

## ALPHARESIST\*

### New generation of plastic piping material for the chloralkali process

\*Made by **ALPHAPLAST, S.L.**, a member of the **STEULER group**

Euro Chlor 10<sup>th</sup> International Chlorine Technology Conference & Exhibition Berlin, 16 - 18 May 2017

Ralf Troschitz / Albert Hemsch

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## Content

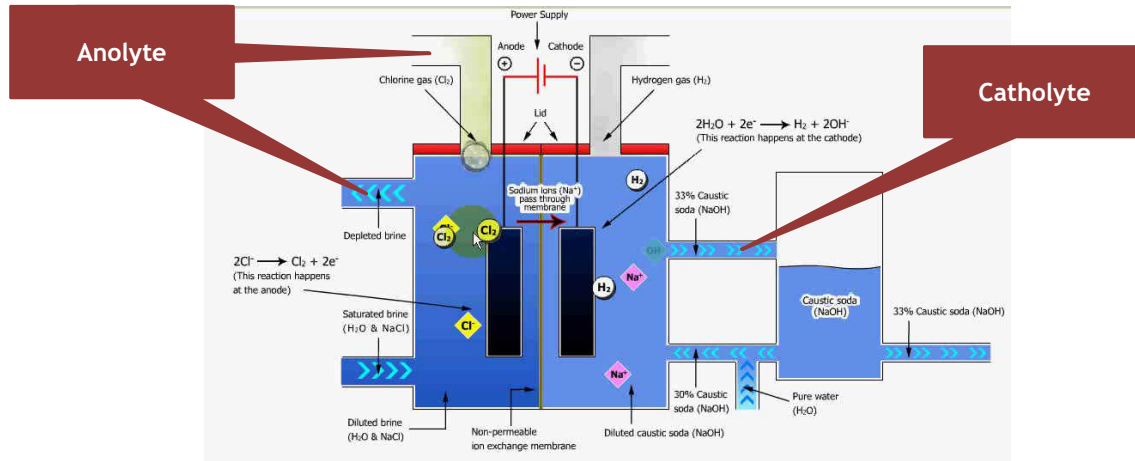
- Motivation
- Idea
- System
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- Summary



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## The membrane cell process with high-maintenance piping



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# Anolyte piping

- Typical loads
  - $\approx 17\% \text{ NaCl}$ ,  $\leq 1\% \text{ Na}_2\text{SO}_4$ ,  $\leq 1\% \text{ NaClO}_3$ ,  $\text{Cl}_2$  saturated
  - $\text{TS} \approx 85 - 95\text{ }^\circ\text{C}$ ;  $\text{PS} \approx 0.2 \text{ barg} - 3 \text{ barg}$ ;  $\text{pH} \approx 1.5 - 5$  (max. 12)
- Material systems
  - CPVC/FRP
    - Chemical resistance extremely dependent on pH-value ( $\text{pH} \geq 3 \rightarrow \text{HOCl} \rightarrow$  fast destruction)
  - FRP with corrosion resistance barrier (CRB) (Glass content<sub>CRB</sub>  $\leq 30\%$ ) or FRP with overall low glass content
    - Chemical attack dependent on load and
      - Resin type (VIAPAL UP 797, DERAKANE MOMENTUM 470, DERAKANE 510 N etc.)
      - curing agents
      - glass content  $\rightarrow$  glass is not resistant
    - Quantity of attack  $\approx 0.3$  to  $1 \text{ mm/a}$
    - Obstruction of the cell membrane and the piping with worn out glass fibres



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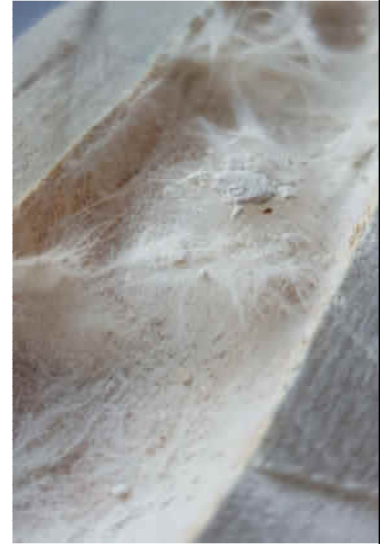
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# Anolyte piping - glass fibre removal



