Assuring 100% Plant Capacity with your Dryer Environmental System -RTO Redundancy-

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Target Zero – Our Global Safety Vision

Making Safety Personal

Zero is Achievable
Incidents are Preventable
Safety is Personal
All Day, Every Day
Willingness to Intervene

TARGET
EACH AND EVERY DAY
ZERO

Sustainable System, Talent & Capabilities

Comprehensive Global EHS&S Management System with externally accredited operations (ISO, OSHAS, OSHA VPP)

Getting Results

Proven results with continually improving best-in-class performance

20% reduction in injury frequency, and

24% reduction in injury severity in 2016

** Benchmark for 1st quartile total recordable incident rate (TRIR). The benchmark is comprised of a composite of OSHA BLS data for B&W SIC codes*

Our mission is to provide best-in-class and top decile performance, striving to be an industry leader and externally recognized leader. Efficient, integrated, market differentiator.

B&W MEGTEC

Babcock & Wilcox MEGTEC Corporate Headquarters

Located in De Pere, Wisconsin:

- B&W MEGTEC employs approximately 350 people in the US and approximately 600 globally
- Chemical, Mechanical and Electrical Engineers and Designers
- 100+ Service, Technical and Support Personnel
- 100+ Manufacturing Personnel
- Dedicated R&D and Pilot Laboratory Support Team
- Oracle ERP, Risk Management Programs, Salesforce CRM

Business Platforms

Products

Wet & Dry Electrostatic Precipitators
Wet & Dry Scrubbers
Pulse Jet Fabric Filters (Baghouses)
Multiclone® Dust Collectors
SCR/SNCR Systems
Evaporative Gas Cooling Systems

Regenerative Thermal Oxidizers (RTOs)
Solvent Recovery Systems
Carbon Adsorption Systems
Distillation Systems
Heat Recovery Systems

Air Flotation Dryers
Belt/Conveyor Dryers
UV or IR Dryers
Custom Drying Systems
Specialized Coating Lines
Material Handling Equipment

Services

Replacement Parts & Service
Equipment Rebuilds

Efficiency Upgrades
Preventive Maintenance

Energy Optimization
Equipment Relocations

Environmental Technology Development

MEGTEC

- Regenerative Thermal Oxidizers
- Catalytic Oxidizers
- Heat Recovery Systems

Calgon

- Solvent Recovery Systems
- Distillation & Purification Systems
- Bioscrubbers/Bioreactors

TurboSonic

- Wet Electrostatic Precipitators
- Wet & Semi-dry Scrubbers
- SNCR $DeNO_x$ Systems
- Evaporative Cooling Systems
- Atomizing Nozzles

B&W

- Pulse Jet Fabric Filters (Baghouses)
- Multiclone® Dust Collectors
- Dry Electrostatic Precipitators
- SCR $DeNO_x$ Systems
- Dry Sorbent Injection Systems
- Engineered Acoustic, Filtration & Emission Systems





In the Beginning…
circa 2001

Wood Panel Board Industry – Do we or don't we?

ê Consent Decrees mid-1990s
- Major Producers forced to install pollution control equipment – "quickly"
- The first wave of products and projects had significant problems

ê PCWP (Plywood Composite Wood Products) MACT promulgated September 28, 2004

ê Large airflows with low VOC/HAP content = high thermal efficiency required

ê Products to offer – WESP/RTO/RCO

ê There will be significant resources and investment required to make a difference

Heavy Condensable Particulate

Media “Glued” Together

B&W MEGTEC Pilot RTO

Venturi
Flow
Control

Burner

Process
Fan

Combustion
Blower

B&W
MEGTEC

Bemidji, MN OSB Flake Dryers, EFB, Bark Burner

Jefferson, TX Dry ESP on Wood Fired SYP

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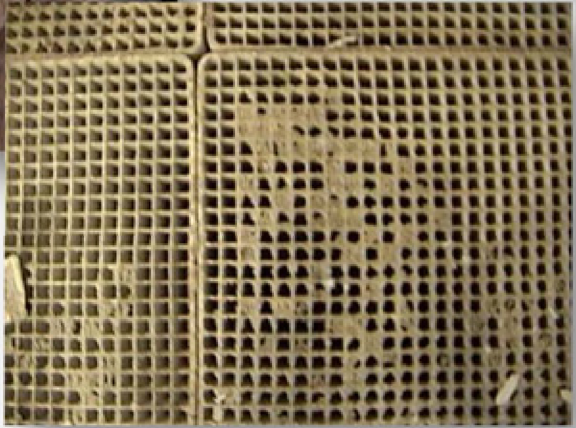
Deposit, NY Northern MDF Wood Fired Dryer

