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Optimized WESP and/or RTO System Design

Refurbish Instead of Replace

Rodney L Pennington, PE 407 492 1955

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Refurbish and / or upgrade of existing WESP and/or RTOs

Correct problem areas only and reuse existing:

- foundations
- power wiring
- Burners and/or piping
- Other items that are acceptable

Optimize and up grade with new features:

- Replace and/or repair needed components identified from inspection.
- Replace hydraulic butterfly with pneumatic poppet valves
- Replace media cold face support susceptible to failure
- Add flow **distribution nozzles** with uniform air distribution
- Add on line bake out system, **<u>no production down time</u>**
- Add thermal Energy alignment for Energy savings

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Common issues with existing older WESP & Regenerative Thermal Oxidizers (RTOs) which can be corrected:

1. **Poor Uniform Air Flow Distribution** and Temperature Profile
2. Poor water management
3. Heat Exchange Media Failure
4. **Chloride-induced stress corrosion** cracking Failure
    a. Insulation anchor Failure
    b. Media support
5. Media Support Failure
6. Flow Control Valve Failure

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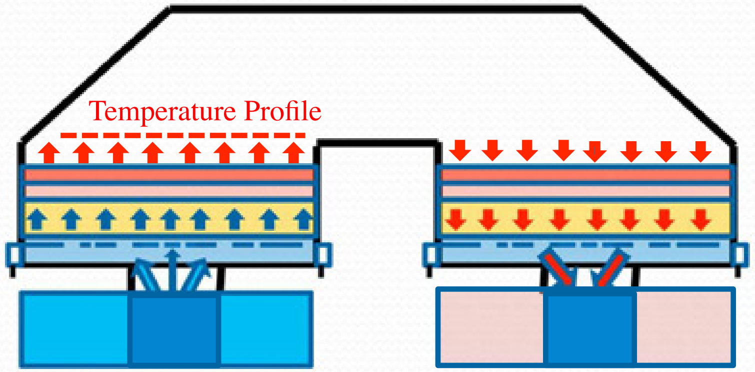
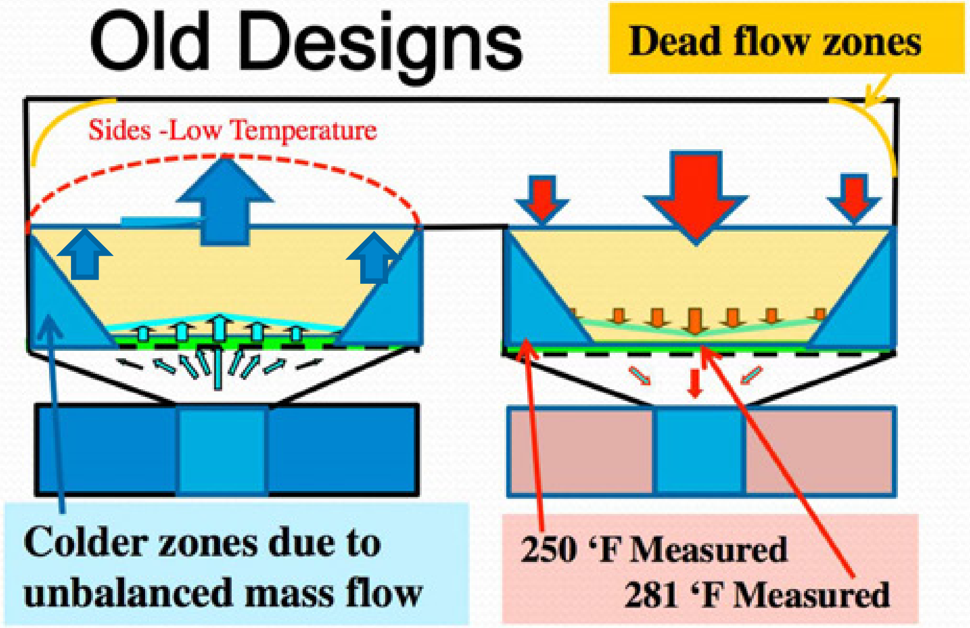
1. Uniform air flow with Uniform temperature…
Minimize un-combusted VOC

