REINHOLD ENVIRONMENTAL Ltd.

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& Expo Presentation

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KOCH KNIGHT, LLC

Bekaplast™ -S Technology

The Use of Polypropylene and Concrete in Flue Gas Scrubbers

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Polypropylene is the Advanced Material Used in Today's WFGD

- General Introduction
- Polypropylene (PP) General Characteristics
- FGD (Flue Gas Desulfurization)
- Concrete Scrubber lined with Polypropylene
  - *Construction Details*
- Polypropylene Spray Systems in FGD
- Summary

Understanding The Process

General knowledge of your process is essential for a successful lining system

- Mechanical
- Physical
- Thermal Properties

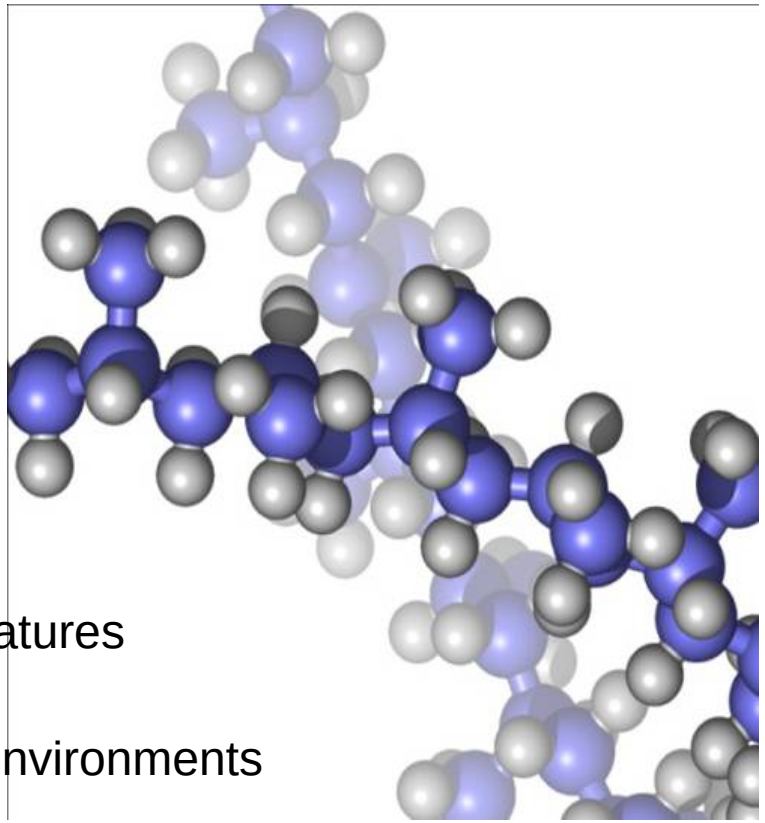
Technology Options

- Advanced Thermoplastic and Concrete
- Fiberglass Reinforced Plastic (FRP)
- Tile and Mortar
- Alloy Steel

	CONCRETE-BEKAPLAST™	FLAKE GLASS	CERAMIC TILE	ALLOY
CHEMICAL RESISTANCE	EXCELLENT	SATISFACTORY	EXCELLENT/FAIR	SATISFACTORY
MEDIA ABSORPTION	NONE	PARTIAL	PARTIAL	NONE
CONSTRUCTION COST	LOW/MEDIUM	LOW	HIGH	MEDIUM/HIGH
DEPOSITS BUILD UP	NONE	PARTIAL	PARTIAL	PARTIAL
MOISTURE PENETRATION (LEAKAGE)	NONE	PARTIAL	PARTIAL	NONE (INITIALLY)
TIME FOR MAINTENANCE	LOW	MEDIUM	MEDIUM	HIGH
WEIGHT	LOW	LOW	HIGH	HIGH
ABRASION RESISTANT	HIGH	MEDIUM	HIGH	HIGH
EASE TO REPAIR (COST AND TECHNIQUE)	LOW	MEDIUM	HIGH	HIGH
INSTALLATION TIME	LOW	MEDIUM	HIGH	MEDIUM

Polypropylene Material Lining for WFGD

Physical Properties



- Good impact strength
- Abrasion resistant
- Smooth and non-porous
- Exhibits tensile strength at elevated temperatures
- Excellent chemical resistance in corrosive environments

Polypropylene is a Thermoplastic Material

- Softens at high temperature and hardens during cooling
  - This allows parts to be formed by extrusion or molding
- Shaped by heat and extrusion welding
  - Not possible with FRP
- Welding joint seamless and uniform microstructure
  - The welding temperature is in the 550 – 575^{o}F range.

Advantages of Polypropylene Lining

Benefits

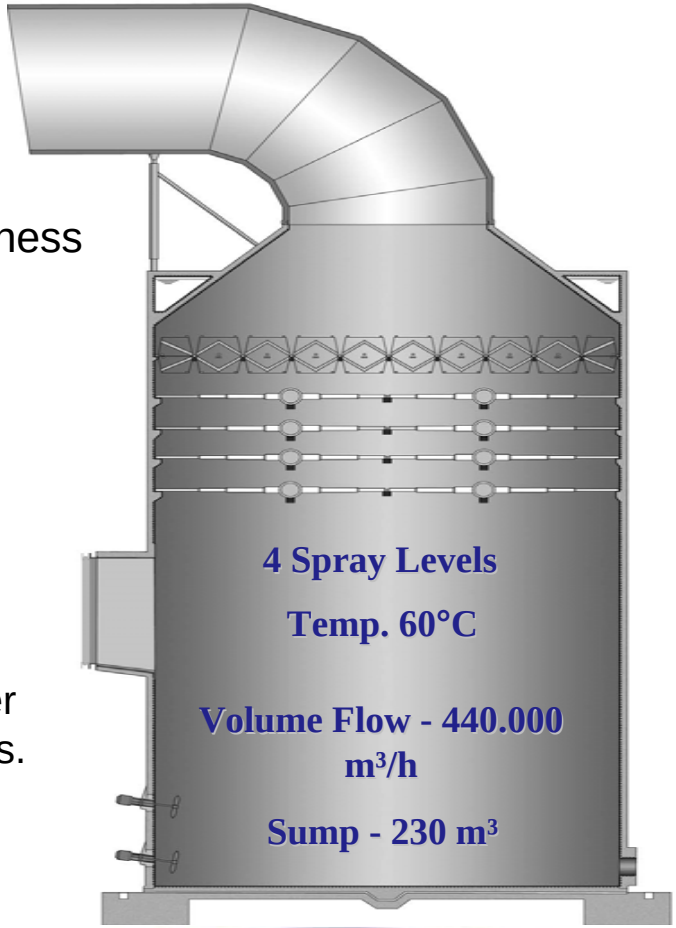
- Quick Installation
- Low Maintenance
- Long Service Life
- Competitive Cost
- Complete Turn Key Job
- Retrofit Services

