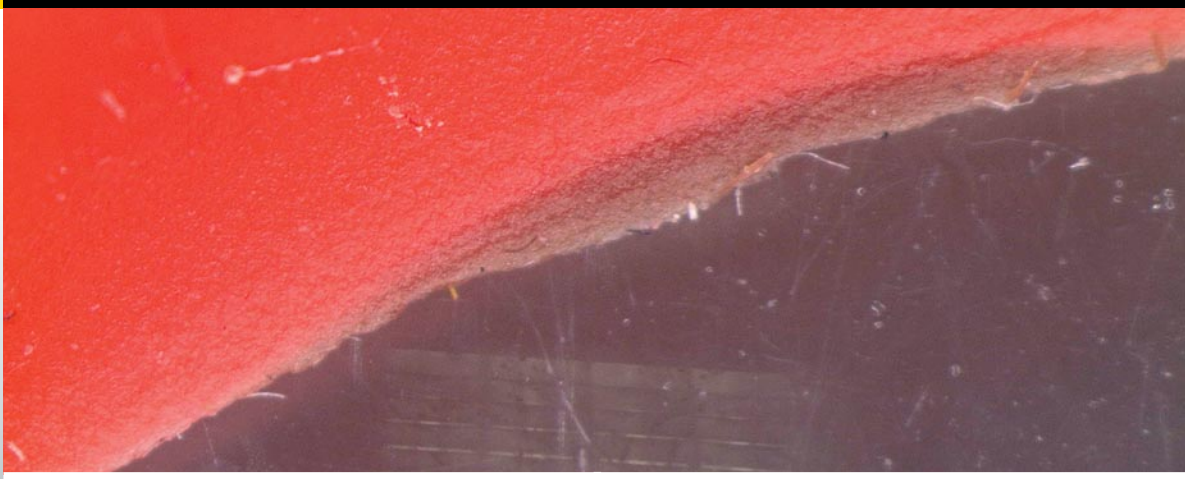

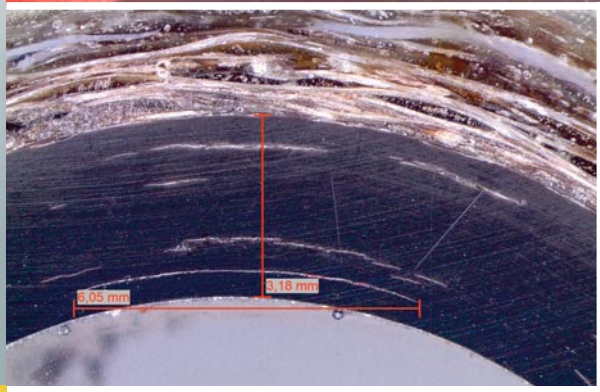

Chemelot Campus 007.1.015
Urmonderbaan 22
6167 RD Geleen
The Netherlands

Postbus 18
6160 MD Geleen
The Netherlands

T +31 (0)46 763 04 05
E info@nikk.nu

Case History

Subject:
Leakage of a PVC/FRP pipe for 96% H_2SO_4 at ambient temperature

Target:
Investigation of the chemical attack of the liner and the FRP aiming at the cause of the crack formation.

Investigations:
FT-IR, microscopy, DSC

Description:
In the installation are PVC/FRP pipes DN32 with different failures. From outside a dark discoloration could be seen due to the reaction of sulfuric acid with the FRP. At one end directly at the edge of the flange the pipe is cracked.

Evaluation:

PVC is not chemical resistant against high concentrated sulfuric acid also at ambient temperature. Due to the equilibrium reaction of sulfuric acid always SO_3 in different quantities is formed which is a very aggressive and oxidizing gas. Due to the reaction of sulfuric acid the PVC structure is complete destroyed (black/dark color). It remains a material with very brittle properties. In case of almost a small mechanical stress cracks can occur. At the edge of the flange is a transition from a stiff material (FRP) to a softer material (PVC). This implies an increase in stress at the transition zone and by means of a mechanical force the flange breaks.

Recommendation:
For very high concentrated sulfuric acid PVC-U is not the best choice. It should be better to choose E-CTFE as liner material in combination with FRP out of Novolak-Vinylester. The E-CTFE liner is more resistant and less brittle in comparison to PVC.