MCC RTO



- uniform flow
  - Cold Face distribution nozzle (proprietary)
- uniform temperature control
  - Multiple burners
  - Auto-thermal alignment control (proprietary)

Old Designs



- Increase CO due to non uniform temperature
  - Increased fuel consumption (reduced TER)
- Reduced DRE due to both non uniform flow & temperature
- 2 to 2.5 times larger un-combusted cold face chamber dirty volume exhausted

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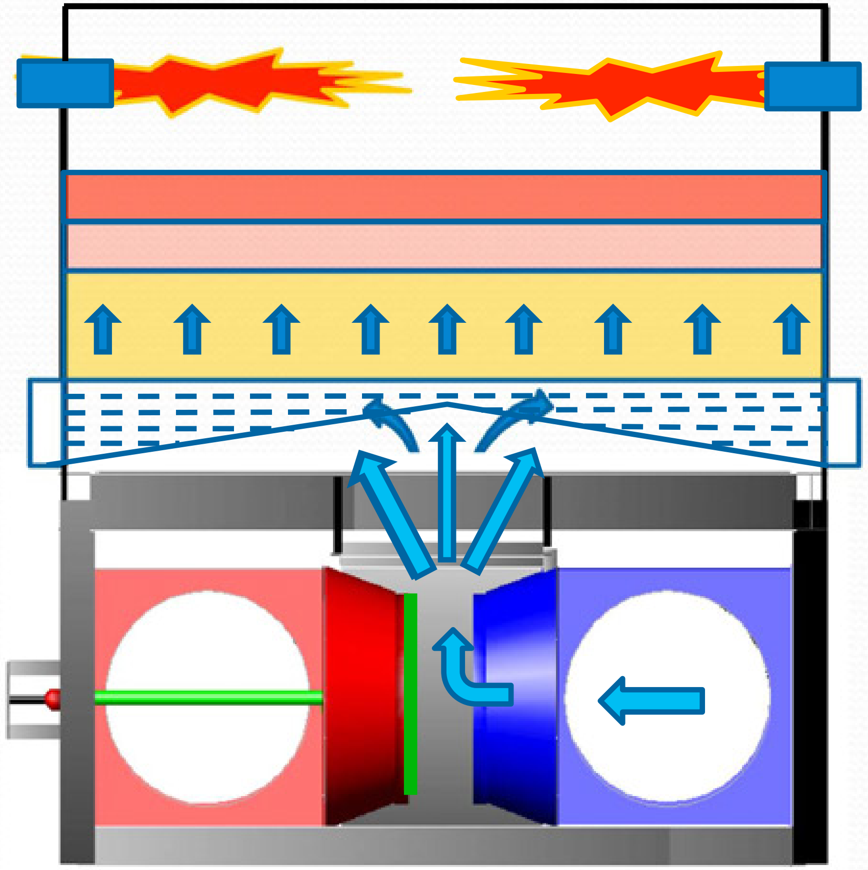
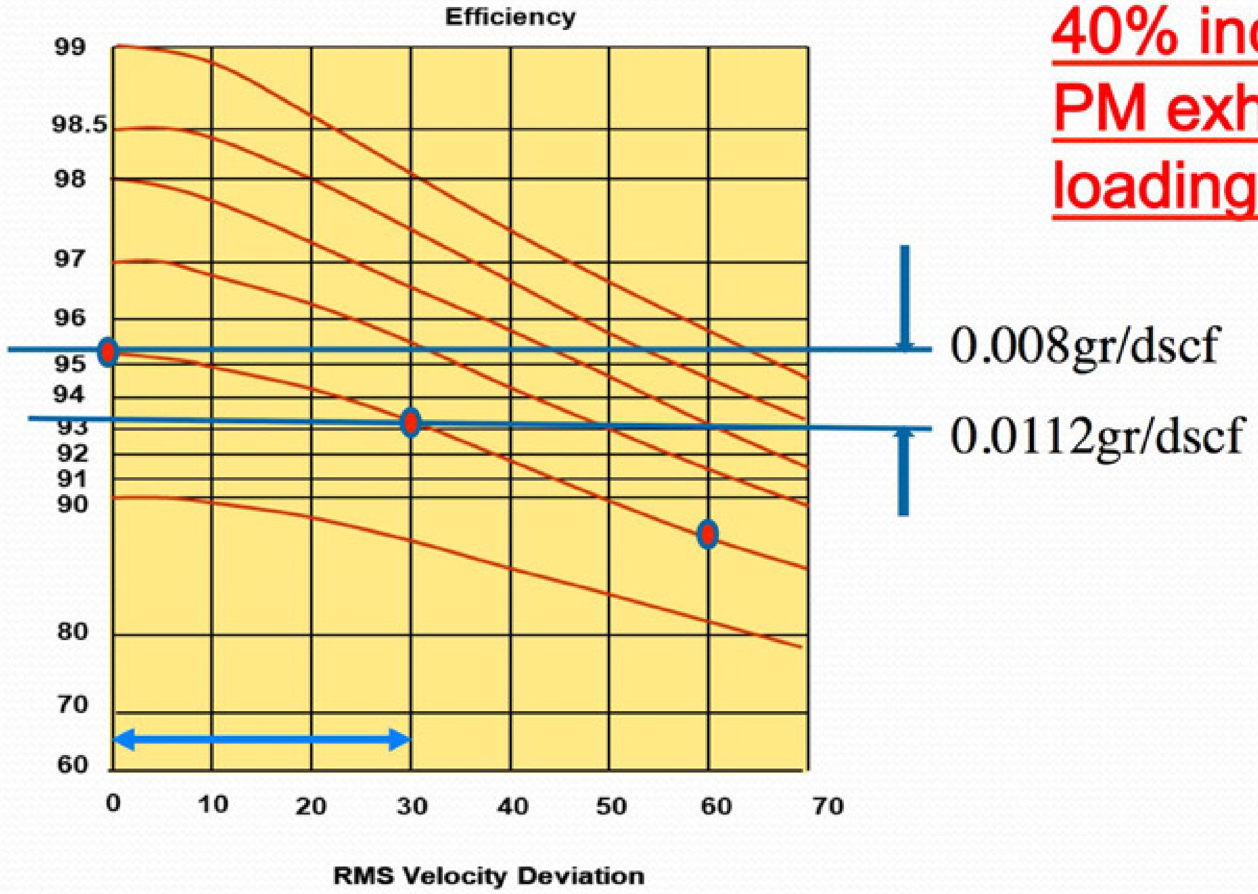
Uniform Air Flow & Temperature Distribution Key to Large Wood RTO UNIT Performance