COAL POWER PLANT

Dimensions	187‘ H x 77‘ Dia.
Location	Germany
Units	2 WFGD
Scope	Engineering, Concrete, Polypropylene liner & pipes, PP sieve baskets, RP manholes.

Cement WFGD Scrubber

Dimensions	Inside Ø 7.10 m (approx. 23´) Height 26.80 m (approx. 88´) 200 m³ of concrete 700 m² of Polypropylene-H, 8 mm thickness
Gas Inlet	11.3 ’ x 13.7 ’
SO2 Raw Gas	3.200 mg/m³
Start of Work **End of Work**	August 2004 February 2005
Scope	Engineering, Concrete, Polypropylene liner & pipes, PP sieve baskets, FRP manholes.



Concrete Scrubber Lined with Polypropylene

FGD – Concrete Scrubber Lined with Polypropylene

Material: Polypropylene

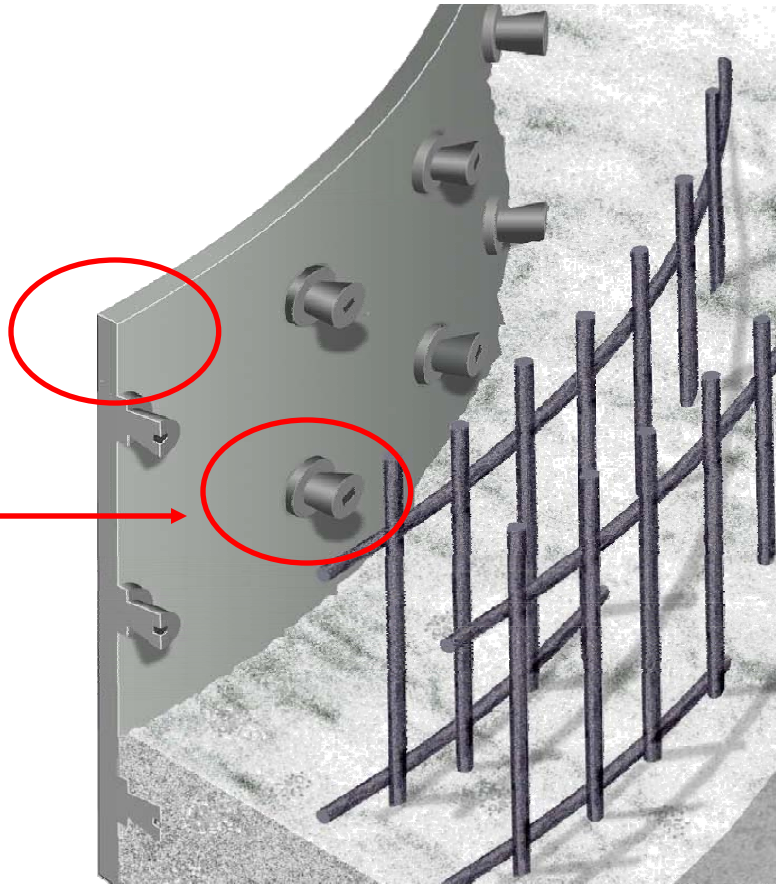
- Thermoplastic Sheets

  Material Thickness:

  5 mm / 8 mm / 10mm

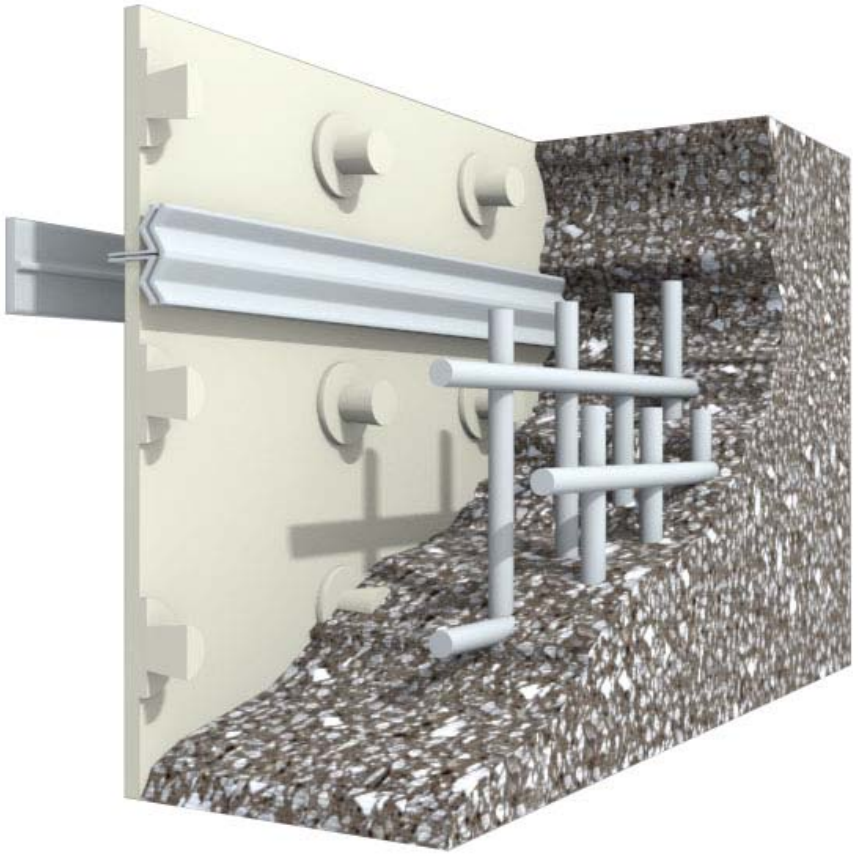
- Backside “Mechanical Anchoring”

