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High temperature resins and their use in hot flue gas applications

Outline

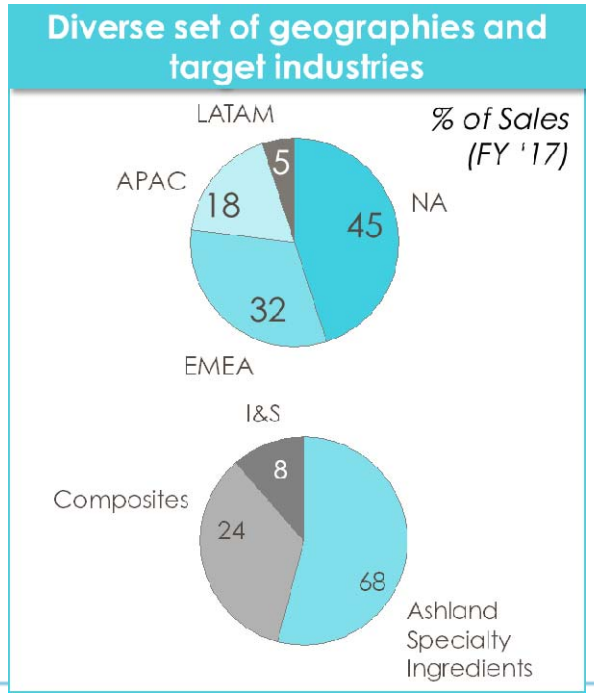
- Companies
- Materials and High Temperature Resistant (HT) Resin
- Case Studies
- Engineering and Fabrication

Introducing
Plasticon Composites

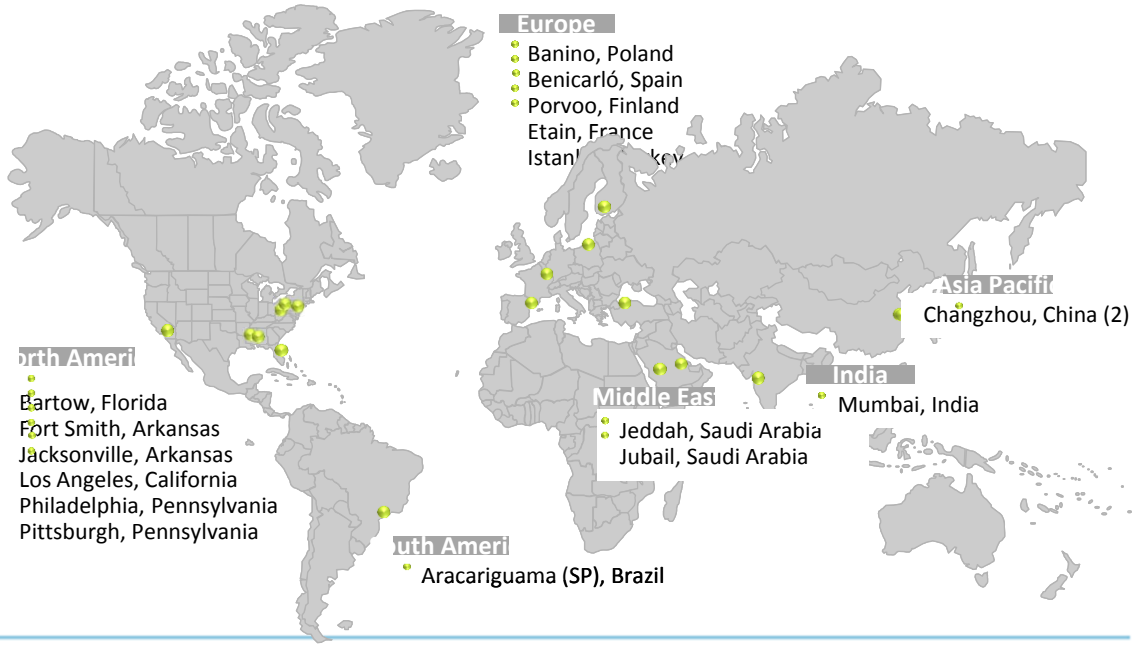
- Headquarter in NL, founded in 1952.
- Worldwide presence, production facilities and sales all over the world.
- More than 700 employees in 16 Production Locations with approx. 80.000 m² size in 13 countries.
- Approx. 1.500.000 hours production capacity per year.
- Capability of 200.000 h/a to do Installation projects.
- 15 stationary and 5 onsite winding machines.

Corporate Profile
Ashland

- Headquartered in Covington, Kentucky, founded 1924
- Specialty Chemicals, sales in over 100 countries
- 6000 Employees, 1100 in Composites
- 41 Production Plants, 16 for Composite Resins
- Revenue: $3.2bn, $770M in Composites



Composite Resin Plants



Why “HT” Resin?

- Fluegases and their condensates etc. can be very corrosive (Chlorides…)
- FRP can even outperform exotic materials such as high nickel alloys
- FRP is cost competitive with stainless steel

HT Novolak Epoxy Vinyl Ester Resin successfully used since 25 years in Quenches, Scrubbers, Ducts and Chimneys

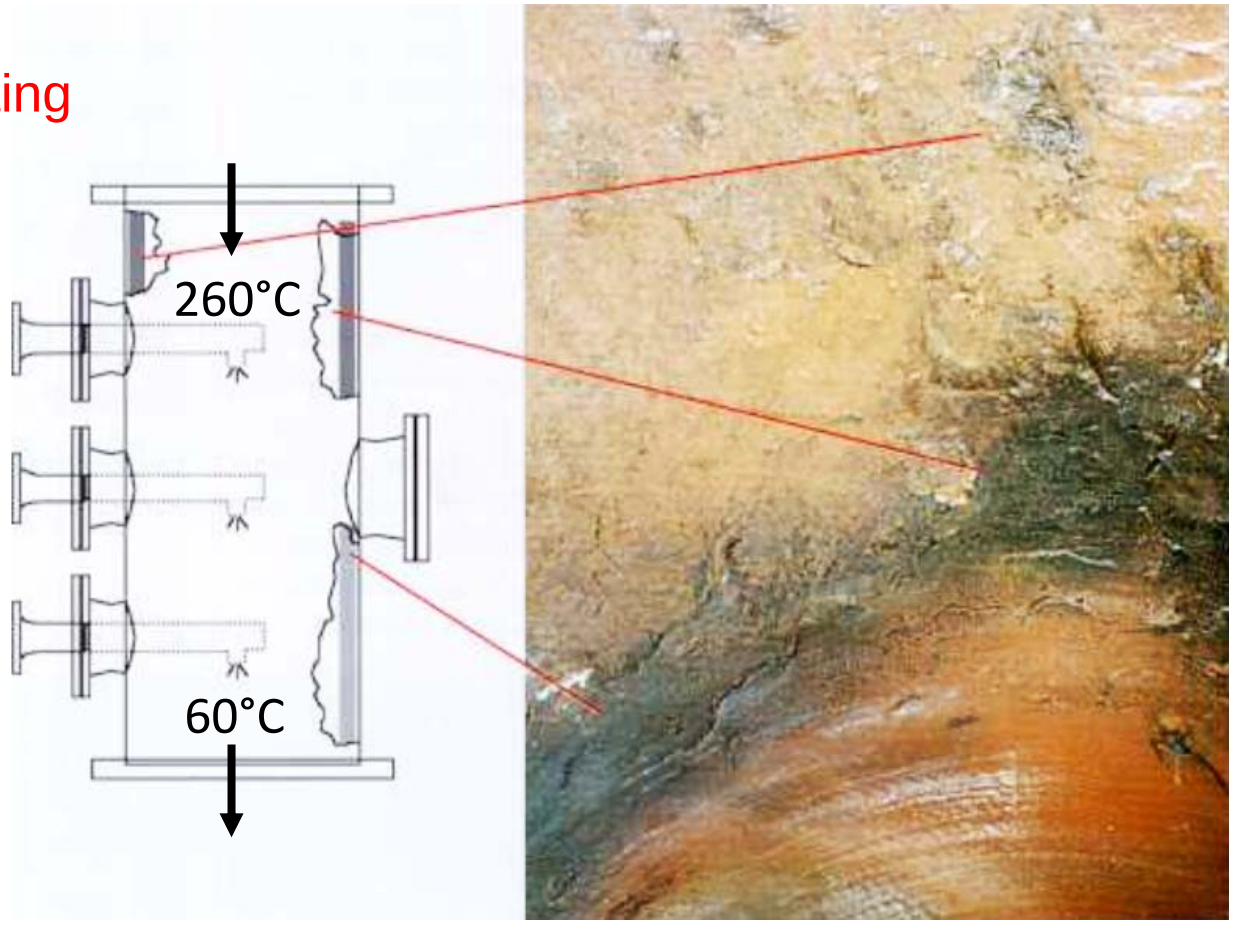
Data Generation

- ✓ Physical Properties
- ✓ Thermal shock and cycling
- ➢ Thermal ageing
- ➢ Upset performance testing