- Media entry nozzle distributor (can be installed in existing RTOs)
- Symmetrical Center media bed entry & exit
- Contour valve entry
- Over sized valves
- Multi-layered media
- Multi-Burner control



WESP Uniform Air Flow, both up & down Flow, Key for Maximum Performance



40% increase in PM exhaust loading to RTO

Down Flow

Up Flow

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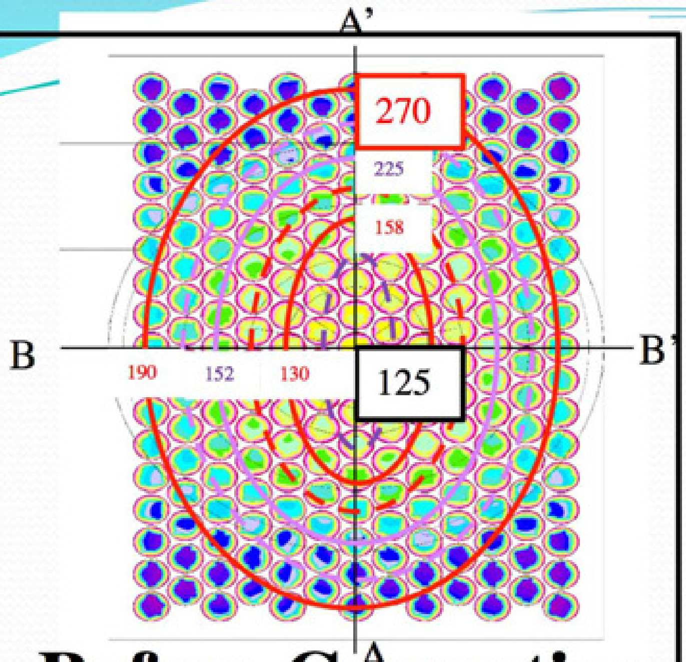
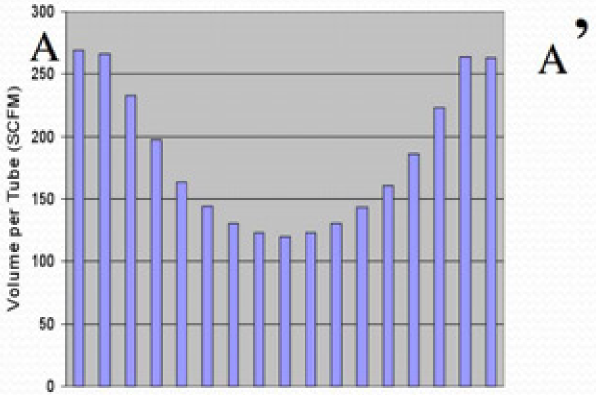
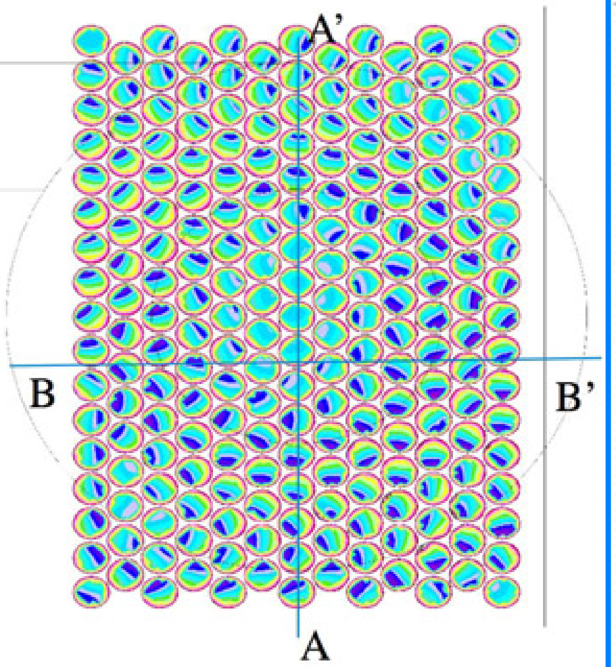
Plan view of WESP tube flow distribution