- Unique anchoring system



FGD – Concrete Scrubber Lined with Polypropylene

- Conical Anchor Studs Mechanical Bond - Thermoplastic Liner to Concrete
- 24 pcs/ft² Conical Anchor Studs
- Polypropylene Strip Joint Between Panels – Help Align Panels and Back Seal Weld Joints
- Reinforced Bar in Concrete Structure
- Long-term Proven System

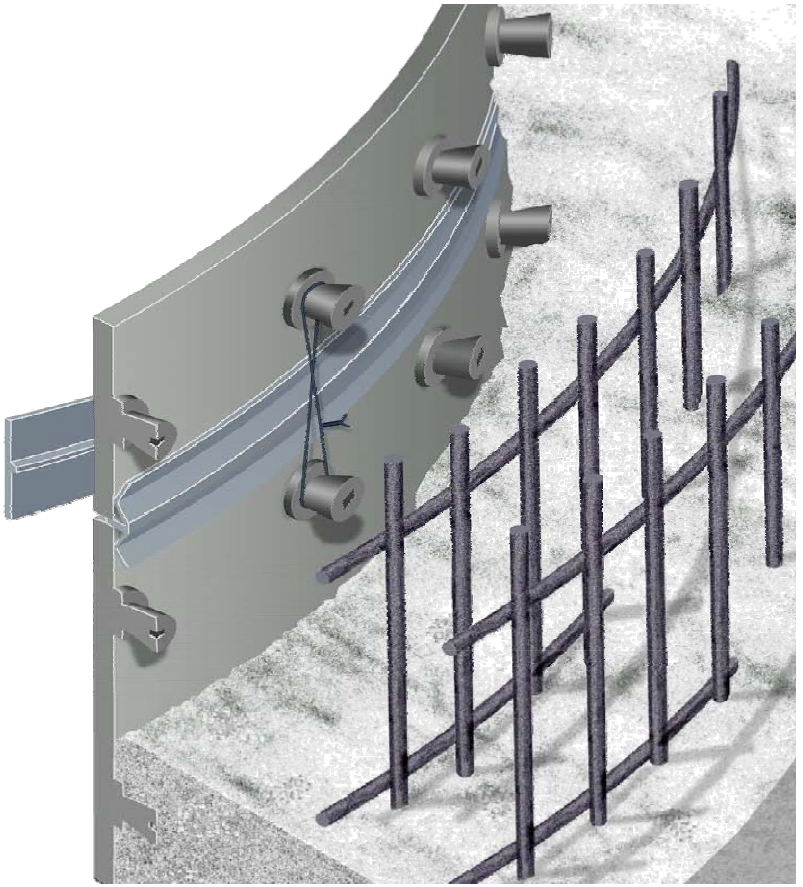


FGD – Concrete Scrubber Lined with Polypropylene

Prefabricated Sheets
- Delivered to Site
- Customized to Fit Formwork

Installed
- Inner Formwork

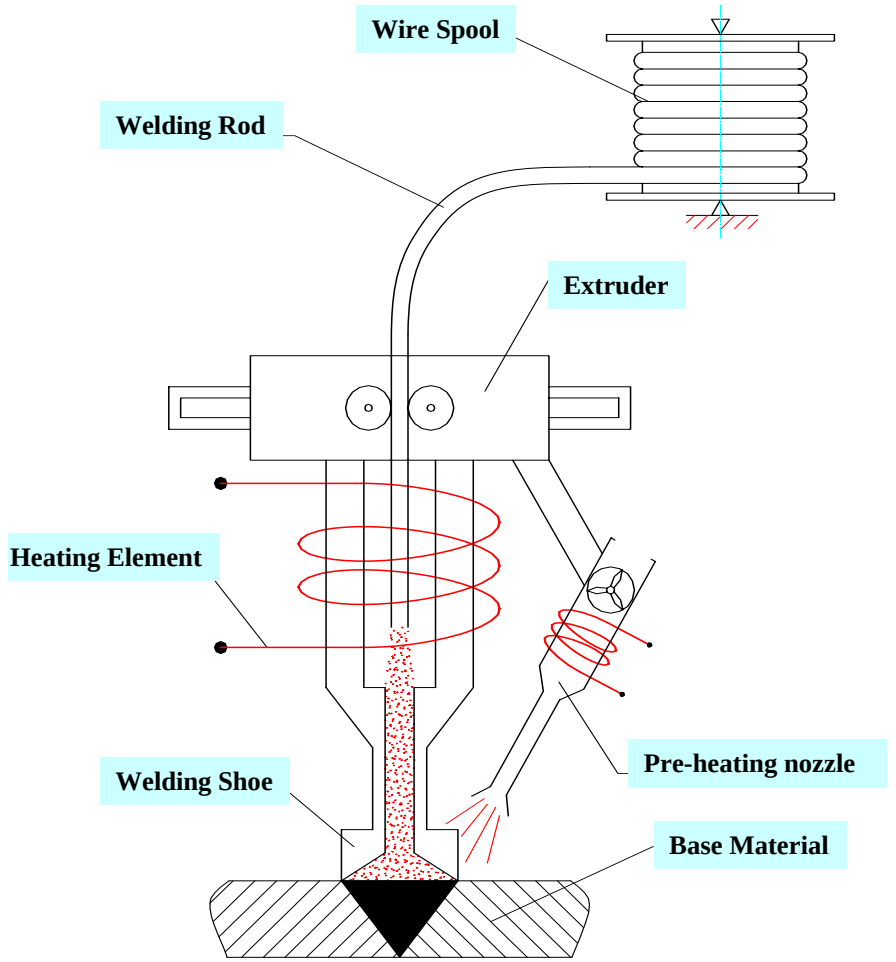
Welded
- Gastight Weld
  - After Removal of Formwork