- ✓ Field Experience:

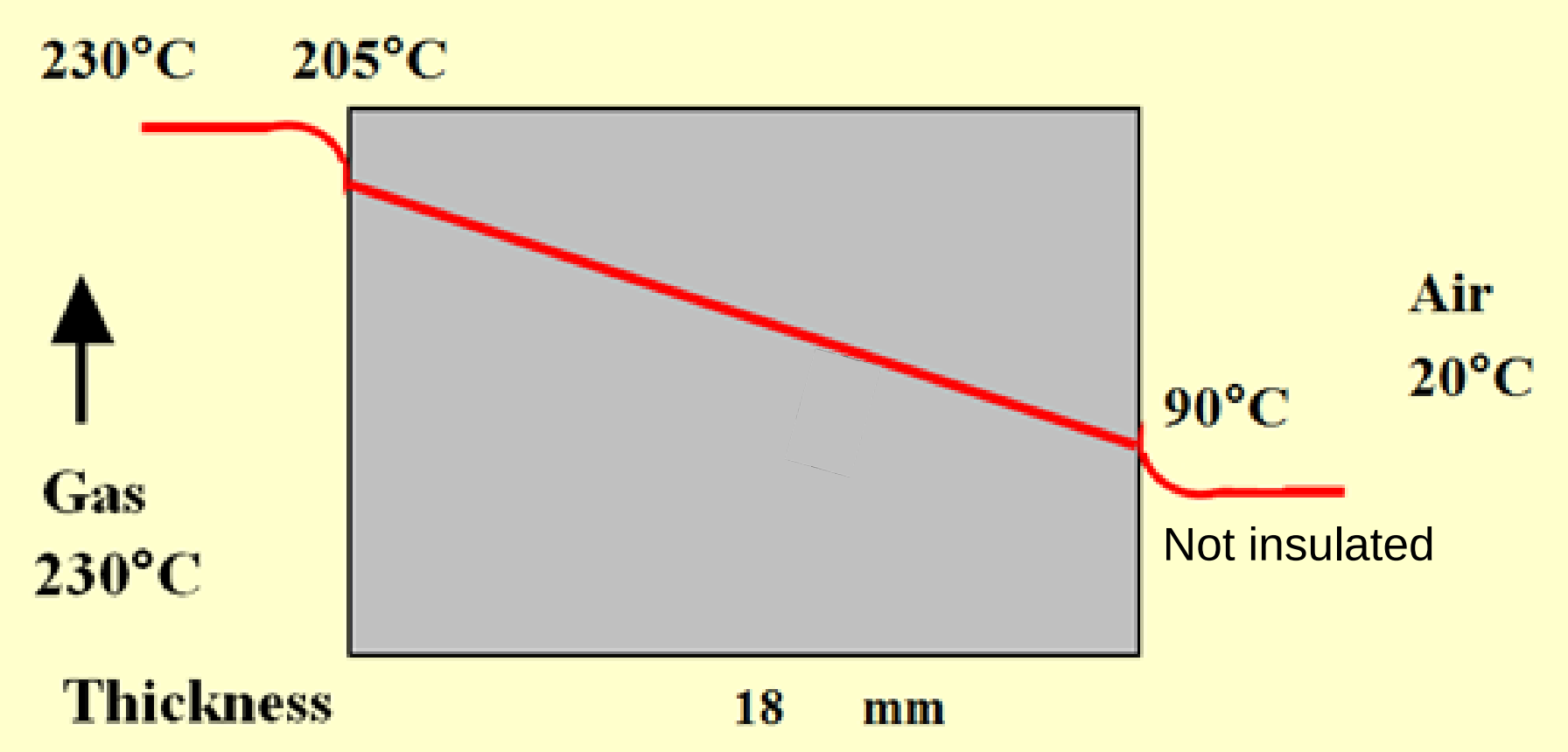
  E.g. Quench with brick lining failure exposing the FRP structure to 260°C for > 1 year.

  Excellent Emergency Running Properties!



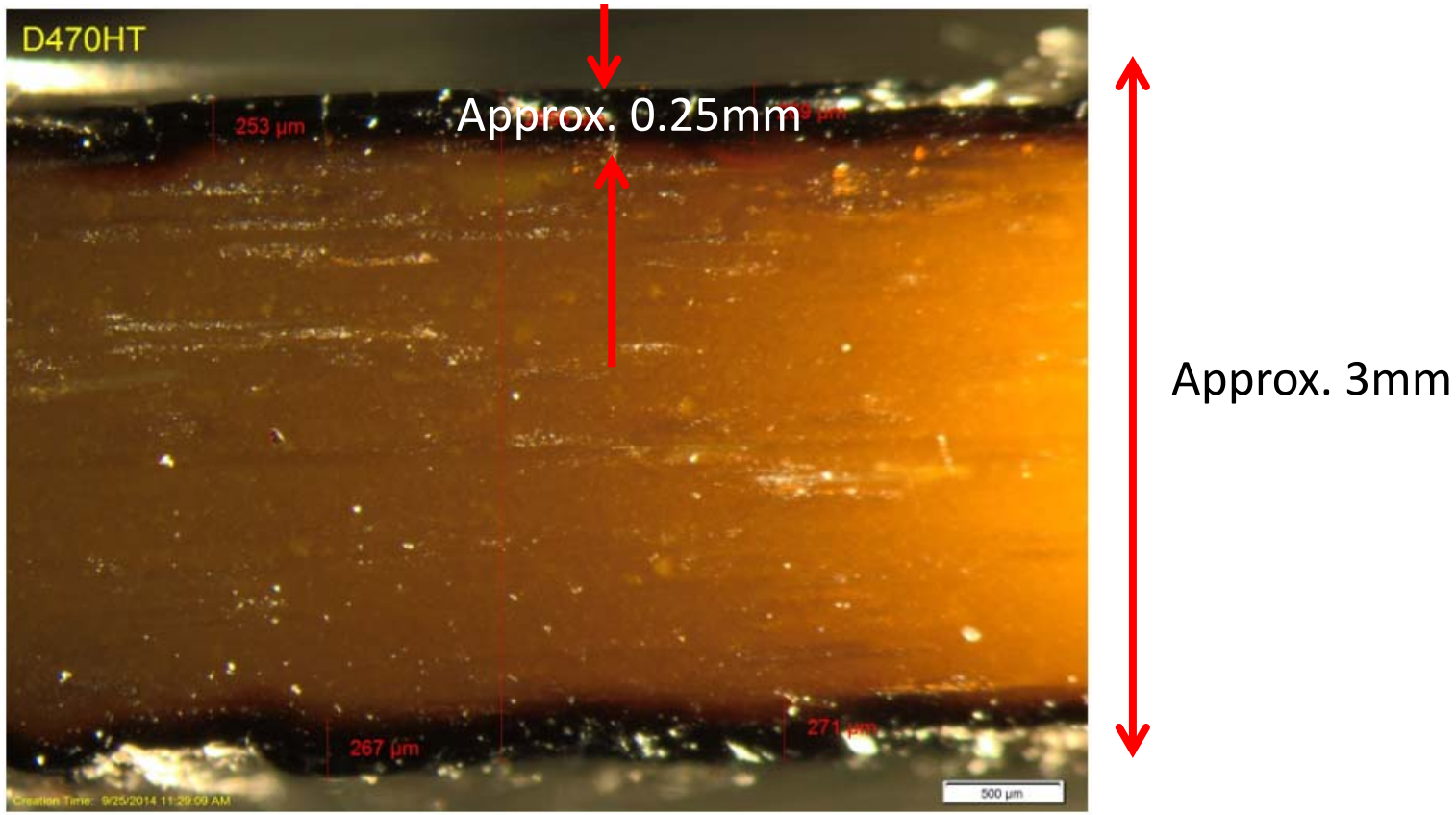
Max. Continuous Fluegas Temperature vs. Insulation

- Not insulated: Max. continuous Fluegas Temperature: ~230°C
- Insulated: Max. continuous Fluegas Temperature: ~200°C