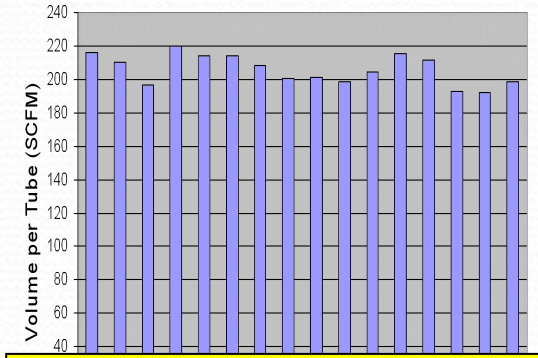
Before Correction



Tube volume variation: ± ~70%



After Correction



Tube volume variation: ± 10%

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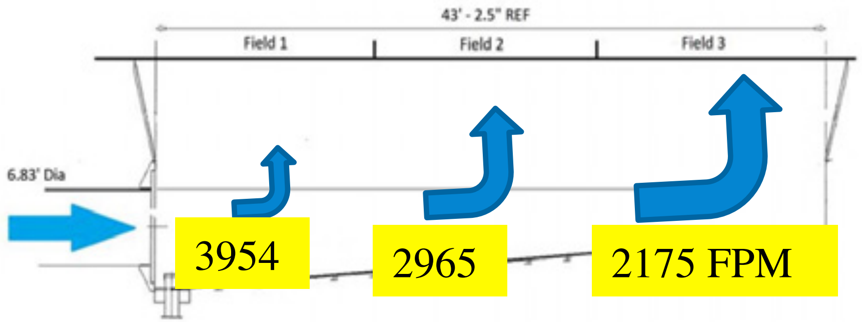
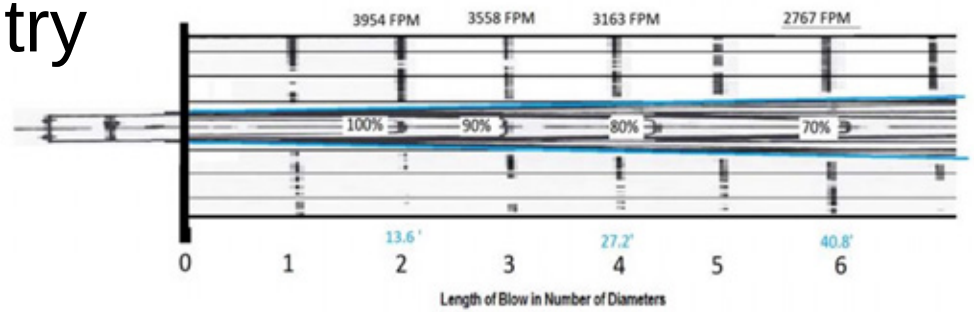
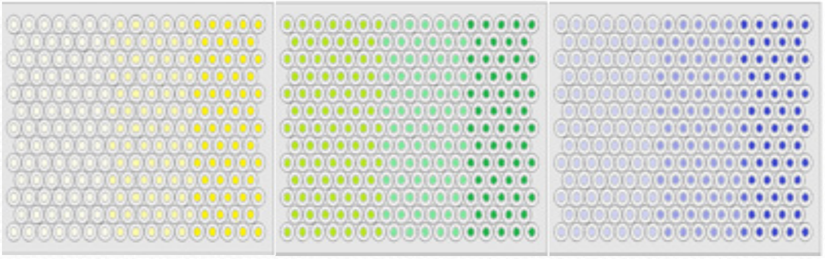
Elevation view of WESP tube flow distribution

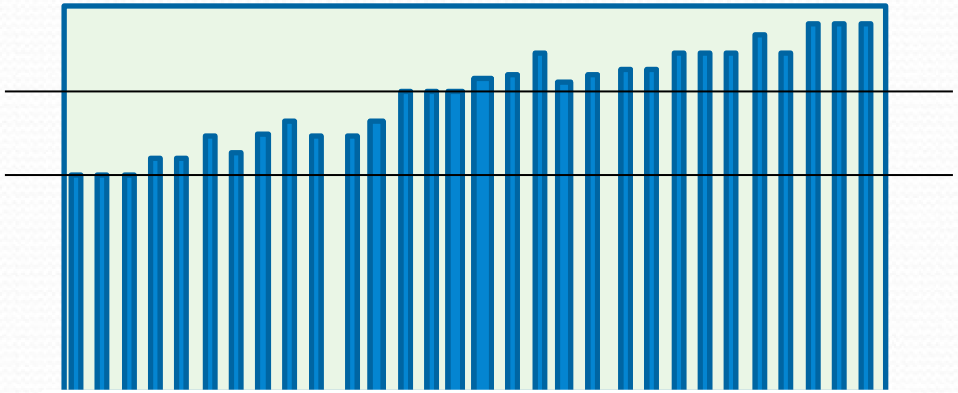


High Entry Flow Velocity



WESP inlet plenum Velocity					
145,000	ACFM flow	WESP inlet duct dia 82"	distance from inlet duct (ft)	Air Velocity	
	Plenum inlet Velocity	6.83		3,954	FPM
	5 dia into plenum		34	2,965	FPM
	10 dia into plenum		68	2,175	FPM