Welding Technologies

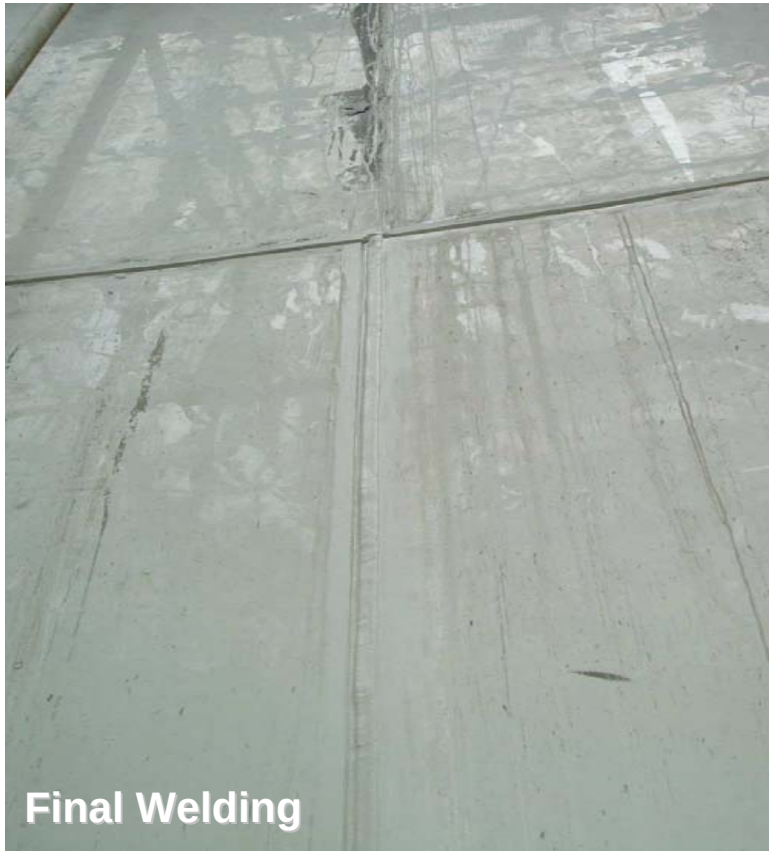
HOT GAS EXTRUSION WELDING TECHNOLOGY

- **AWS B2.4 2010**
- **All welder must qualify for the thermoplastic and welding process that will be used (similar to the DVS requirements**
- **Welding rod and base material the same polymer composition**



Horizontal Welding on Wall Lining

Construction Sequence



FGD – Concrete Scrubber Lined with Polypropylene

Supports and Mounting Parts

Lining for the support ledge

Reinforced Tie-ins designed to swing 90 degrees from structure wall

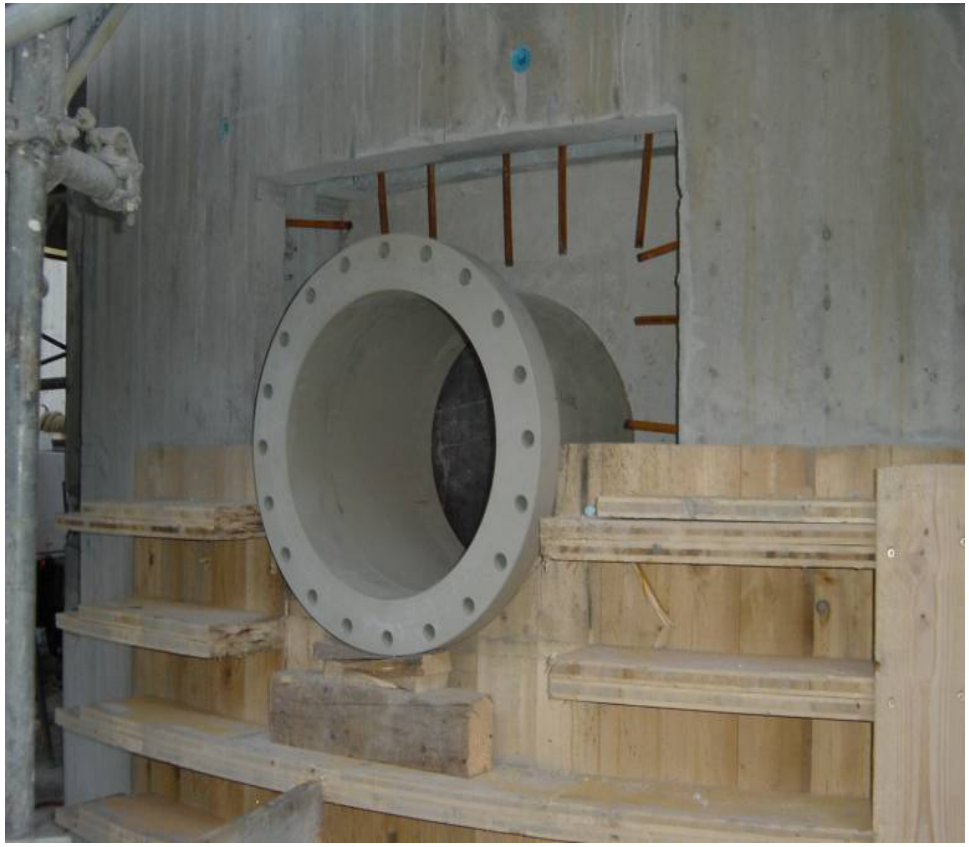
Additional rebar welded onto tie-ins for structural support

Liner and concrete set in place for unified and monolithic fit

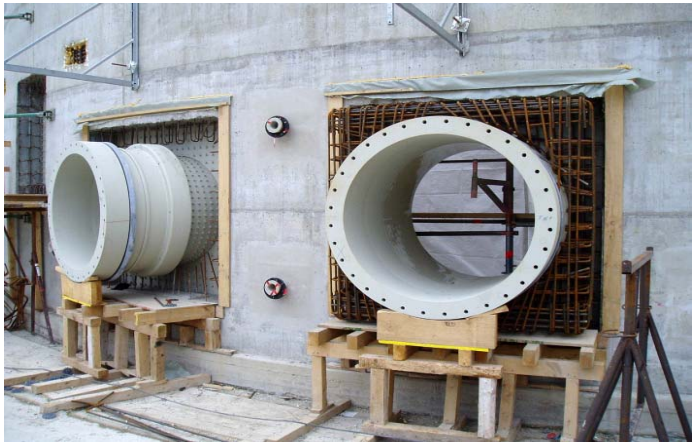
FGD – Concrete Scrubber Lined with Polypropylene