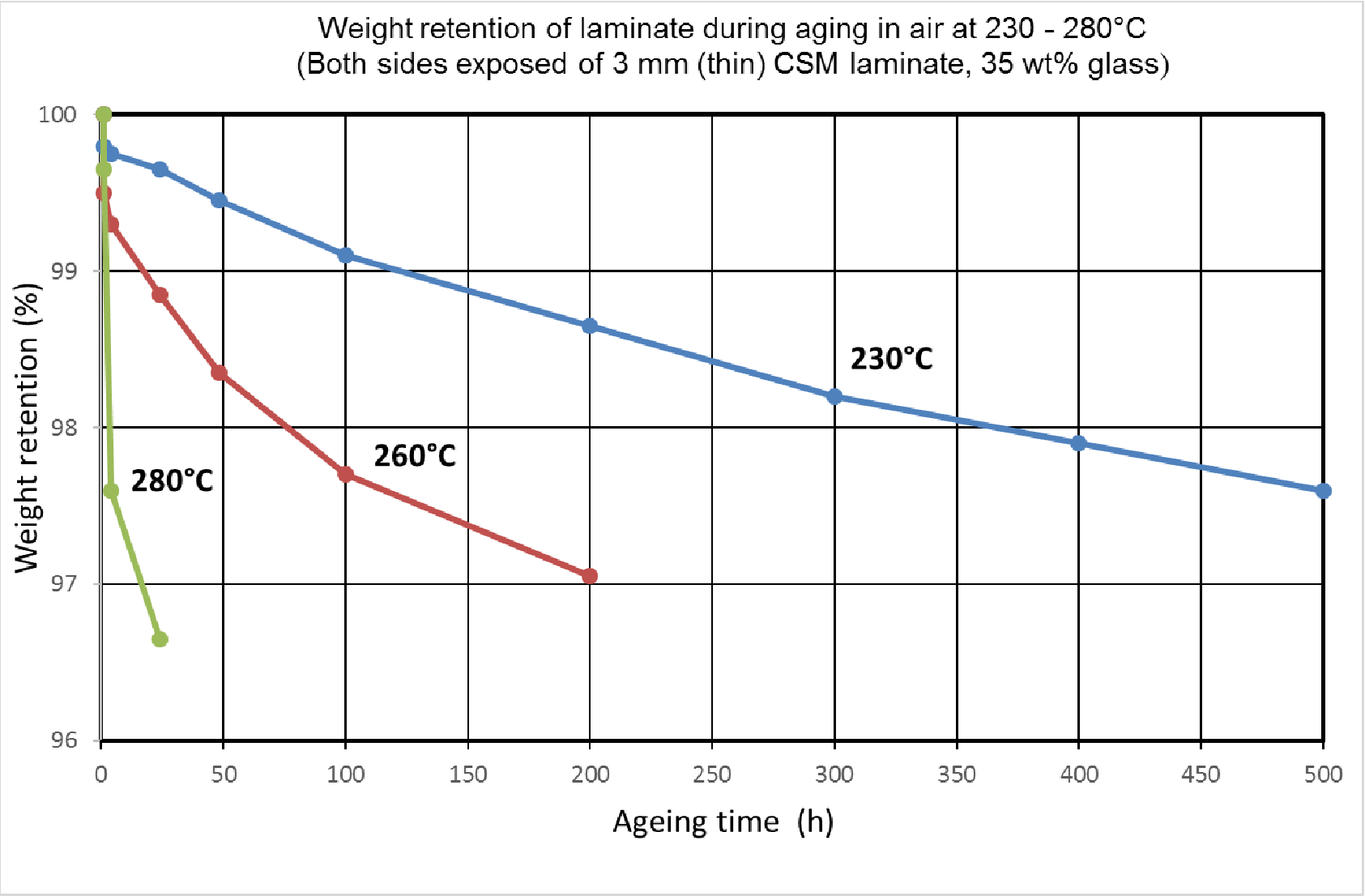


12-month Exposure in Air at 200°C

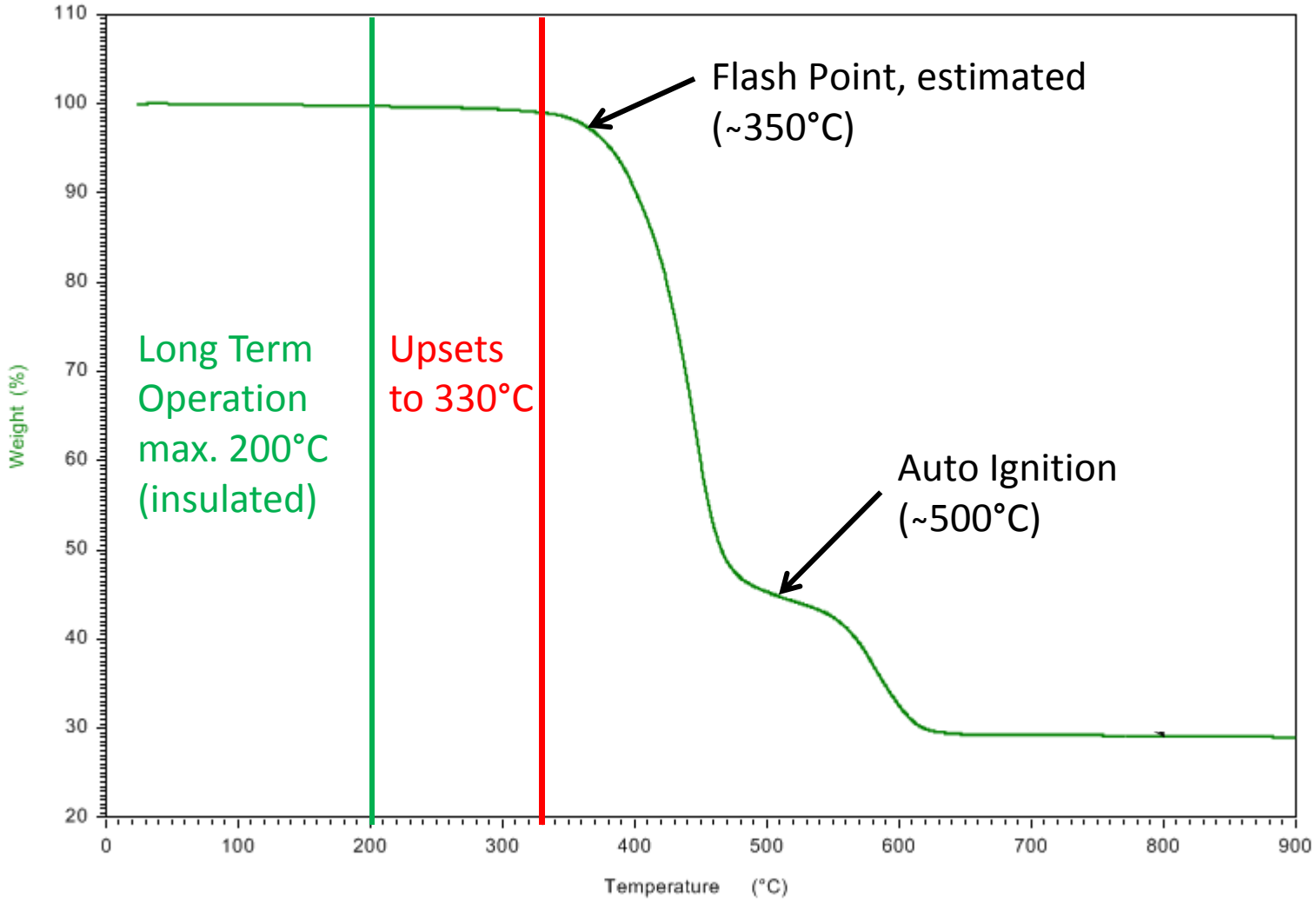
3mm VE-HT resin Laminate after 12 months at 200°C: Approx. 0.25mm of the surface is oxidised, the core looks like new!