+/- 22% in tube flow = Reduced efficiency

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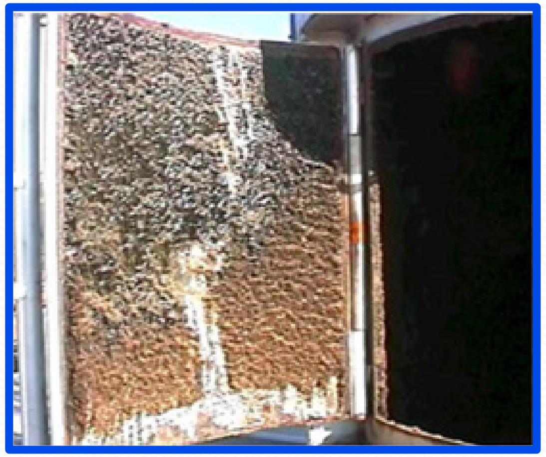
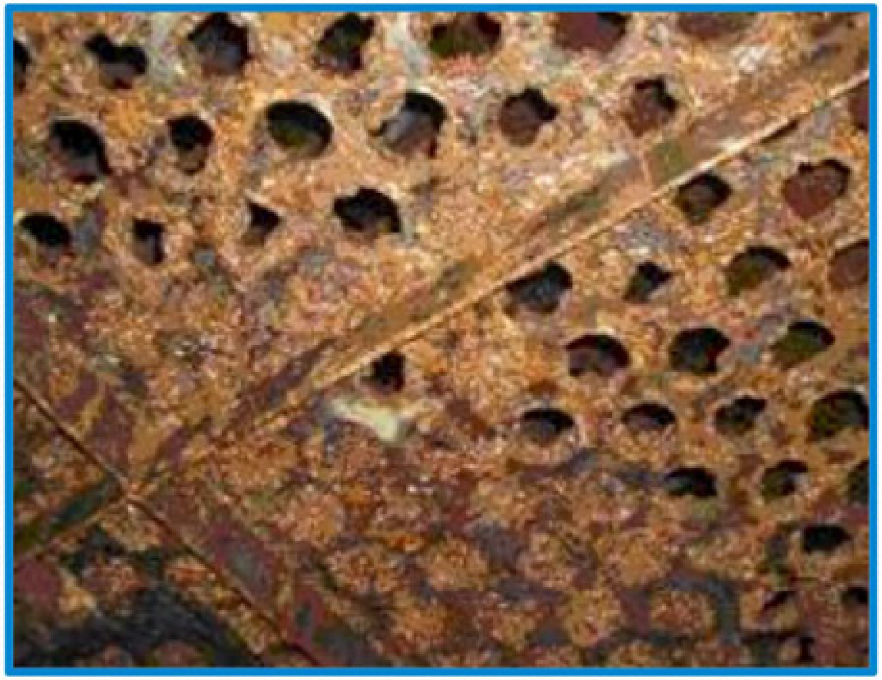
Poor WESP performance results in condensable/PM build up





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WESP water management key for maximum performance

- Separate cleaner water streams from the dirty streams
- Recirculation tank with sloped bottom centrifuge exhaust
- Blow down system to maintain solids less than 5%
- Heated flushing water system
- Caustic with Membrane Cell less than 75 ppm NaCL
- Demisting system to eliminate/minimize water carry over