Finished Polypropylene Lining

FGD – Concrete Scrubber Lined with Polypropylene



Supplementary Installation of Nozzles



Pre-manufactured nozzle sleeves

FGD – Concrete Scrubber Lined with Polypropylene

FGD – Concrete Scrubber Lined with Polypropylene

Hot Gas Inlet

FGD – Concrete Scrubber Lined with Polypropylene

FGD – Concrete Scrubber Lined with Polypropylene

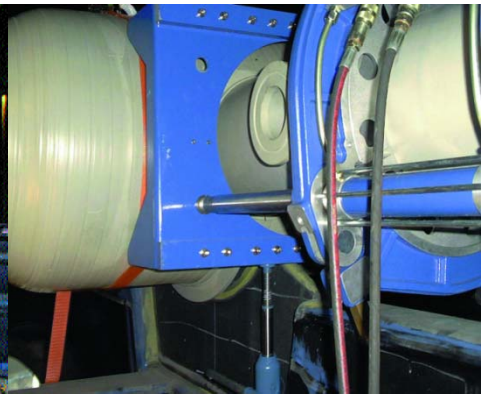
Scrubber Cone Detail

Spray Systems Made of Polypropylene

Proofed pre-fabrication of the pipe sections in the factory

Transport of the pipe sections into the absorber

Installation of the pipe sections in the absorber

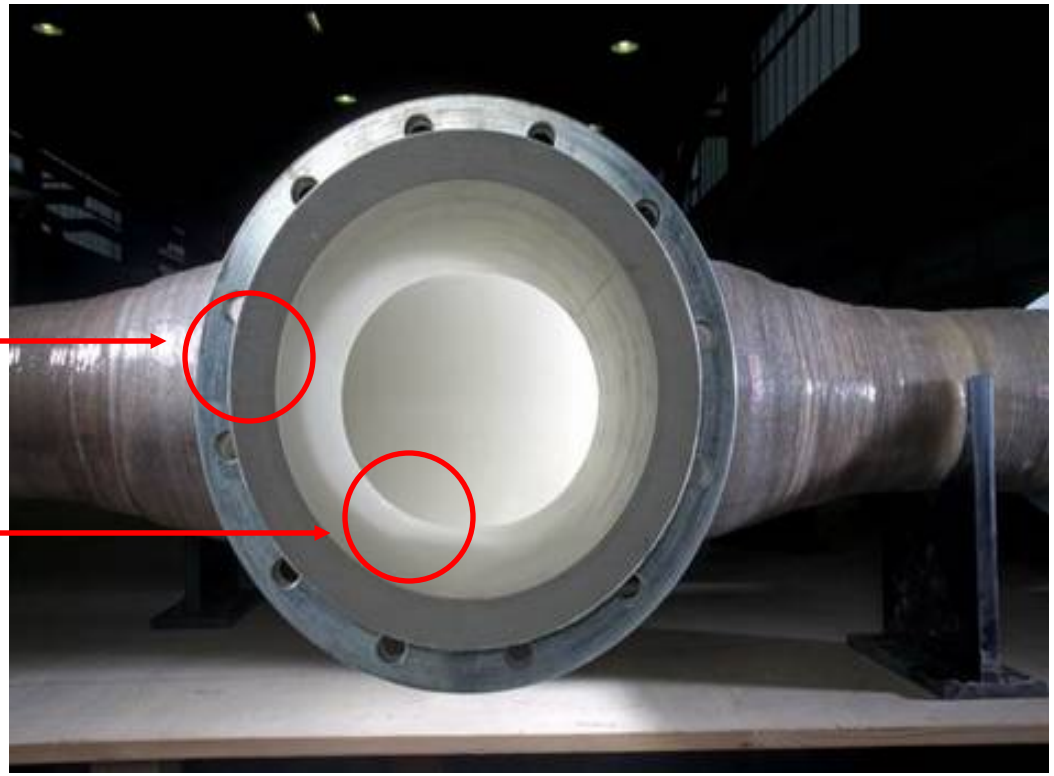


Welding of the individual sections

Composite Pipes FRP / PP

FRP Shell

Polypropylene
Inner Wall Lining

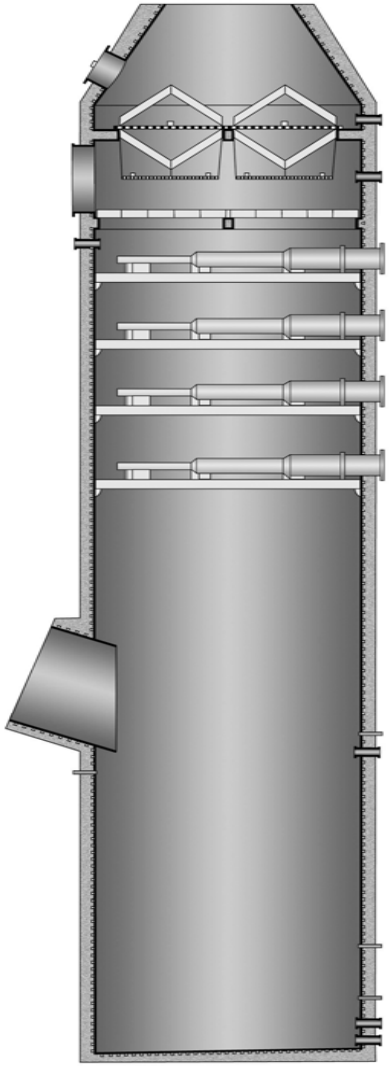


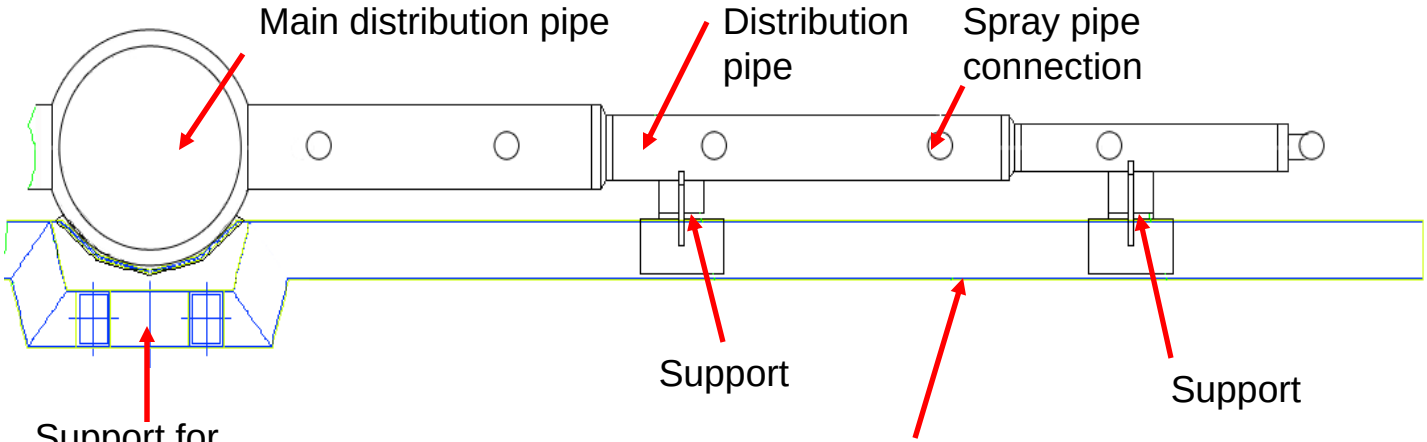
Spray Systems Made Of Polypropylene

THE ADVANTAGES :

- No media absorption, deposit build up or changes in the surface due to chemical loads
- Smooth pore-free surface
  prevents from deposits and scaling
- Standardized modular construction
- Pre-determined installation times
- Early designs in service for more than 25 years with near zero maintenance