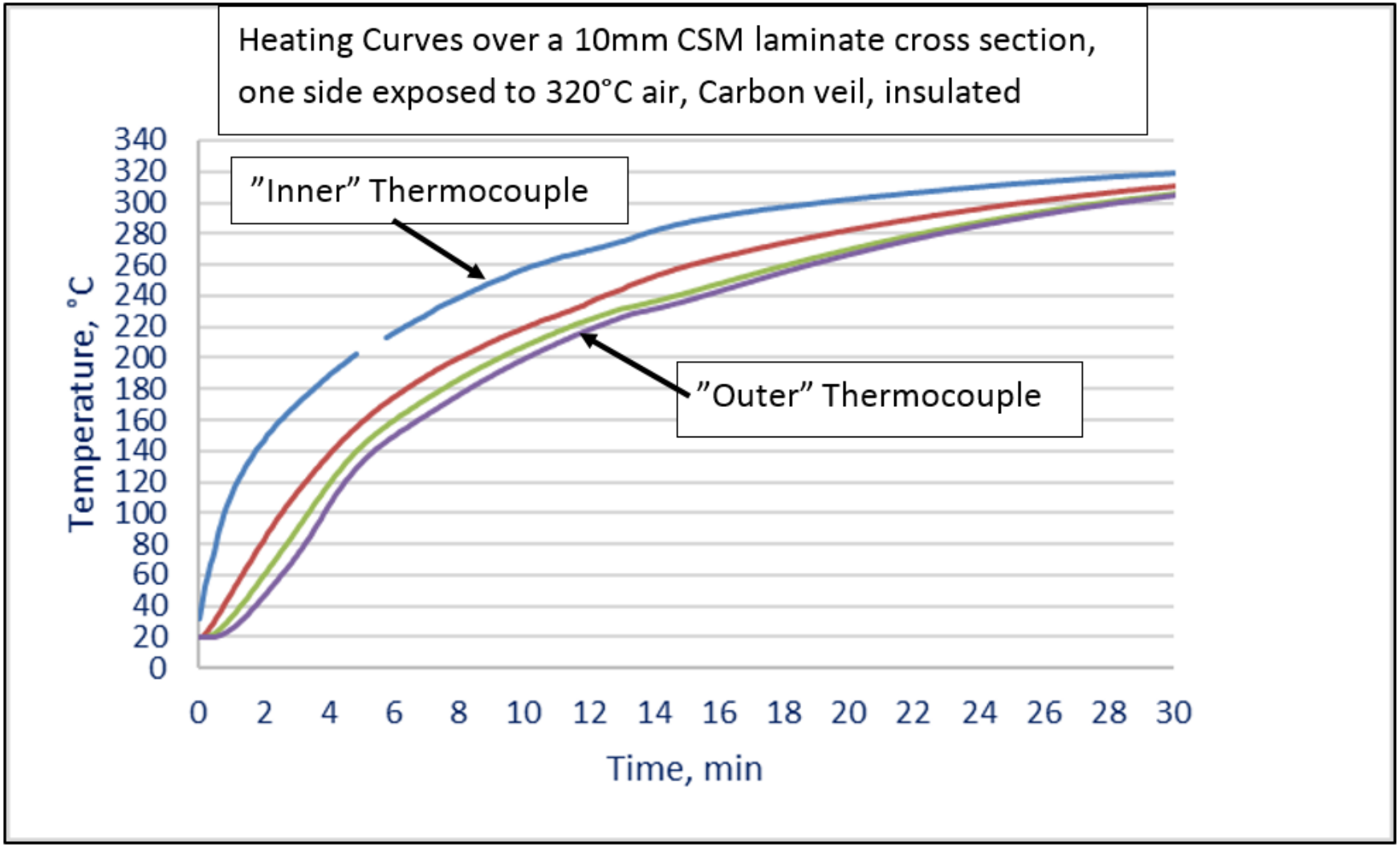
Weight Retention vs. Temperature, 230-280°C