## Examples of annually attack:

- Length of Pipe: 50 m
- Glass content of CRB: 30 %
- Annual chemical abrasion: 0.5 mm/a
- Density: 1.6 kg/dm<sup>3</sup>



Nominal diameter	Surface	Volume	Removal	
			FRP	Glass
DN 50	7.85 m <sup>2</sup>	3.93 dm <sup>3</sup>	6283 g	1885 g
DN 80	12.57 m <sup>2</sup>	6.28 dm <sup>3</sup>	10053 g	3016 g
DN 100	15.71 m <sup>2</sup>	7.85 dm <sup>3</sup>	12566 g	3770 g
DN 150	23.56 m <sup>2</sup>	11.78 dm <sup>3</sup>	18850 g	5655 g
DN 200	31.42 m <sup>2</sup>	15.71 dm <sup>3</sup>	25133 g	7540 g
DN 400	62.83 m <sup>2</sup>	31.42 dm <sup>3</sup>	50265 g	15080 g

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# Idea -> System for anolyte piping



Development of an adapted FRP system  
without **glass fibres** in the CRB  
and  
reduced attack  
to the piping!



**Solution**

CRB	Resin	VE-NK- or UP-HET-type
	“Reinforcement”	Instead of <b>glass fibres</b> use of inert mineral powder
Structural laminate	Resin	VE-NK- or UP-HET-type
	Reinforcement	Glass fibre
Type name		Alpharesist-A

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## Lab-testing @ Alphaplast in Spain



### Specimen preparation

- Sheet
  - Pipe
- with different
- Resins
  - Curing systems / hardener
  - Fillers
    - Type
    - Content



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## Catholyte piping



Standard material: PPH 2222/36/FRP material system

- Typical loads
  - 32 % NaOH,  $\leq 20$  ppm NaClO<sub>3</sub>
  - TS  $\approx 85 - 95$  °C
  - PS < 1.5 barg
- Decomposition of PP-stabilisers results in
  - Stress cracking of welds!
  - Caustic glass corrosion!
- Different coefficients of thermal expansion

Starts and shutdowns results in debonding of lining



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## Idea -> System for catholyte piping



Development of an adapted FRP system  
without **glass fibres** in the CRB  
and  
reduced attack  
to the piping!



### Solution

CRB	Resin "Reinforcement"	Epoxy-type Instead of <b>glass fibres</b> use of inert mineral powder
Structural laminate	Resin	Epoxy-type
	Reinforcement	Glass fibre
	Type name	Alpharesist-K

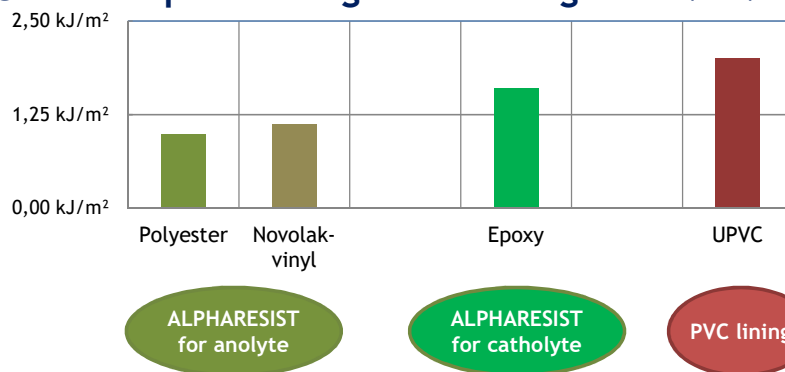
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## Lab-testing - impact properties



### CHARPY impact strength according to DIN EN 179-1



Impact strength of ALPHARESIST CRB  
with a filler content of 30 % is slightly lower than that of PVC