Polypropylene Spray Pipe



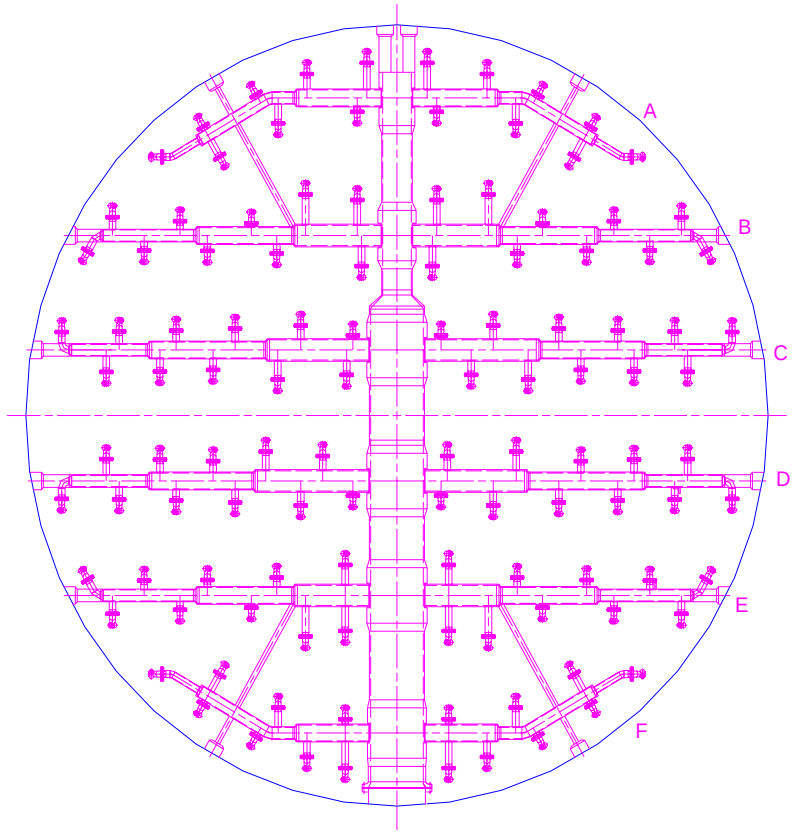


(Centralized Distribution)
Side View

POLYPROPYLENE SPRAY HEADER FIELD INSTALATION

Spray Bank - Polypropylene

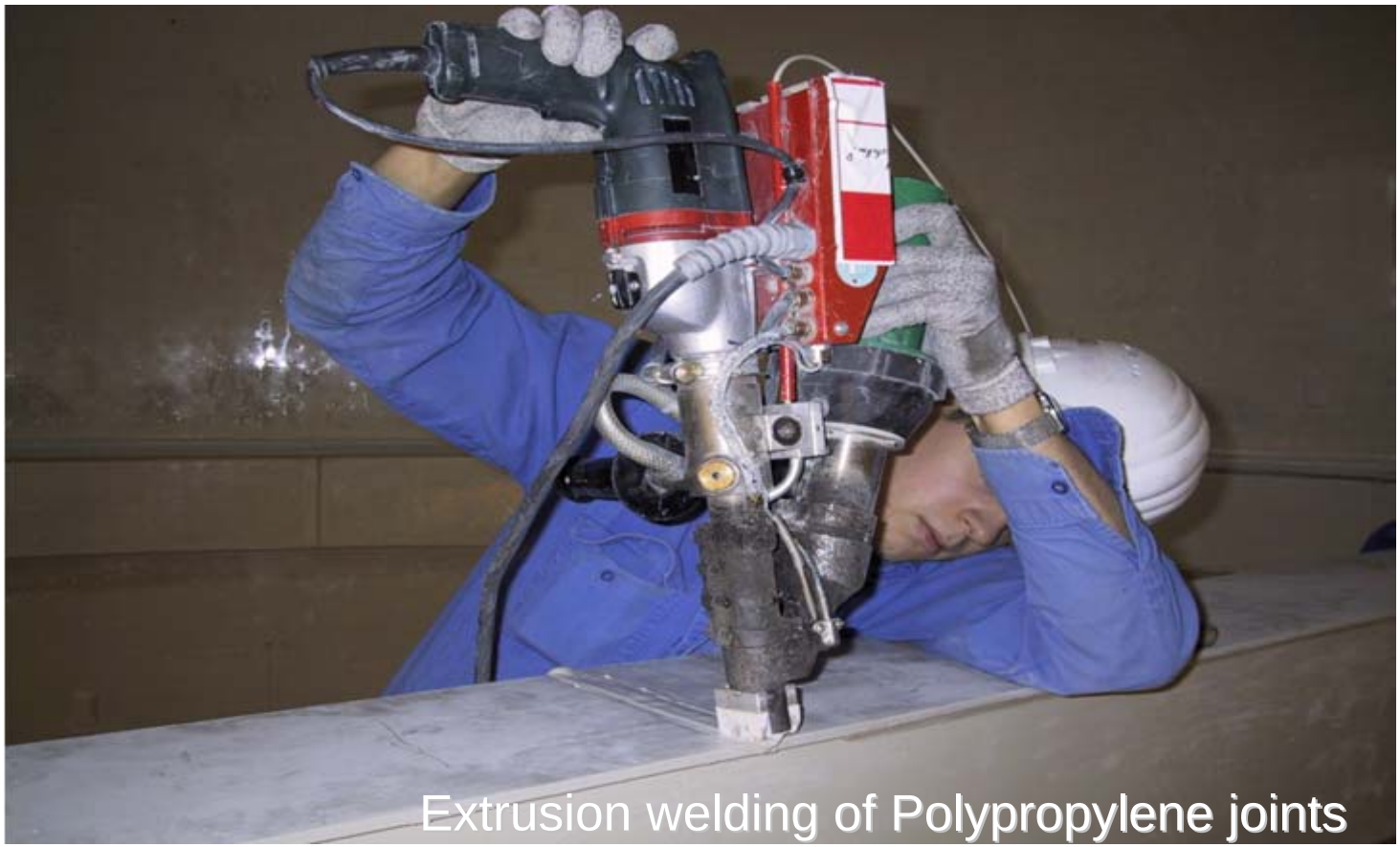
Spray level with centralized distribution