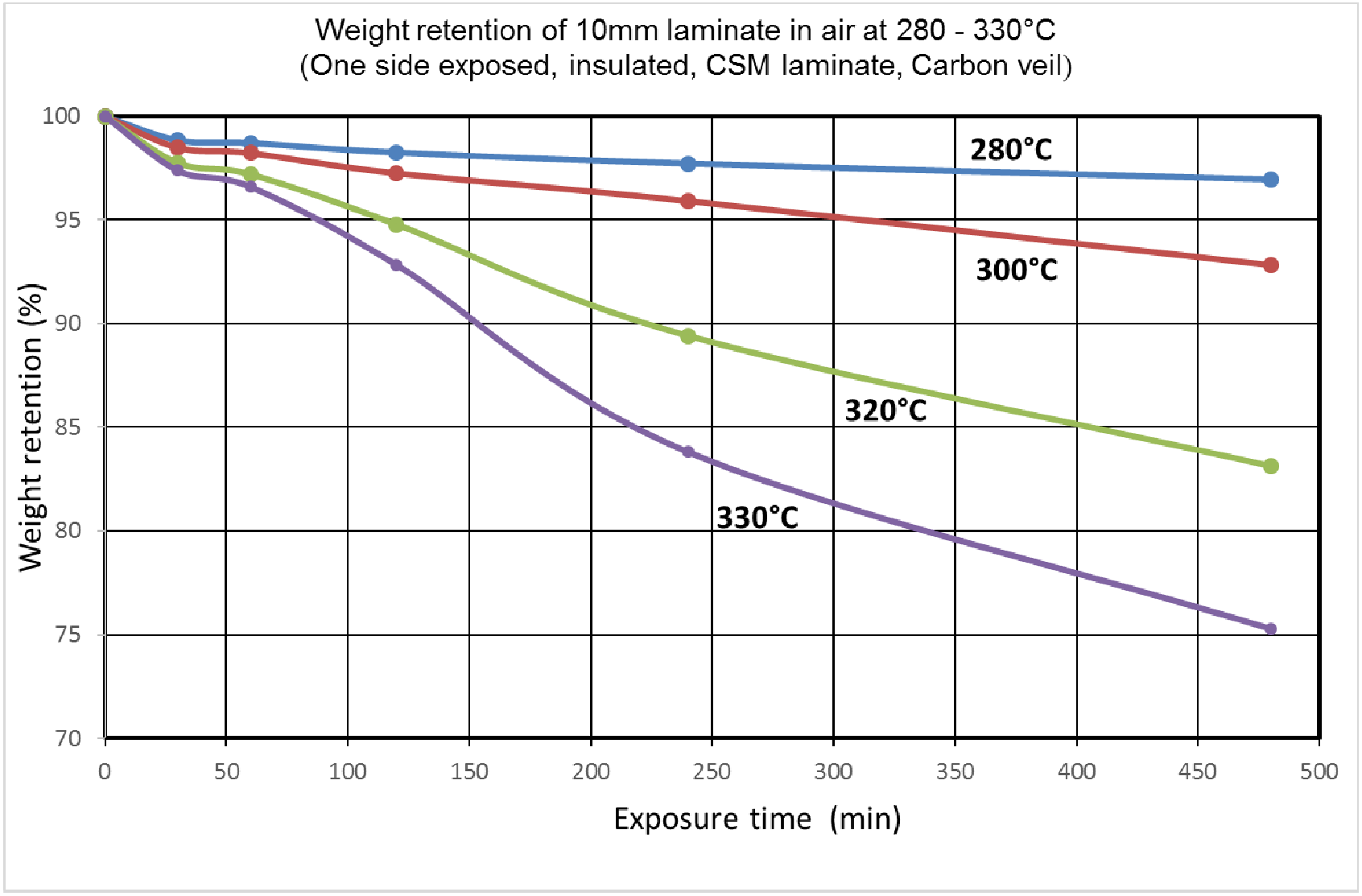
TGA HT Resin, 25-900°C, 40K/min



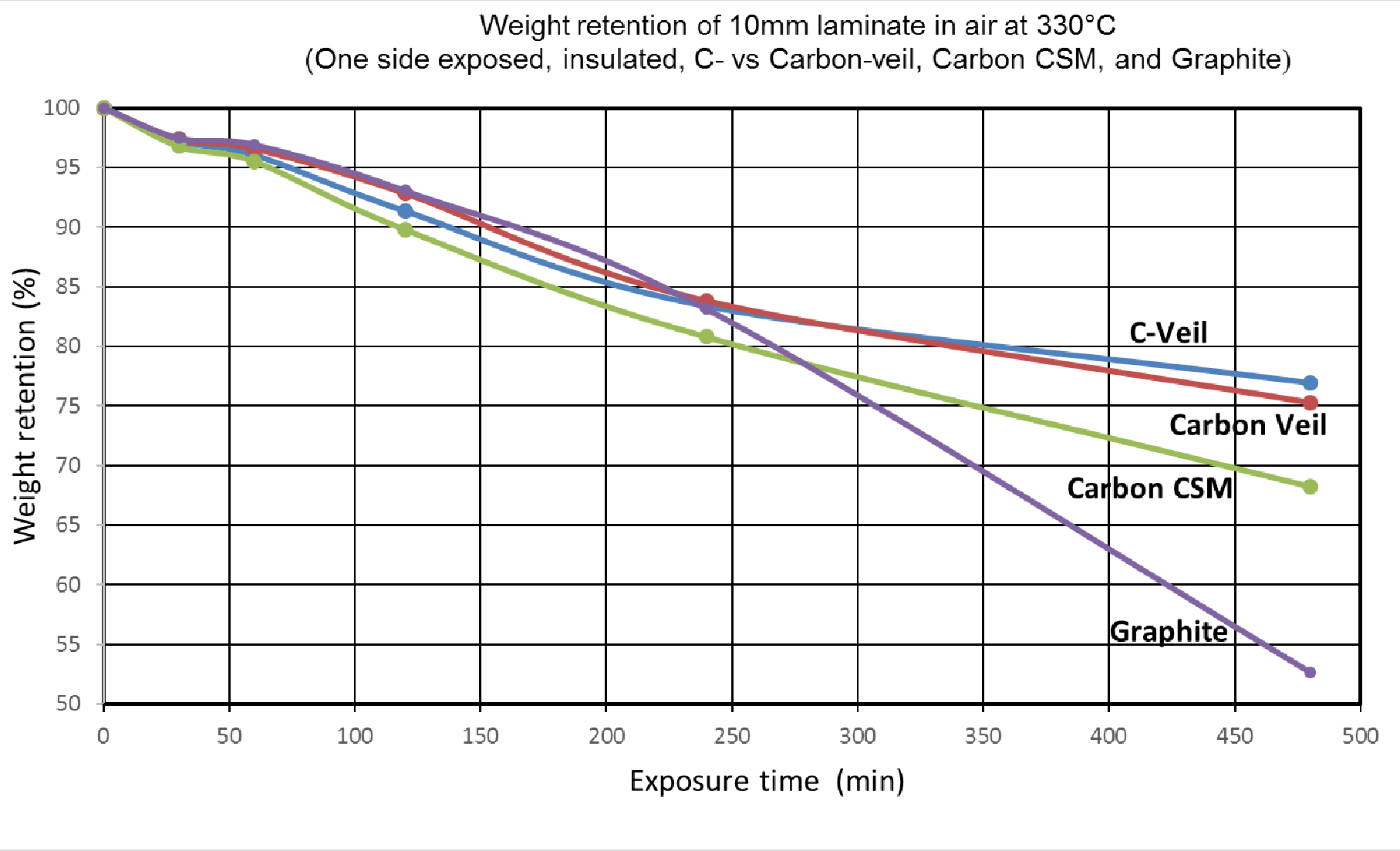
Laminate heat-up to 320°C, 30 min



Weight Retention vs. Temperature, 280-330°C



Weight Retention vs. Concept



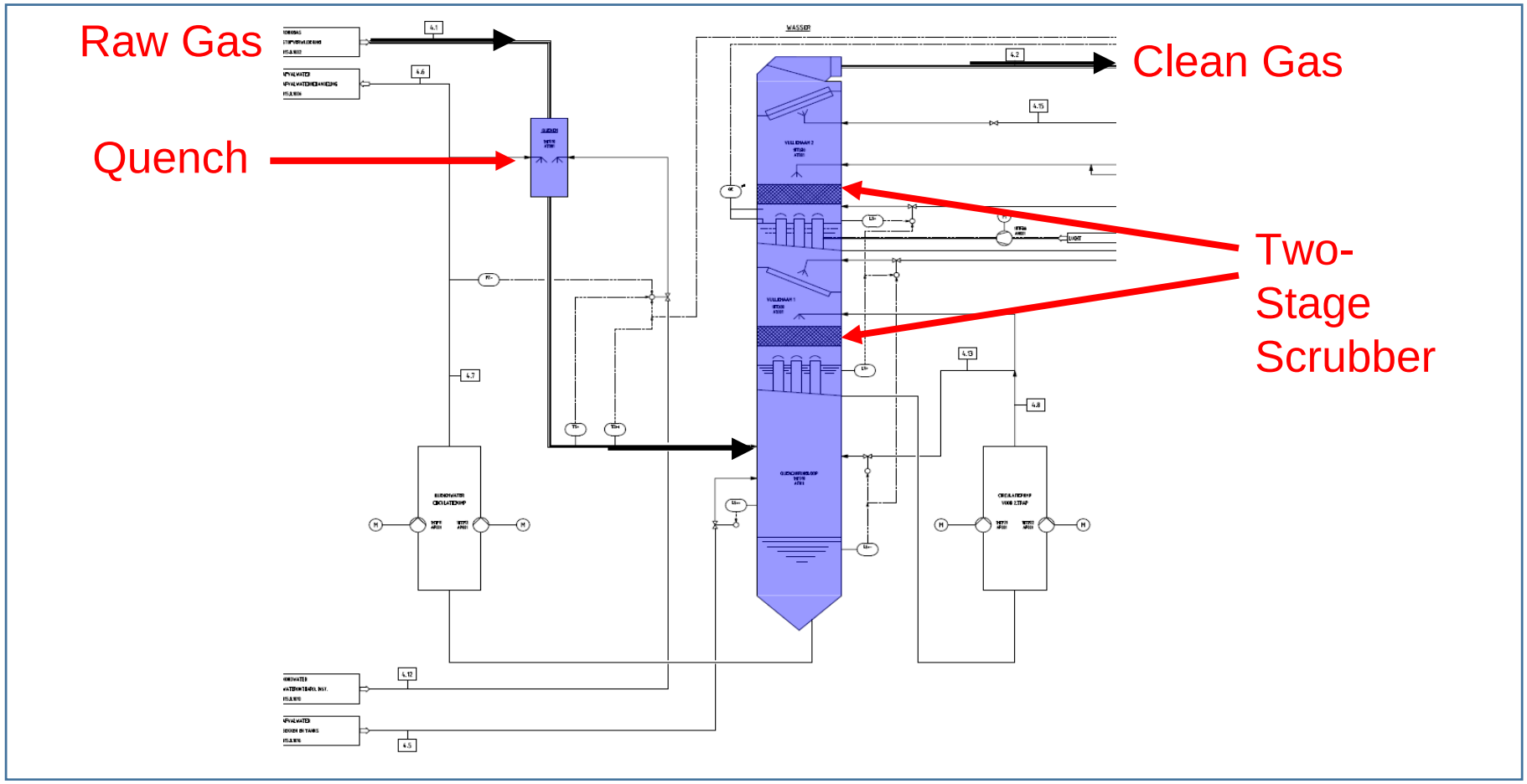
Alkmaar Case Study

- “Waste To Energy” Plant, HVC Alkmaar/NL, 1995
- 1 million tons of waste per year
- 4 trains with FRP quench and scrubber

Alkmaar Case Study

Fluegas Treatment System, HVC Alkmaar:

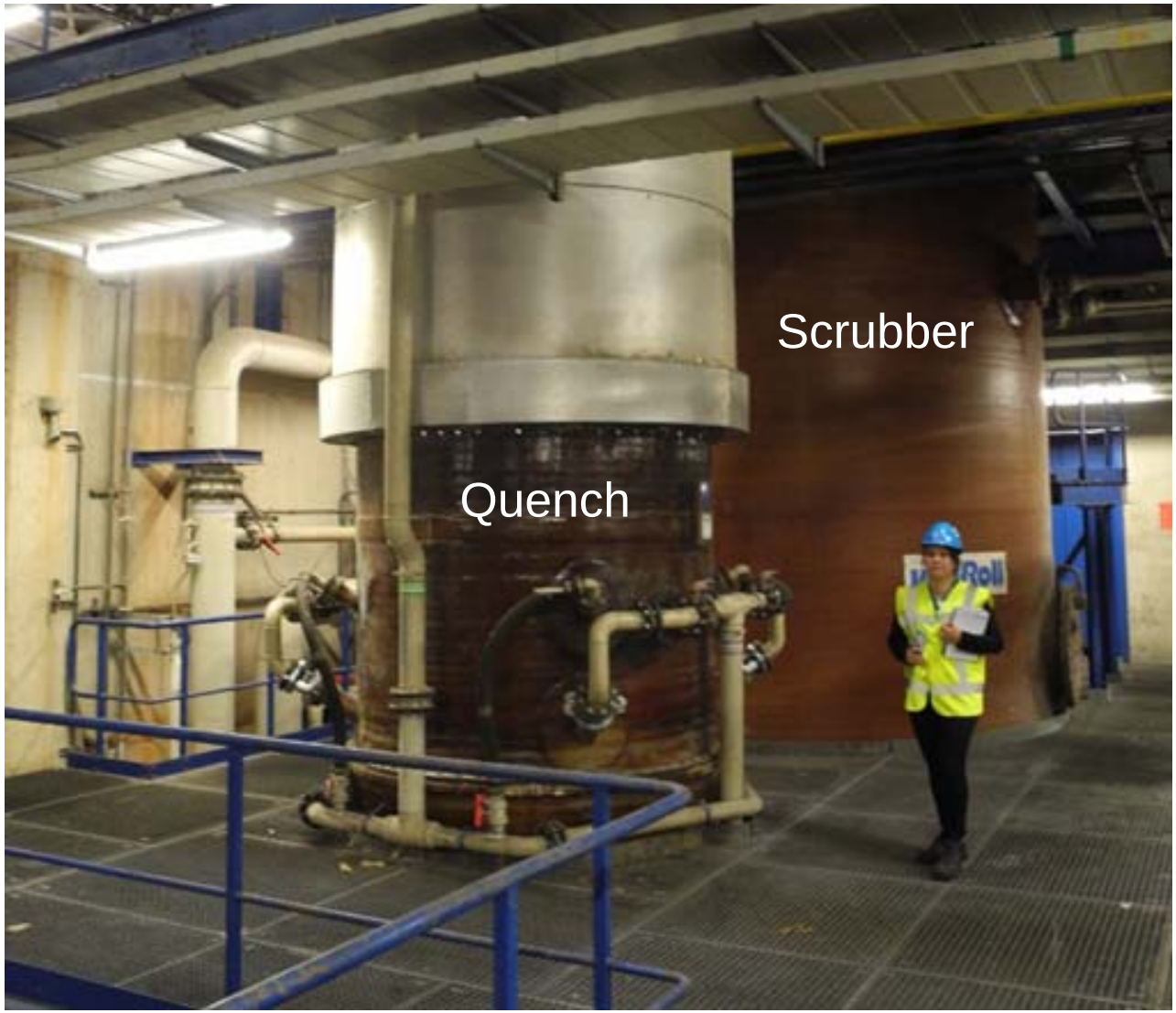
- 4 Quenches, HT resin, designed for max. 230°C
- 4 Scrubbers, two-stage (acid/alkaline), VE resin, designed for 90°C



Alkmaar Case Study

Quench History:

- Flue gas with HCl, HF, SO_2, SO_3, NO_x, dust.
- Service time 1st unit: 1995 – 2008 (average service life = 13 years)
- CR Liner renovation every ~3 years



Quench CR Liner before and after renovation

Recap HT Resin

- FRP based on “HT” resin outperforms conventional materials in hot flue gas applications since 25 years
- The Alkmaar HVC WTE plant is in operation since over 20 years and confirms the superior performance of quenches based on HT resin in flue gas cleaning.
- Data for short and medium term upset conditions have been generated. While several weeks of operation appear feasible at 230°C (insulated), it seems reasonable to limit excursions to 330°C to max. 30 min, followed by an inspection. Higher temperatures are not considered.
- Fillers like e.g. graphite may have a detrimental effect above 300°C. This needs to be further studied.

Chimney Liner

Ducts inside Cooling Tower

Chimneys

Ducts outside Cooling Tower

Storage Tanks

Absorber

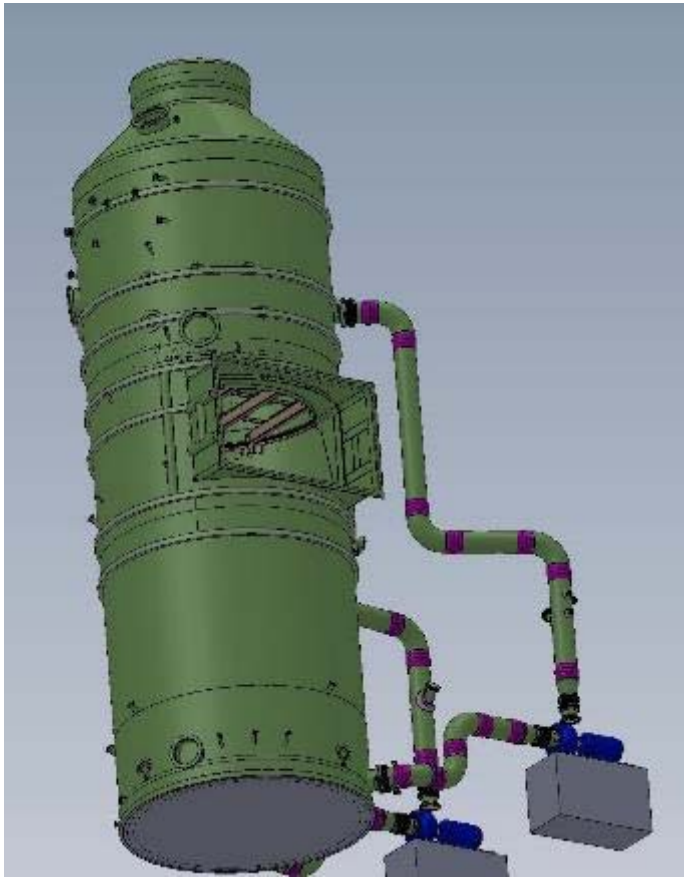
Recirculation pipes

Spray header

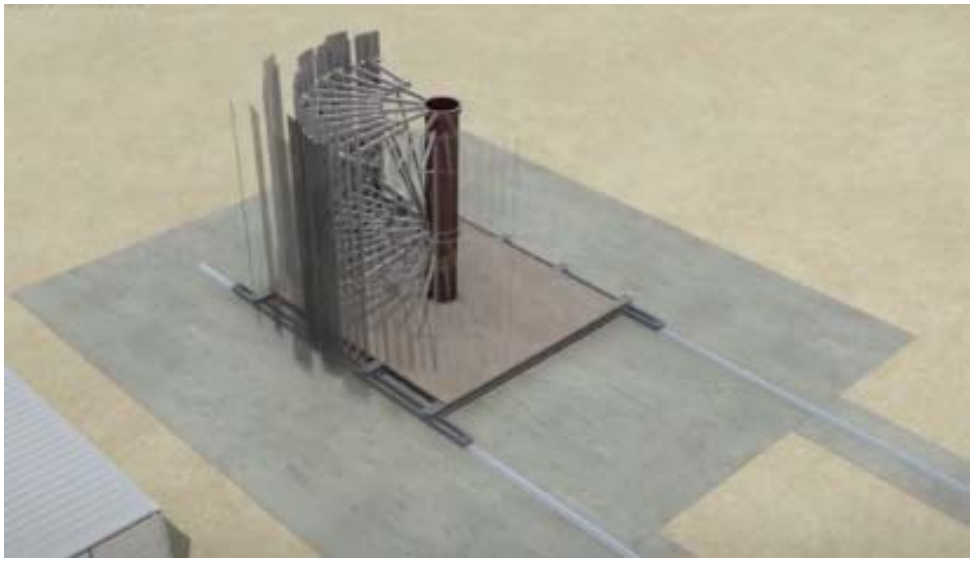
Plasticon Composites always makes a detailed FEM analysis and assessment for the choice of the laminate (Combination and type of Resin and Glass) for major power plant components, to ensure reliability and long term performance of the product considering required loads and combination of loads:

- Medium
- Own weight
- Temperatures

  (Operating under FGD, Malfunction/Bypass)
- Pressure
- Seismic
- Ash load
- Snow load
- Wind
- Connected platforms