Random and Structured Bed in Pilot Unit

Random Media Samples, 7 months

Structured Block Testing



Pilot RTO Bed Inspection

Media Testing Samples

Megtec Tag	Mnf	Type	Ceramic	Proprietary	Proprietary	Proprietary	Proprietary
New							
101	Proprietary	1 inch Typak	Alkaware		X		X
102	Proprietary	1 inch Typak	Porcelain		X		
103	Proprietary	25 cell mono	NT	X			
104	Proprietary	1 inch LPD	Porcelain	X			
105	Proprietary	1 inch LPD	GR	X			
106	Proprietary	1 inch saddle	Alkaline resistant	X			
107	Proprietary	MLM 180	Porcelain				
108	Proprietary	25 cell mono	HTH	X			
109	Proprietary	25 cell mono	HT	X			
4 month sample at 1500							
101	Proprietary	1 inch Typak	Alkaware	X	X		X
102	Proprietary	1 inch Typak	Porcelain	X	X		
103	Proprietary	25 cell mono	NT	X		X	
104	Proprietary	1 inch LPD	Porcelain	X			X
105	Proprietary	1 inch LPD	GR	X			X
106	Proprietary	1 inch saddle	Alkaline resistant	X	X		
107	Proprietary	MLM 180	Porcelain		X		
108	Proprietary	25 cell mono	HTH	X		X	
109	Proprietary	25 cell mono	HT	X		X	