(Plan view)

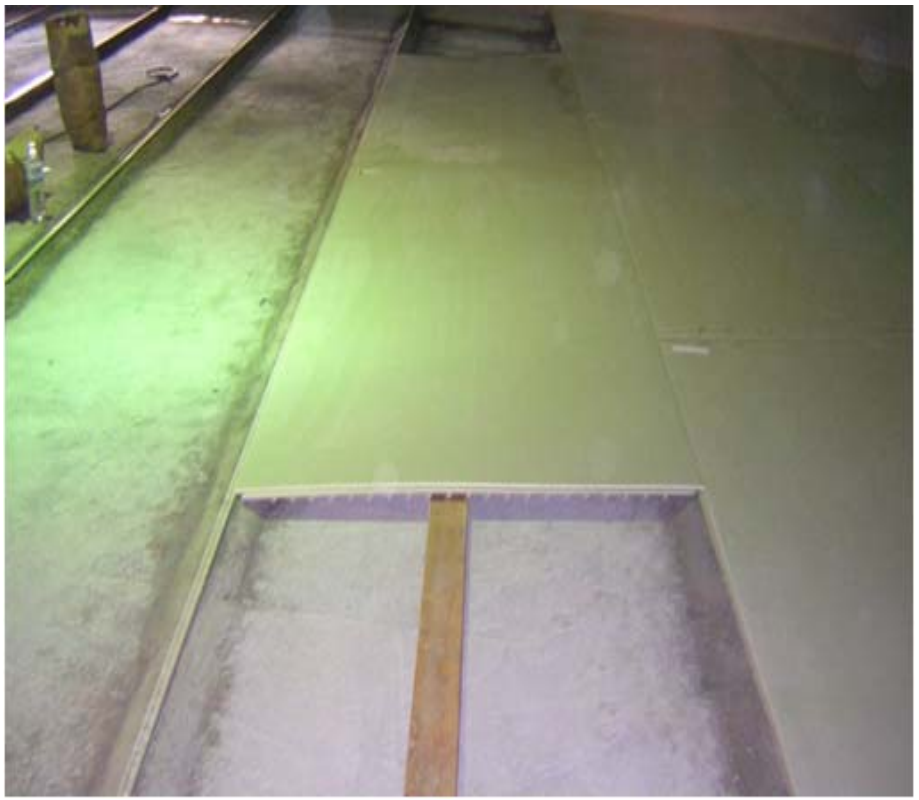
Spray Bank - Polypropylene

Horizontal Welding on Spray Bank Support

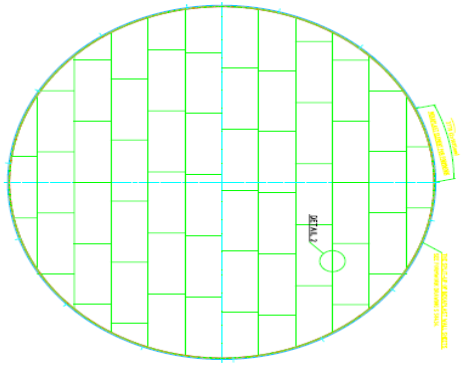


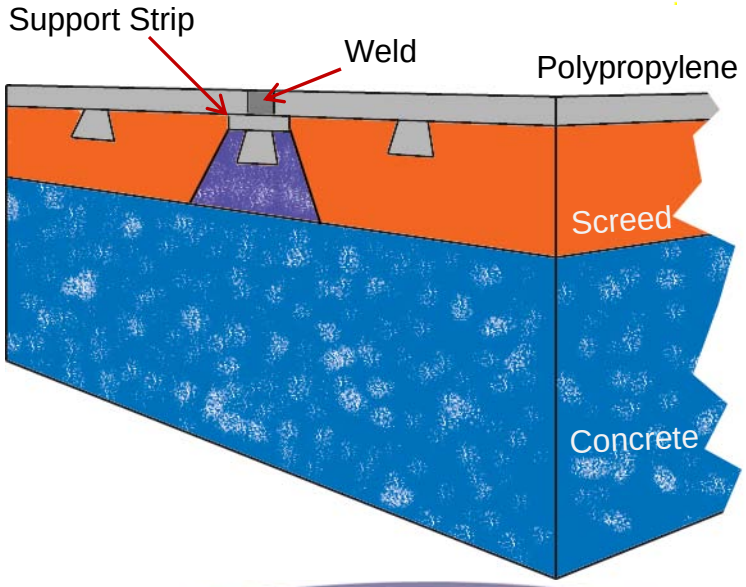
Extrusion welding of Polypropylene joints

