



**McIlvaine**  
**December 19, 2013**

**Ed Wesson – AOC Resins**

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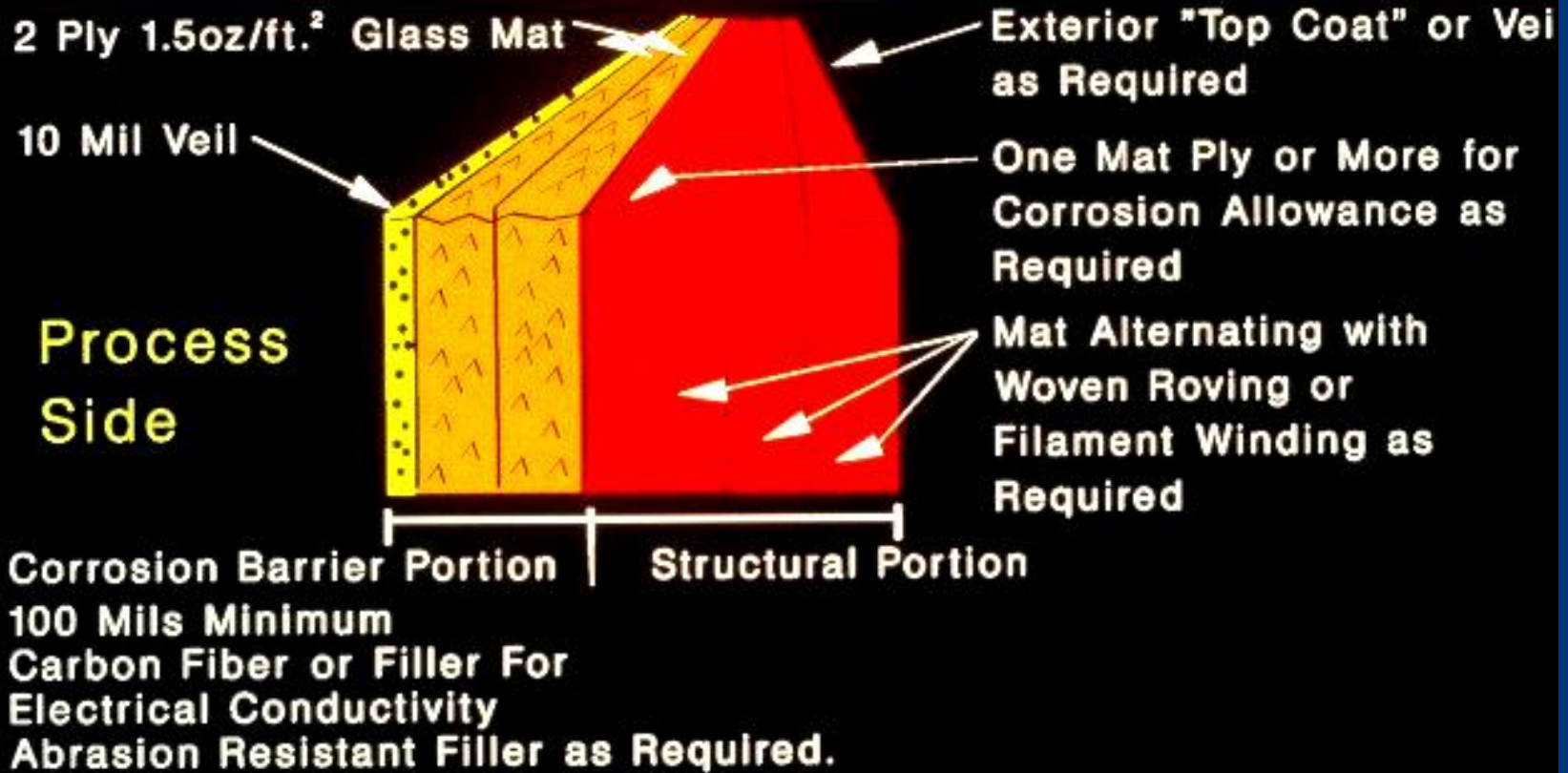


# Introduction

FRP Has been used successfully in power plant applications for many years

- Gas Ducting
- Storage Tanks
- Reactors
- Piping
- Other Unique Applications

# STANDARD CONSTRUCTION CORROSION RESISTANT LAMINATE



# SUCCESSFUL APPLICATION



- RESIN SELECTION
- DESIGN / ENGINEERING
- INTERFACES
- FABRICATION
- INSTALLATION
- INSPECTION

# RESIN SELECTION



- CHEMICAL SERVICE
  - CONCENTRATION (MAX./ MIN.)
  - TEMPERATURE (OPERATING-MAX./ MIN.)
  - UPSETS
  - FLAME RETARDANCY
  - ABRASION
  - INSULATION
  - MANUFACTURING PROCESS

# TYPICAL FABRICATION TECHNIQUES



- HAND LAY-UP/CONTACT MOLDING
- SPRAY-UP
- FILAMENT WINDING
- CONTINUOUS PULTRUSION
- RESIN TRANSFER MOLDING
- VACUUM INFUSION
- PRESS MOLDING