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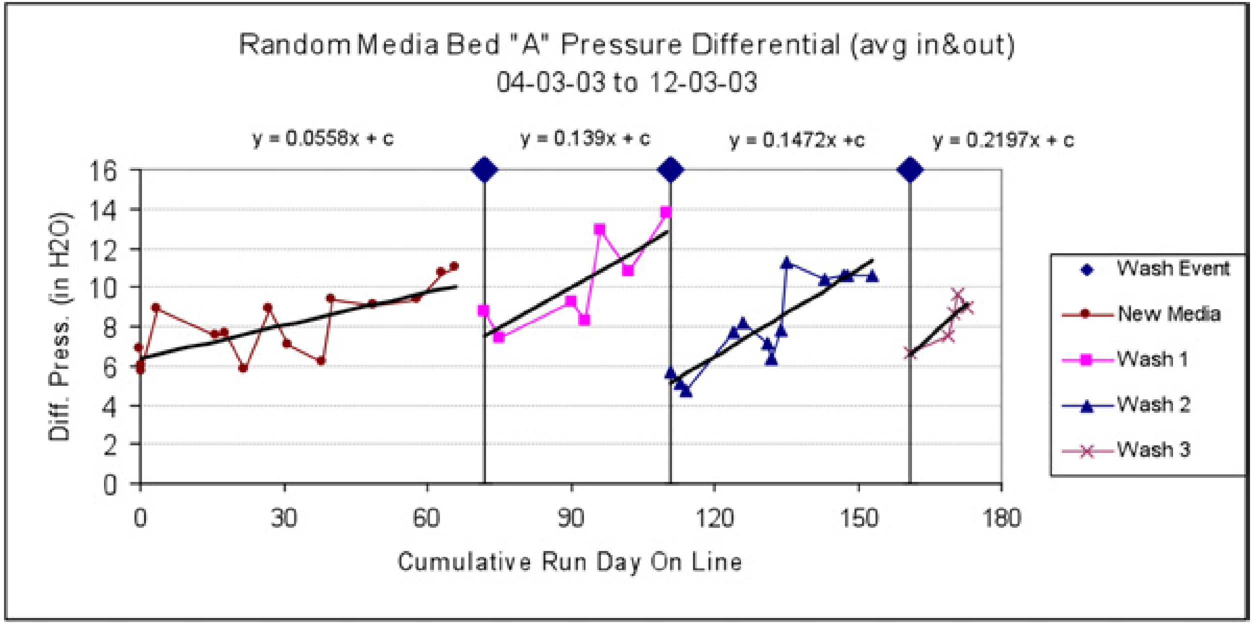
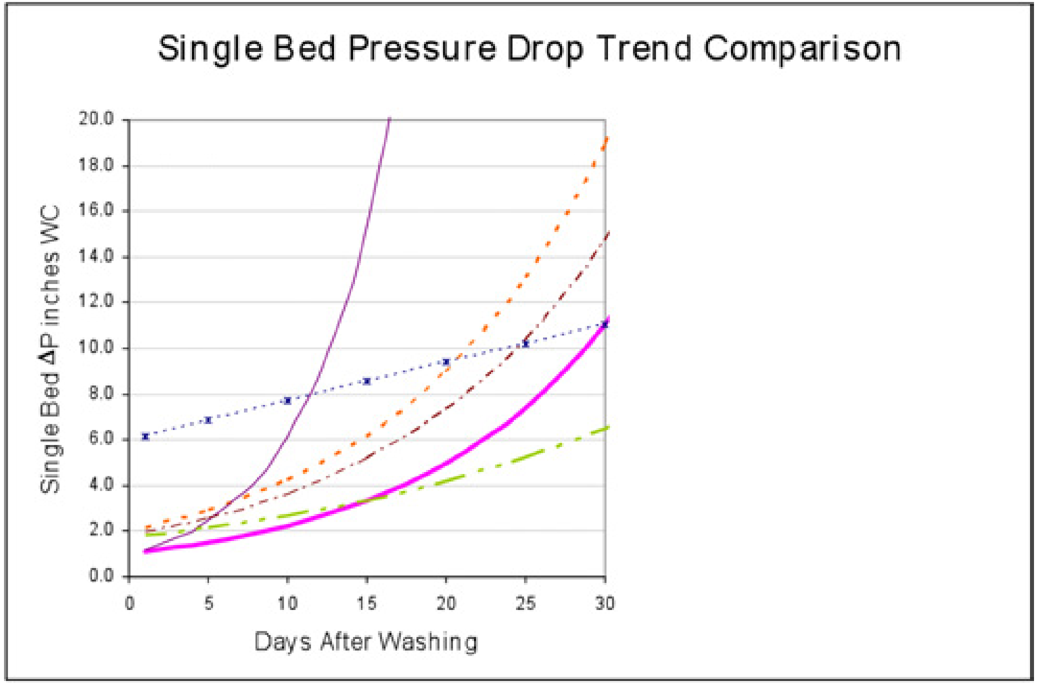
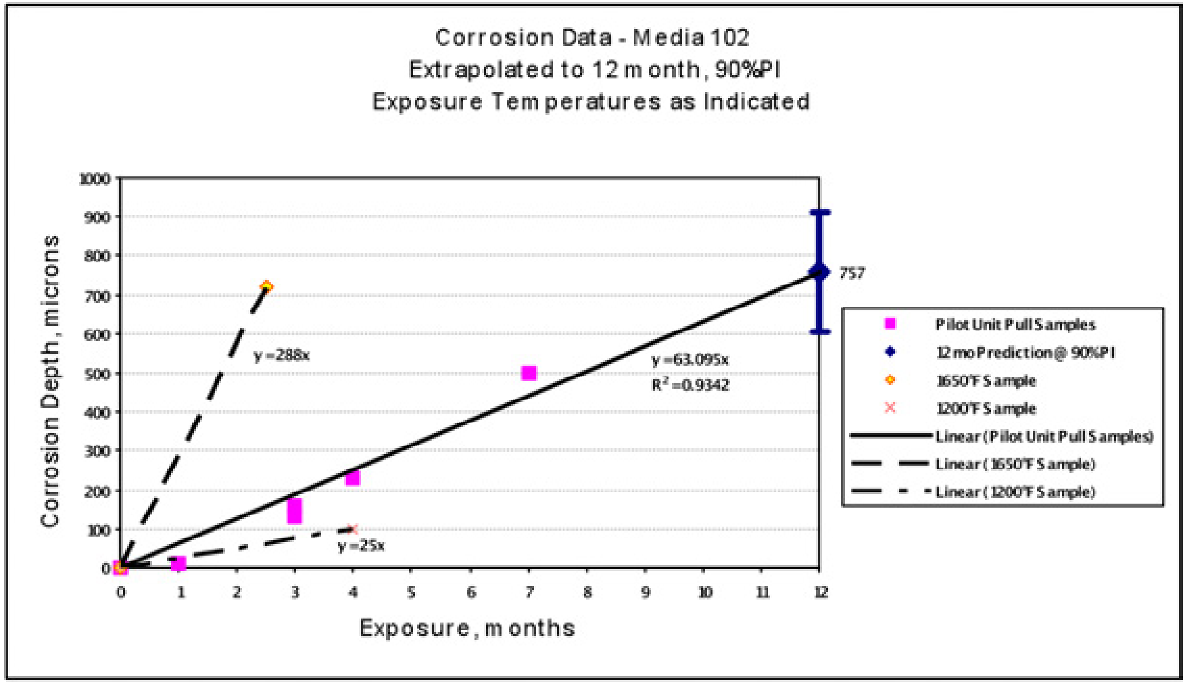
Research and Development