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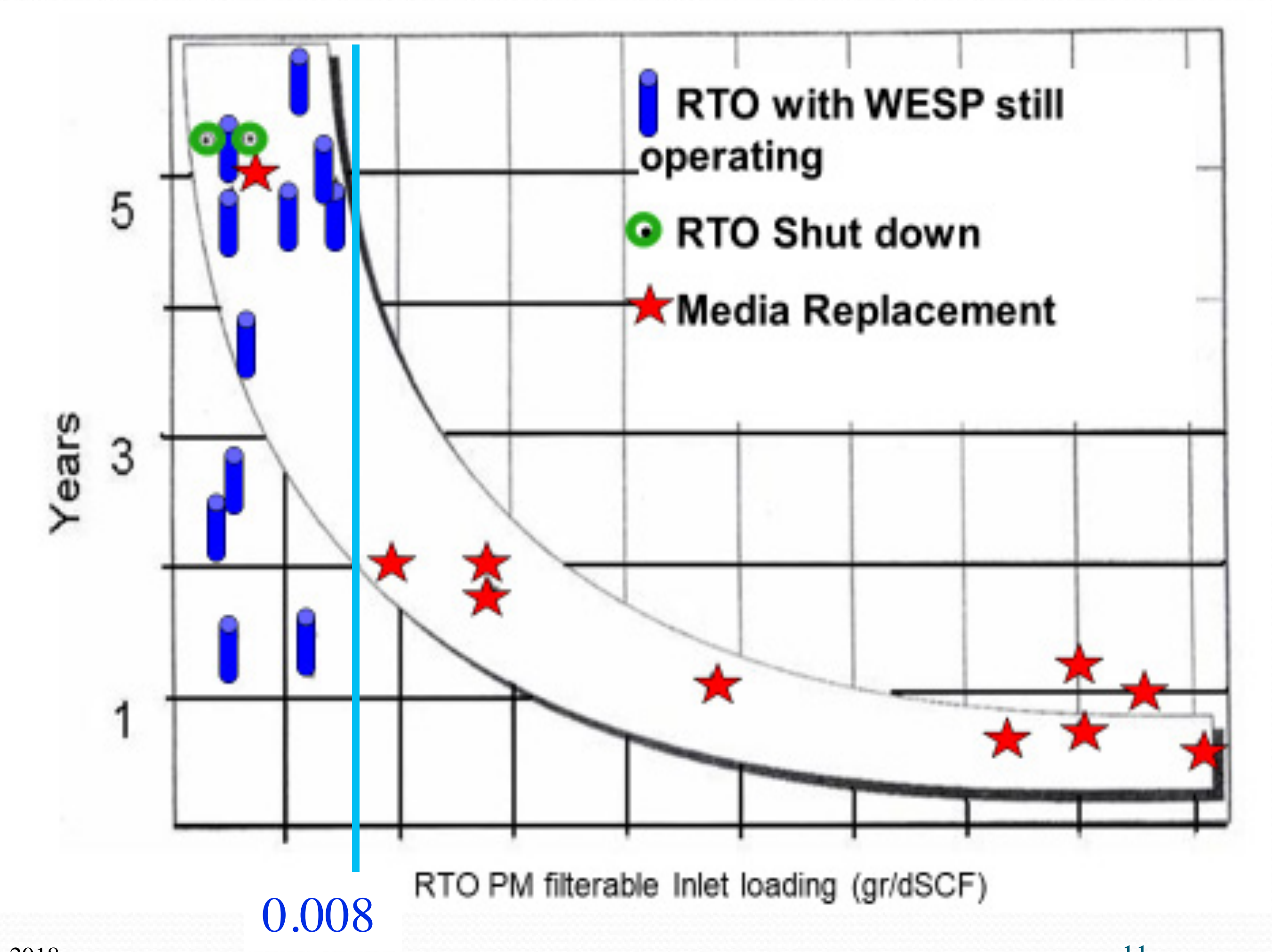
2. RTO Media Life with & without PM (Fly-ash) Control
On Wood fired dyer applications



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RTO Heat Exchange Media failures

Selecting the correct media bed composition and type of media, including multiple media layers can eliminate or minimize RTO heat exchange problems.

- Heat exchange media plugging, degradation and fusion due to fly ash, & potassium, etc.



- Media Composition Percentage (% AlO_2 based on fly ash)

Alumina Oxide	17-25	18-23	18-28	27.4	30 - 33	30-41	45-55	55-65
Silicon Dioxide	> 73	65-75	63-75	65	60 - 64	52-63	37-47	25-30
Sodium Oxide	4	2 - 4	1 - 4	4.1		0-1	0-5	0-0.5
Potassium Oxide					2 - 3	0-5	0-5	1-1.6

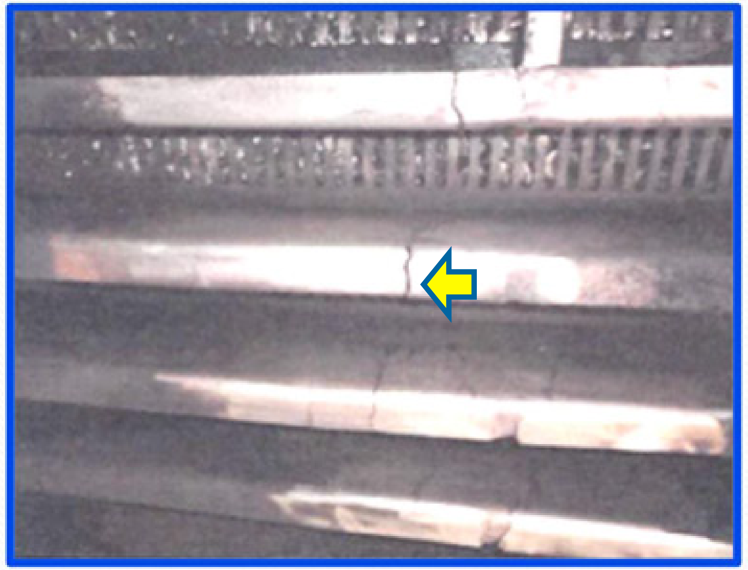
- Burner flame impingement (combustion chamber design)