-> Check of ultimate elongation

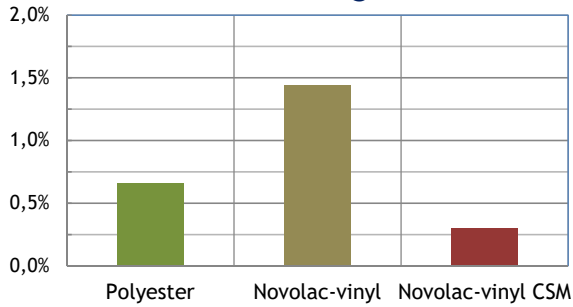


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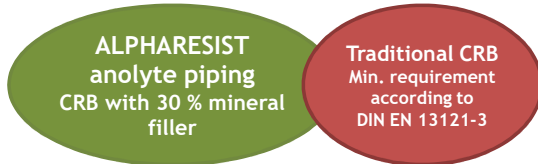
## Lab-testing - Ultimate elongation

### Design strain for Alpharesist anolyte piping determined with bending tests



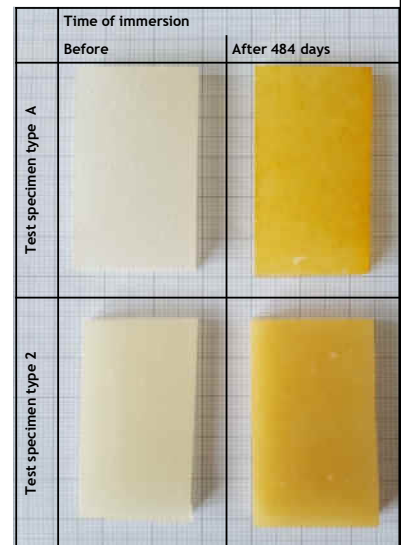
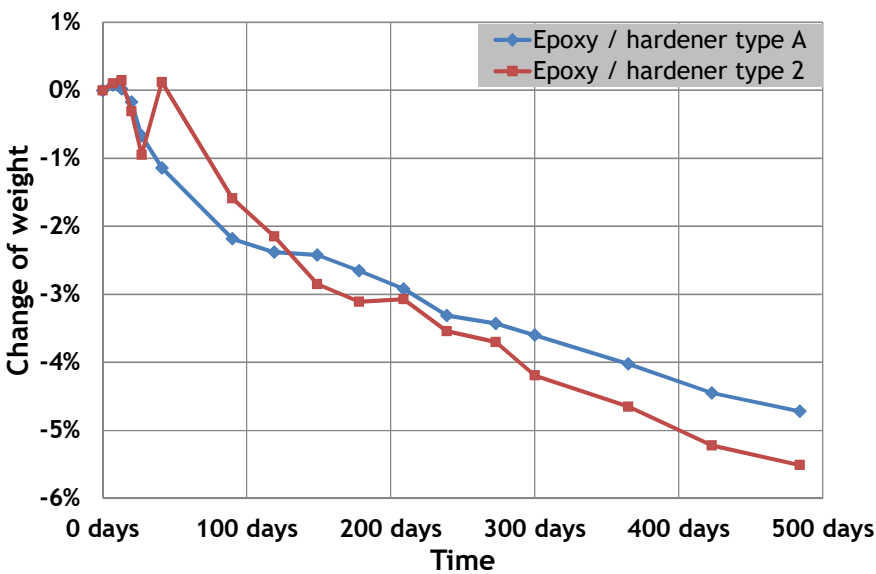
Catholyte piping with epoxy resin shows higher ultimate strain