Research and Development



Research and Development



Research and Development

Media/ Bed Description	Measured Corrosion Rate at Temperature µm/month[1]			Estimated Corrosion Limit	Estimated Time to Failure in Hot Face	Corrosion Rating[2]	Water Usage per Cleaning	Washout Pressure Recovery	Media Cost
ID #	1200°F	1500°F	1650°F	µm	months	1 = Best 4 = Worst			
101	nil	nil	nil	600	>24	1	High	Fair	Med
102	25	63	288	600	9.5	3	High	Fair	Low
106	No Data	nil	nil	400	>24	1	High	Poor[4]	Med
107	40 @ 1300°F	50	No Data	400	8.0	4	Medium	Good	Low
108	No Data	3	15 @ 1500/1650°F	200	>24	2	Low	Good	High
109	<1 est.	26	ref 112	200	7.7	3	Low	Good	Med
110	No Data	nil	nil @ 1500/1650°F	200	>24	1	Low	Good	High
111	1 est.	ref 103	128	200	ref 103	3	Low	Good	Med

Ceramics Engineering

What We've Learned

- Characteristics of random and structured ceramic beds in OSB with SYP and northern hardwoods and MDF with northern hardwoods
- No two mills are the same – ever!
- Plugging factors (organic and inorganic particulate) associated with EFB and dry ESP upstream of RTO
- Where (exactly) inorganic ash builds up in the ceramic bed
- Cleanability of random and structured ceramic beds
- Impact of sodium and potassium salts on many different types of media (random and structured) including the impact of temperature
- Became experts on inlet gas stream characterization and the importance of how it applies to different ceramics and RTO design
- How to design and deliver high thermal efficiency beds
  - Every % increase in thermal efficiency > 95% = 20% lower gas consumption

Two Fold Problem

Bed plugging

ORGANIC

- Buildup on coldface
- Condensables on ducting and valves
- Solution is an <u>EFFECTIVE</u> bakeout

INORGANIC

- Inorganic buildup in bed
- Hard to clean out
- Solution is <u>EFFECTIVE</u> bed wash

Bed degradation

- Alkali attack over 1000F
- Spalling, chipping and cracking
- Fusing together eventually plugs the bed
- Solution is particulate control of sub-micron ash, and/or alkali-resistant ceramics

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What Producers Want...........