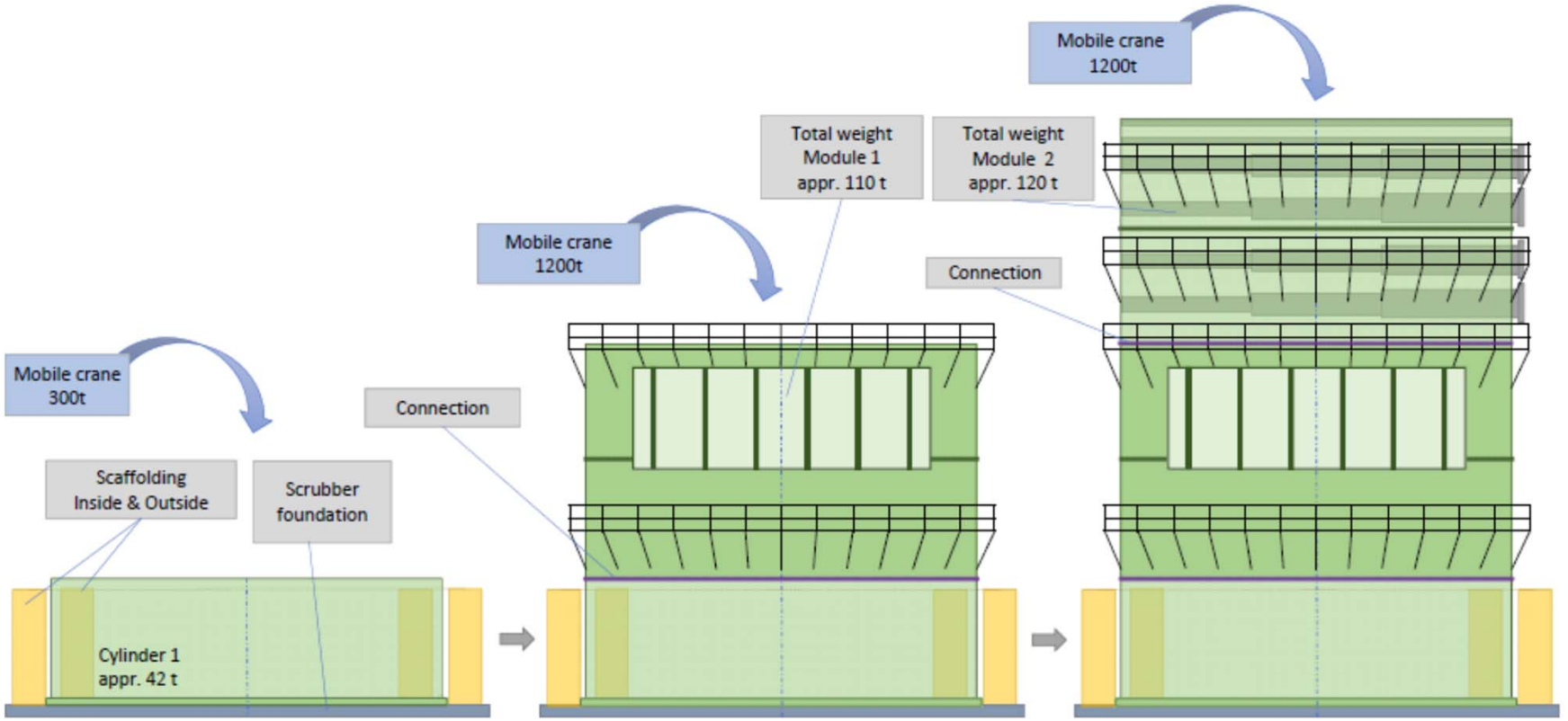


Production / Onsite winding



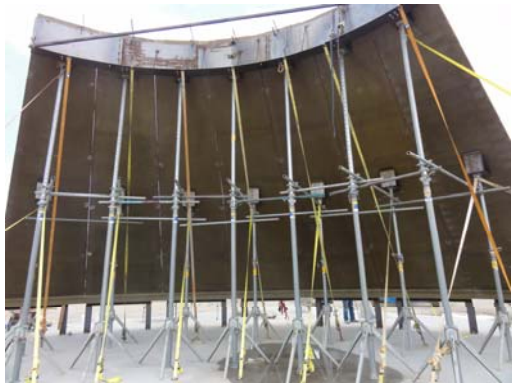
- Installation on concrete foundation, provided by the client.
- Air conditioned double wall tent.
- Winding wagon, movable on rails.
- Mould made of steel or carbon fibre.
- Length of the can 6 or 10 m, and diameter up to 21 m.
- Can ø 8 m and length of 6 m incl. stiffeners = 2 days production

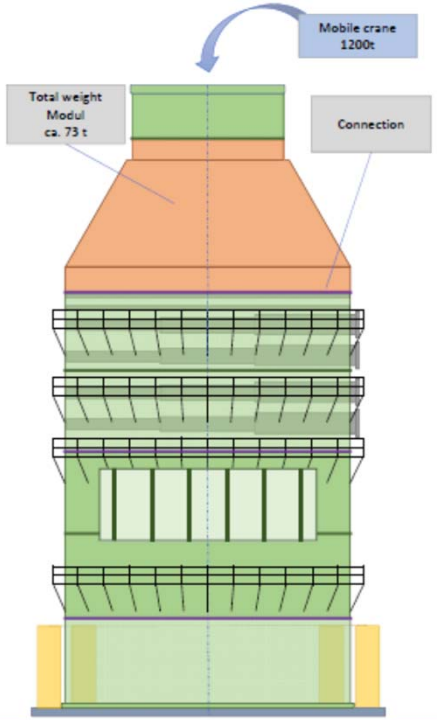
Assembly and installation



- Assembly of single cans to modules incl. internals, pipes and attachments such as platforms and ladders to modules.
- Installation of the bottom made of board material.
- Installation of the modules with mobile cranes.
- Access to the seams with console scaffolds.

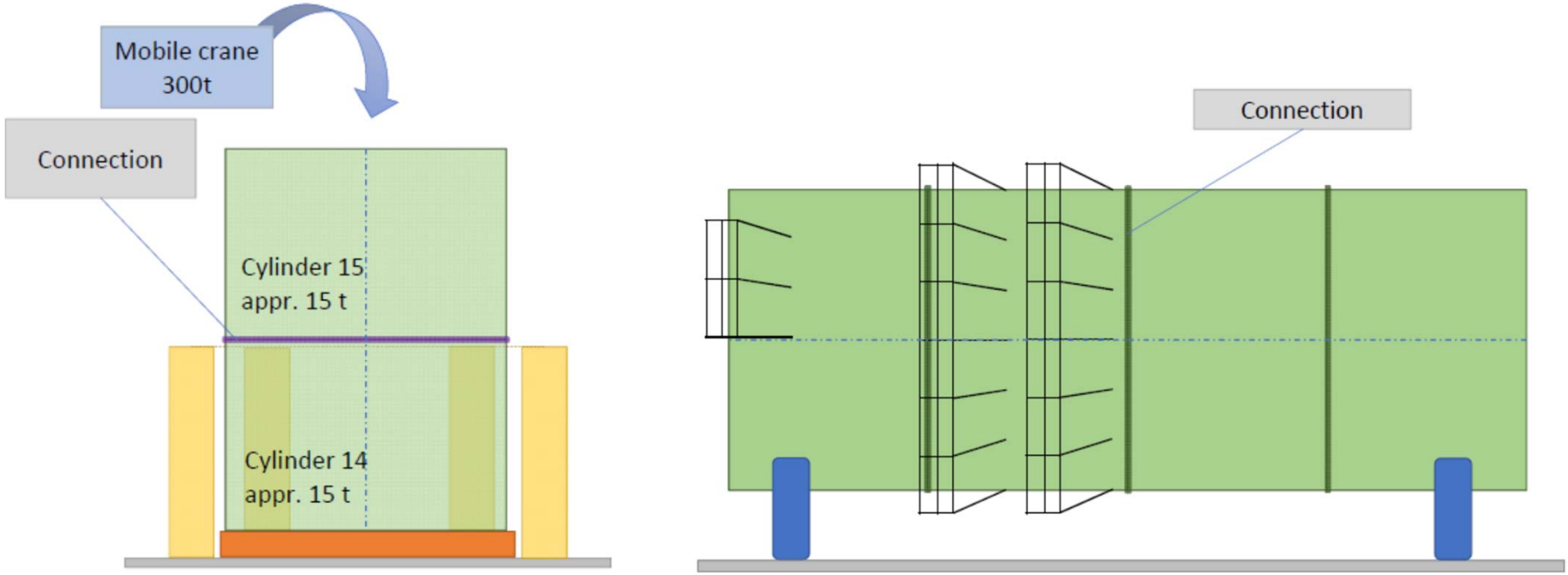
Assembly and installation





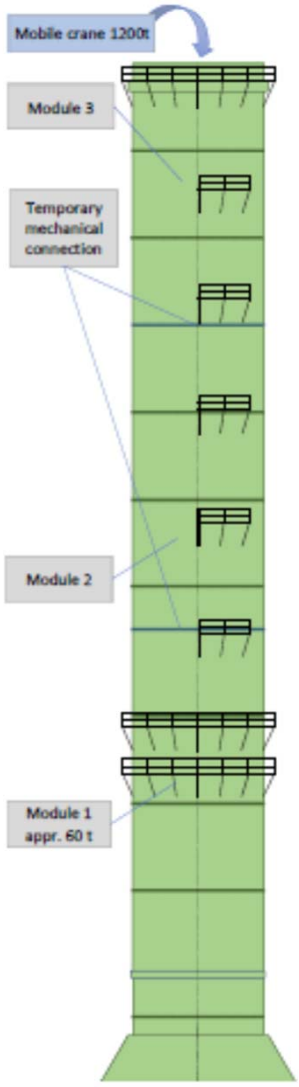
- Assembly of the transition piece and the lowest chimney can.
- Installation of the modules with a mobile crane.
- Access to the seams with console scaffolding.