Construction Sequence



Floor Lining



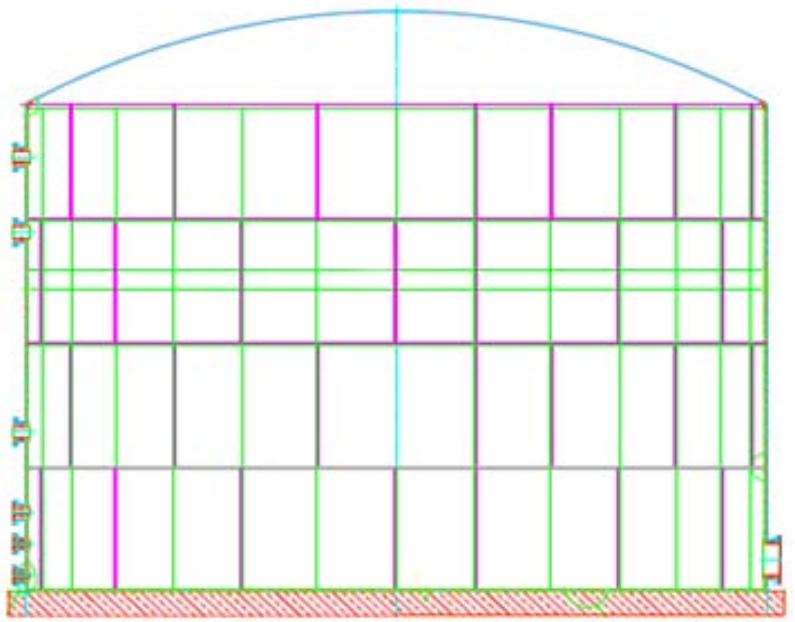


Retrofit Steel Structures with Polypropylene

- Technical Solution: Polypropylene connection with a steel substrate
- Technical Solution: Shuttering / Formwork Technology

Spent Acid Tanks (Key Data)

Substrate	Steel
Dimensions	Ø = 57.0 Ft,
	H = 40.0 Ft,
Chemical Load	H_2SO_4 65%
Temperature Load	Max. 194°F

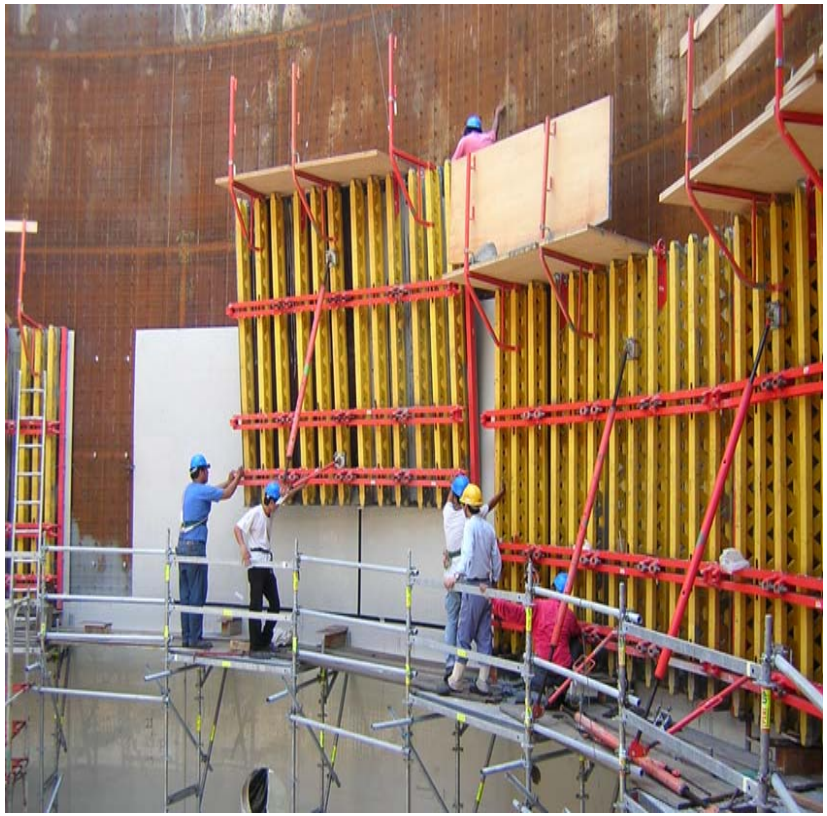


Construction Sequence

1st Section Back-filled with Concrete
After The Removal Of The Shuttering

H –Profile Horizontal
Connection 2nd Section

Construction Sequence



Placing of 2nd Section

Summary

Polypropylene is the Advanced Material Used in Today's WFGD

AFTER 10 YEARS CONCRETE SCRUBBER CONSTRUCTIONS

- No evidence of corrosion and chemical attack in the entire vessel with no leaks.
- Proven lining technology with high abrasion resistance.
- Design life expectations (>30 years)
- High impact and mechanical durability that can be welded to ensure a gas and water leakage barrier.
- Reduced construction time with prefabrication, welding and assembly.
- Over 25 years experience with polypropylene spray banks.

Koch Knight, LLC Headquarters
PO Box 30070
5385 Orchard View Drive SE
East Canton, Ohio 44730
USA
Phone: +1 (330) 488-1651
Fax: +1 (330) 488-1656
Email: Geza.Zirczy@kochknight.com

Geza N. Zirczy
Business Development Manager
WFGD

Visit us on the web @
www.kochknight.com