- Safety
- Maximum Up Time
- Simplicity
- Reliability
- Maintenance Friendly Design
- Predictable Maintenance
- Reduced Energy Consumption

Effective Maintenance

- Effective 2-hour bake outs (condensable particulate)
  - Effective = uniform airflow and temperature
  - Can be accomplished monthly during a down day
- Effective Wash outs (filterable particulate)
  - Ceramic beds that are "washable"
  - Proper RTO wash water drainage system

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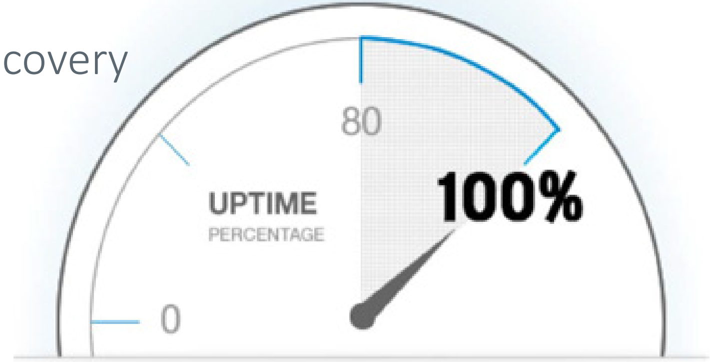
RTO Redundancy

- 100% plant capacity during predictive or unpredictive maintenance events
- Lower Operating Costs
  - Natural Gas – Increased Thermal Energy Recovery
  - Electrical – Lower Operating Bhp
- Increased Capital Costs
  - “More” RTO
  - Man-safe isolation dampers
- Maintenance is done off-line and in a controlled environment
- No need to wait for a regular down day or scheduled outage to do maintenance work



RTO Redundancy

- What is the cost of unexpected down time for your mill?

Hardwood OSB Dryer RTO - 2005 (EFB)

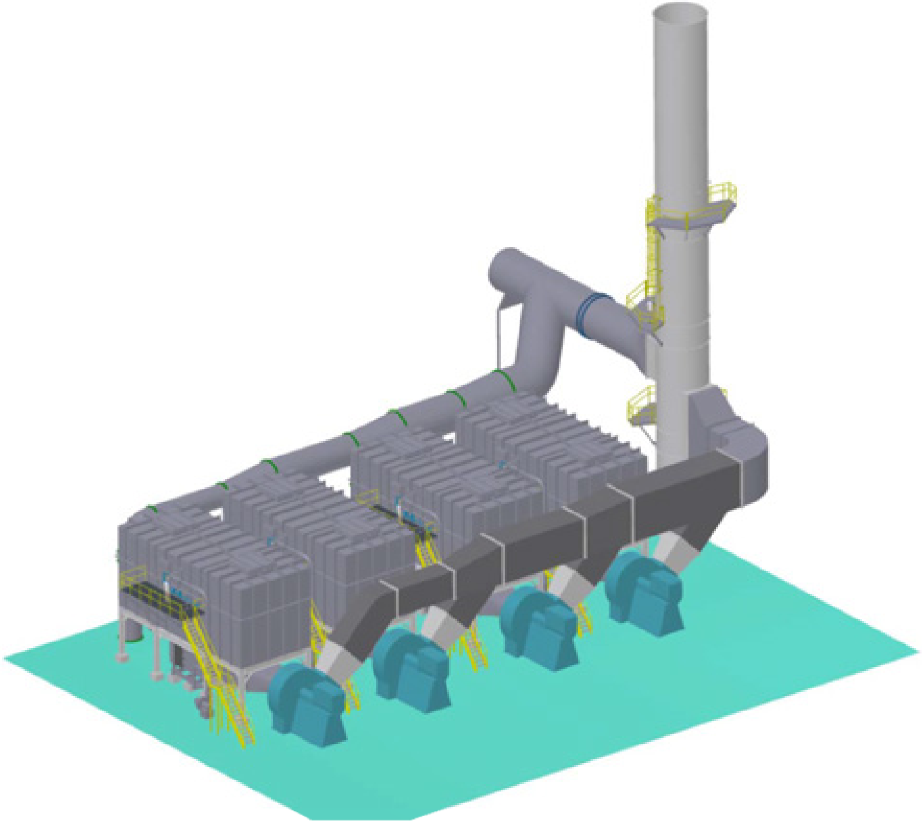
400,000 acfm SYP

400,000 ACFM

Energy Savings & Payback

Capital Cost Increase	18%
Fuel Savings	6.2 MM Btu/hr
Electrical Savings	212 kW
Annual Operating Cost Savings	$300-$400,000
Payback	3-4 years