Assembly and installation



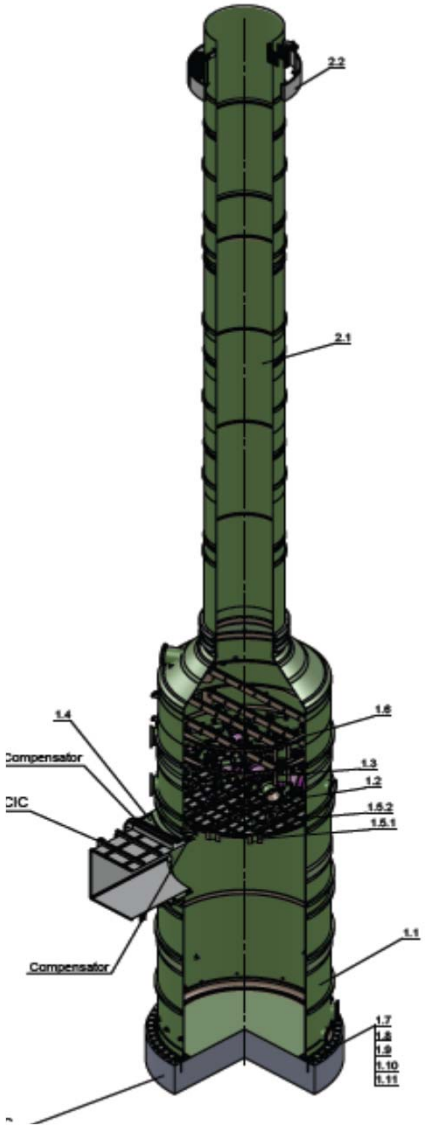
- Assembly of 2 Cylinders in vertical Position.
- Assembly of in each step 2x2 Cylinders in horizontal Position, incl. internals, pipes and attachments such as platforms and ladders to modules.

Assembly and installation



- Installation of the modules with a mobile crane.
- Access to the outer seams with console scaffolds.
- Access to the internal seams with a mobile platform.

References



Project:	Cabot Project
Customer:	Babcock Wilcox
Product:	GRP Absorber including all internals, with self-supporting stack, and FRP holding tank.
Medium:	Clean Flue Gas
Year:	2017
Country:	United States of America
Description:	Turnkey incl. Engineering, Prefabrication, Transport, Lifting, Installation, Supervision and Quality control.

	Absorber	Stack	Aux. Tank
Dimensions:	Dia. 8,23 m Height 25,1 m	Dia. 3,8 m Level + 66,8 m	Dia. 8,23 m Height 11,2 m
Temperature:	82°C (255°C at Flue Gas Inlet)		77°C
Pressure:	-0.012 / 0.087 bar		-0.0254/0.0635bar

References

Project:	Turow, Integration of WFGD
Customer:	Babcock Noell GmbH
Product:	3 x Chimney liner & Bypass
Dimensions:	Dia. 5,3 m / Length 690 m
Temperature:	20°C to 163°C
Pressure:	-10 mbar / +20 mbar
Medium:	Clean Flue Gas
Year:	2014 / 2015
Country:	Poland
Description:	Engineering, Prefabrication, Installation, Supervision and Quality control.

References

Project:	Orot Rabin & Rutenberg
Customer:	CDI
Product:	4 x GRP liner in Concrete chimney
Dimensions:	Dia. 7.0 m / Height +210 m
Temperature:	52°C (150°C Excursion)
Pressure:	- 100 mbar / + 100 mbar
Medium:	Clean Flue Gas
Year:	2015 – 2016
Country:	Israel
Description:	Engineering, Prefabrication, Lifting, Jacking System, Installation, Supervision and Quality control

References

Project:	Fort Martin; Stack liner
Customer:	Karrena
Product:	1 x Stack liner
Dimensions:	Dia. 8.2 m – Height 125 m
Temperature:	65°C (190°C @ 4 hrs)
Pressure:	
Medium:	Clean Flue Gas
Year:	2008
Country:	USA; West Virginia
Description:	Turnkey incl. Engineering, Prefabrication, Transport, Lifting, Installation, Supervision and Quality control.

References

Project:	KW Neurath BoA 2&3
Customer:	RWE Energie AG / GEA
Product:	2 x Flue gas duct Absorber to CT
Dimensions:	Dia. 10,0 m / Length 150m + 30m Elbow
Temperature:	-10°C to 73°C
Pressure:	-0,005 bar / +0,01 bar
Medium:	Clean Flue Gas
Year:	2007 / 2008
Country:	Germany
Description:	Turnkey incl. Engineering, Prefabrication, Transport, Lifting, Installation, Super-vision and Quality control. Project scope M€ 20 We faced the challenge to construct a FRP duct of 10 m Ø at a support distance of 75 m.

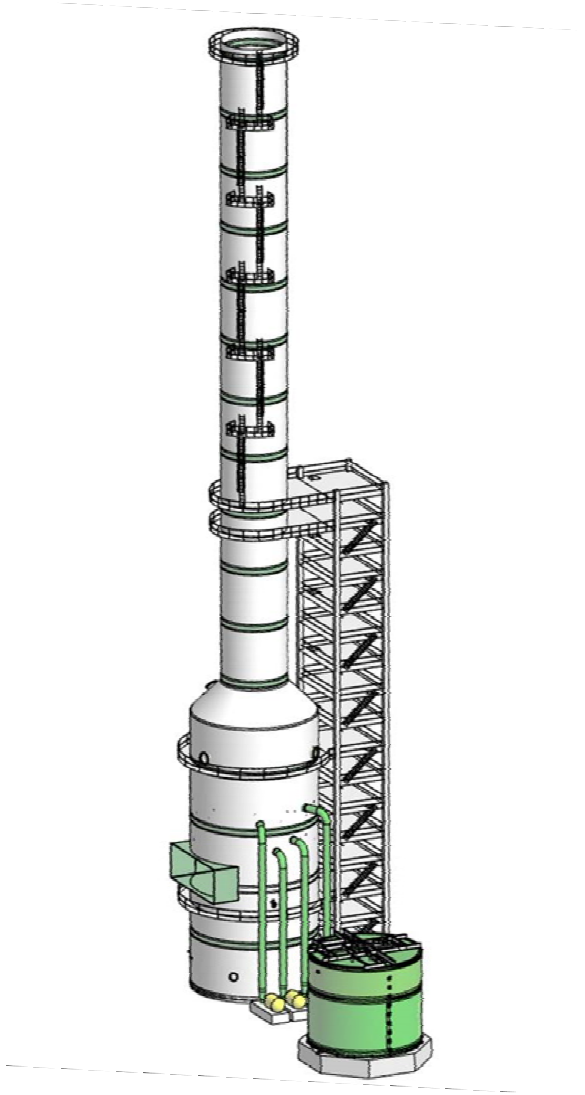
References

Project:	PP Opole (PL); Clean gas ducts
Customer:	Alstom Power Italia S.p.A
Product:	2 x Clean gas ducts
Dimensions:	Dia. 8,0 m / Length 65 m
Temperature:	52°C
Pressure:	-10 / + 10 mbar
Medium:	Clean Flue Gas
Year:	2012 / 2013
Country:	Netherlands
Description:	Turnkey incl. Engineering, Prefabrication, Transport, Lifting, Installation, Supervision and Quality control.

References

Project:	Turow, Integration of WFGD
Customer:	Babcock Noell GmbH
Product:	3 x Chimney liner & Bypass
Dimensions:	Dia. 5,3 m / Length 690 m
Temperature:	20°C to 163°C
Pressure:	-10 mbar / +20 mbar
Medium:	Clean Flue Gas
Year:	2014 / 2015
Country:	Poland
Description:	Engineering, Prefabrication, Installation, Supervision and Quality control.

Thank you very much for your attention !



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