-> Requirement of design strain fulfilled by material system



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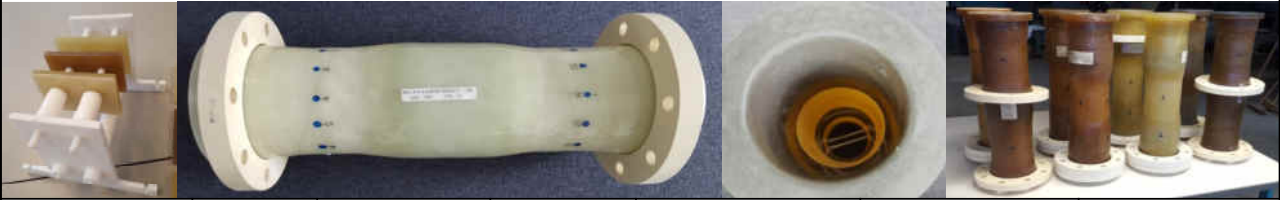
## Lab-testing of Alpharesist-K Immersion to 32 % NaOH @ 100 °C



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# First field tests of Alpharesist

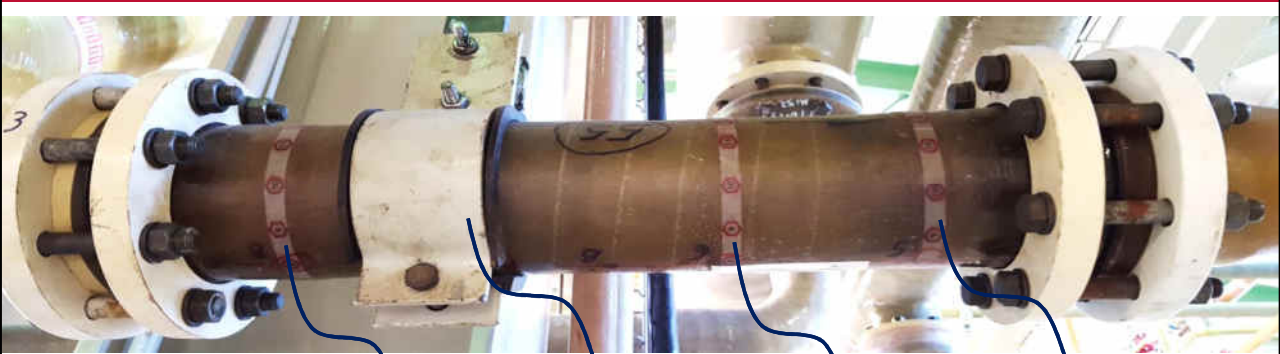


Test piece	Load	Material	Resin	Filler	Location of electrolysis	Duration
Flanged pipe DN 100 x 600	Anolyte	Alpharesist-A	VE-NK, UP-HET	Two different types	Germany	Since April 2016
Flanged pipe DN 150 x 1000	Catholyte	Alpharesist-K	Epoxy	Ceramic	Middle East	Coming soon
Bypass piping DN 150 x 6000	Catholyte	Alpharesist-K	Epoxy	Ceramic	Germany	Since May 2017
Piping isometric DN 80	Anolyte	Alpharesist-A	VE-NK	Ceramic	Middle east	Upcoming
Piping isometric DN 100	Catholyte	Alpharesist-K	EP	Ceramic	Middle east	Upcoming
4 flanged pipes DN 100 x 600	Anolyte	Alpharesist-A	VE-NK UP-HET	Two types	Germany	Since May 2017

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# Field test of Alpharesist-A in a anolyte piping



Pipe	Load	Material	Resin	Filler	Location	Duration	Remarks
DN 100 x 600	Anolyte	Alpharesist-A	VE-NK, UP-HET	Two different types	Germany	Since April 2016	No anomalies @ inspection May 2017

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### ALPHARESIST\*

- Anolyte piping
  - Glass-fibre free chemical protection layer based on special polyester or vinyl ester resin
  - No contamination or blockage from removed glass fibres
  - Optimized maintenance intervals
- Catholyte piping
  - Glass-fibre free chemical protection layer based on epoxy resin
  - Full fibre-reinforced plastic piping without thermoplastic lining
  - Homogenous material system
  - Easy erection on-site without welding

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### ALPHARESIST\*

## New generation of plastic piping material for the chloralkali process

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“THANK YOU  
FOR YOUR ATTENTION”

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