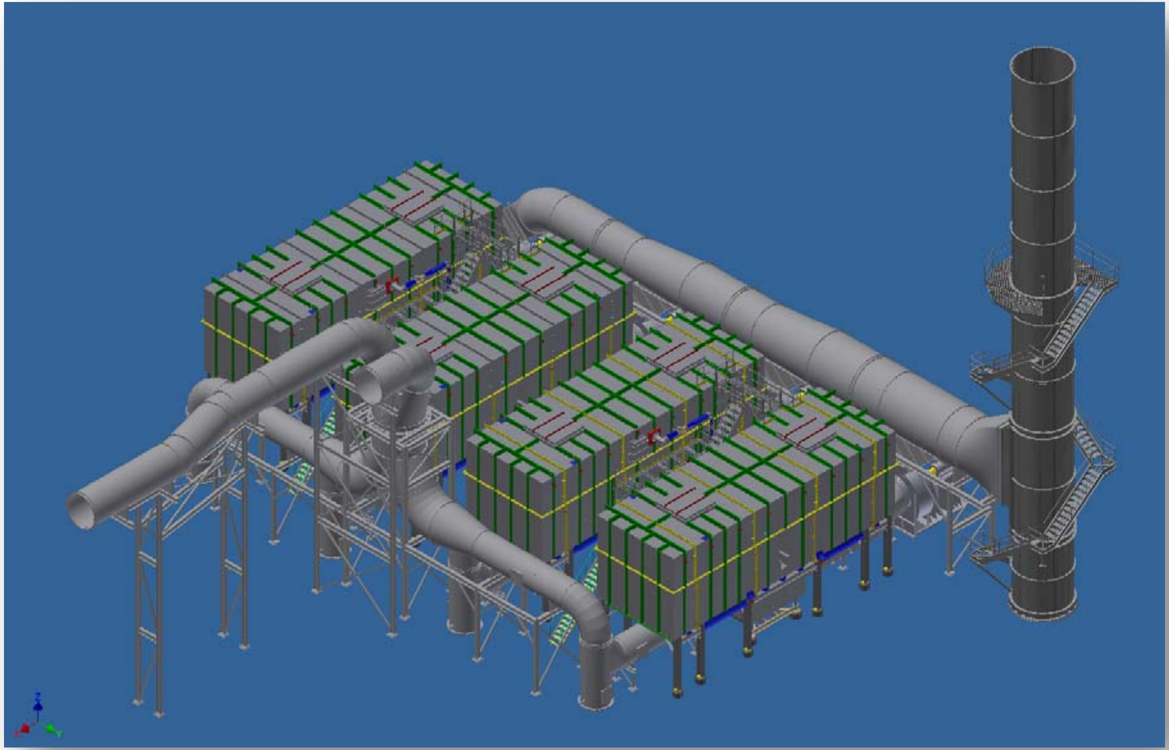
286,000 ACFM - SYP



Energy Savings & Payback

Capital Cost Increase	26%
Fuel Savings	6.2 MM Btu/hr
Electrical Savings	326 kW
Annual Operating Cost Savings	$400-$500,000
Payback	2-3 years