# Design Process

- Requirements (Specs, Process Conditions, Manf Process, etc...)
- History
- Laminate Types
- Analysis Methods
- Level of Expertise
- Interface Points
- Factors of Safety
- Erection/Handling Considerations



# Engineering Process

- Laminate Types
  - Type 1
  - Type 2
  - Type 10
  - FW
  - Cored
  - Corrosion Barrier
  - Dual Lam





# Engineering Process

- Analysis Methods
  - Classical
  - Laminate Analysis
    - **Trilam**
    - **Vector Lam**
- Testing
- FEA
  - **Algor, Ansys, Caesar, Solidworks, NASTRAN, more**
- Consultants



# Engineering Process

## Basic Composite Design

- Directional Strength and Stiffness
- X, Y, Z
- Fiber Concentration
- Volume vs Mass Fraction
- Thermal Expansion

# INDUSTRY SPECIFICATION FOR FRP EQUIPMENT



- ASME RTP-1, the standard for reinforced thermoset plastic corrosion resistant equipment code
- ASME B31.3 process piping code
- ASME Section X (10)
- ASTM D3299 – Above Ground Vertical Filament Wound Tanks
- ASTM D4097 – Above Ground Vertical Contact Molded Tanks
- ASTM D2996 – Filament Wound pipe
- ASTM D2310 – Machine-made Pipe
- ASTM D3982 – Contact Molded Duct and Hoods
- ASTM D4024 – Reinforced Thermosetting Plastic (RTP) Flanges
- ASTM D6041 – Contact Molded Pipe and Fittings
- ASTM D5364 - Chimney Liners
- API 12P

# INSPECTION OF FRP EQUIPMENT OF FRP EQUIPMENT



## WHEN SHOULD IT BE DONE?

- DURING AND AFTER FABRICATION
- WHEN RECEIVED AND INSTALLED
- AFTER A PERIOD OF USE
- CHANGING SERVICE

## MOST COMMON TESTS

- BARCOL HARDNESS
- VISUAL
- ACOUSTIC EMISSION
- ULTRASOUND
- INFRA RED

# FRP ADVANTAGES



- No Electrochemical Corrosion
- High Strength and Stiffness for Low Weight
- Tailored Mechanical Properties
- Tailored Corrosion Resistance
- Ease of Repair/Rework

# Applications

**AOC**<sup>®</sup>  
World Leader in Resin Technology



**JBR Slurry Strainer (NMR)**



**Wet ESP (B&D Plastics)**



**Chiyoda JBR**



# Flue Gas

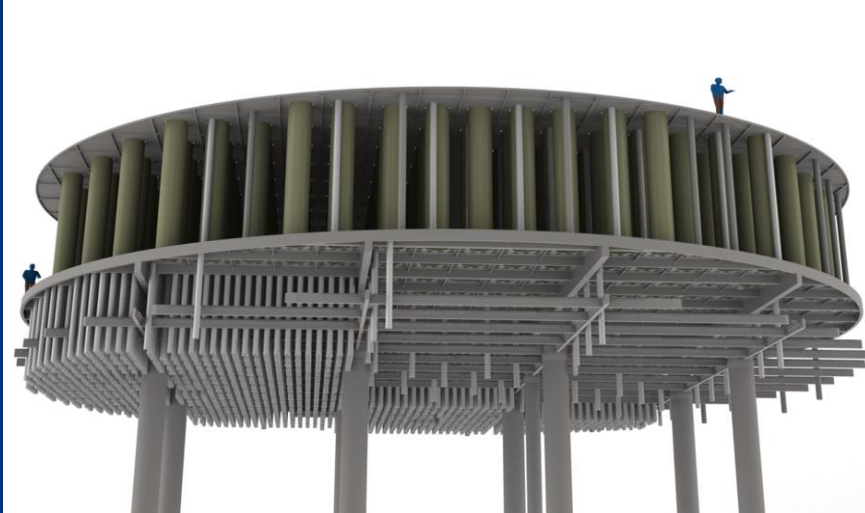
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**Flue Stack Liner (Augusta)**



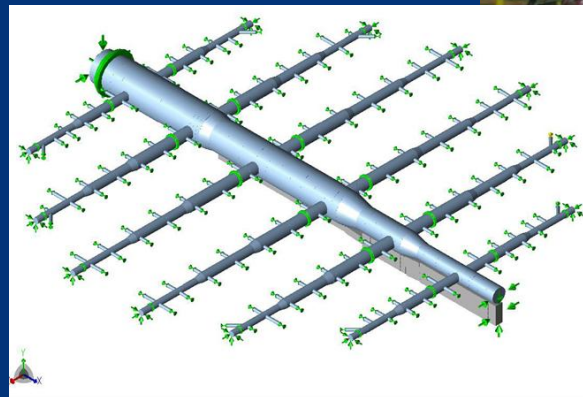
# Applications



**Chiyoda JBR**



**Outlet Duct (NMR)**



**Spray Header**

The logo features the letters 'AOC' in a bold, white, sans-serif font. The 'A' is a simple triangle, the 'O' is a square with a smaller square inside, and the 'C' is a thick, open curve. A registered trademark symbol (®) is positioned to the right of the 'C'. The logo is centered over a stylized world map in a darker shade of blue.

**AOC**®

*World Leader in Resin Technology*

**Thank You!**