300,000 ACFM – Hardwood/Softwood

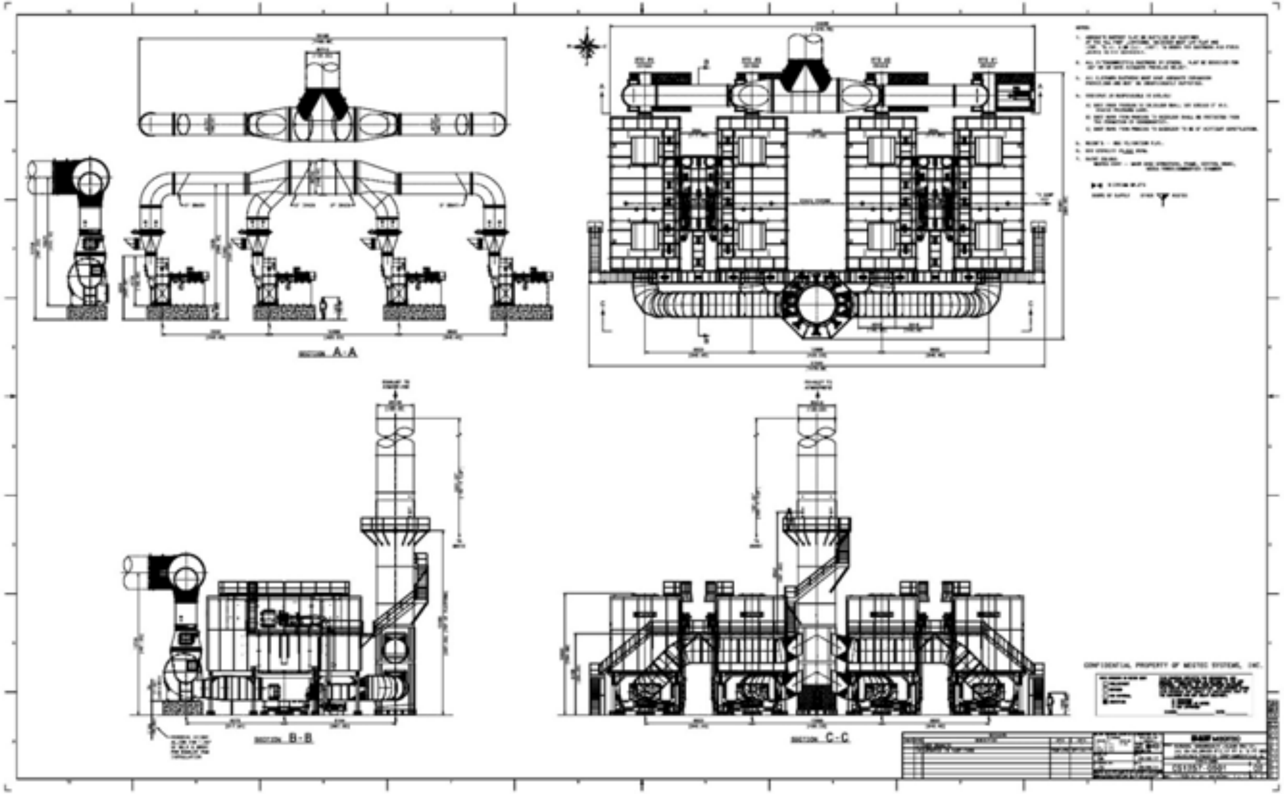


300,000 ACFM – Harwood/Softwood

Energy Savings & Payback

Capital Cost Increase	26%
Fuel Savings	4.9 MM Btu/hr
Electrical Savings	242 kW
Annual Operating Cost Savings	\$300-\$400,000
Payback	4-5 years

300,000 ACFM - SYP



300,000 ACFM - SYP

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300,000 ACFM SYP

Energy Savings & Payback

Capital Cost Increase	27%
Fuel Savings	7.2 MM Btu/hr
Electrical Savings	236 kW
Annual Operating Cost Savings	$400-$500,000
Payback	3-4 years

What We've Accomplished to Date

OSB/Wood	3,800,000 acfm treated
MDF	802,000 acfm treated
Particleboard	600,000 acfm treated
Plywood Veneer	525,000 acfm treated
Total:	5,727,000 acfm treated

Maximize Up Time

- RTO Redundancy
  - 100% plant capacity during predictive or unpredictive maintenance events
  - Lower Operating Costs
    - Natural Gas
    - Electrical
  - Increased Capital Costs
  - Predictive maintenance can be done off-line and in a controlled environment
  - No need to wait for a regular down day or scheduled outage to do maintenance work

Thank you!