3. RTO Chloride-induced stress corrosion cracking (SCC) Failures

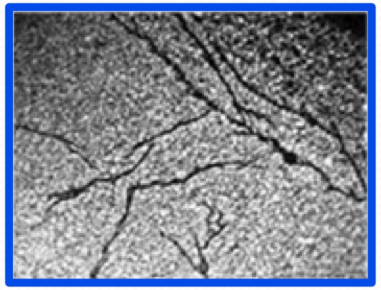
OCCURS when very specific conditions exist **simultaneously:**

1. Chlorides present in the environment where austenitic stainless steel is being used.
2. The metal surface must be wet; that is, liquid water must be available.
3. Threshold stress must be exceeded for cracking to initiate or propagate.

Insulation anchor failure with 304 SS RTO



304 SS cold face SCC failures



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RTO Chloride-induced Stress Corrosion Cracking solutions

SCC can be minimized, and often eliminated entirely, by removing one or more of the necessary conditions:

1. Use a WESP Caustic with:
   - (NaOH with Membrane Cell <75 ppm NaCL)
2. Minimize WESP water droplet carry over to RTO
   - Small droplets after WESP ..... < 5 micron
   - Chevron with uniform flow
     - Sizing
     - Washing frequency with ~ 3.5 gpm/ft2 at 30 psi at spray nozzles
3. Install a moisture barrier and/or use a stainless steel with high resistance to Stress Corrosion Cracking.
4. Located media supports out of the process flow. (proprietary design)

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4. RTO Media Support Failures

Thermal expansion not accounted for

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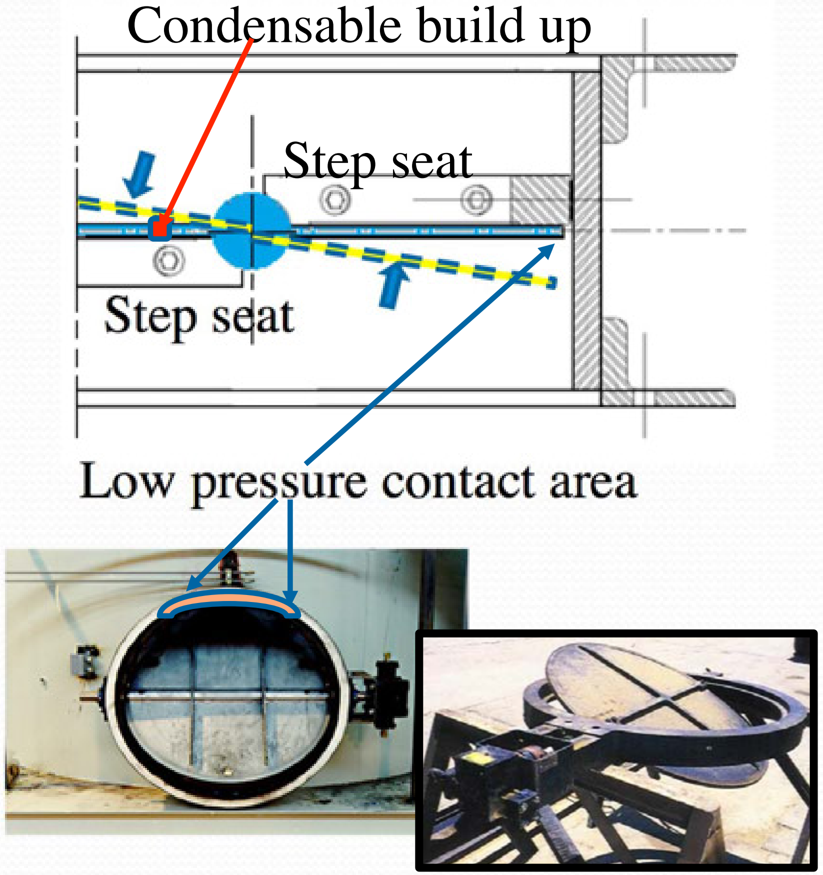
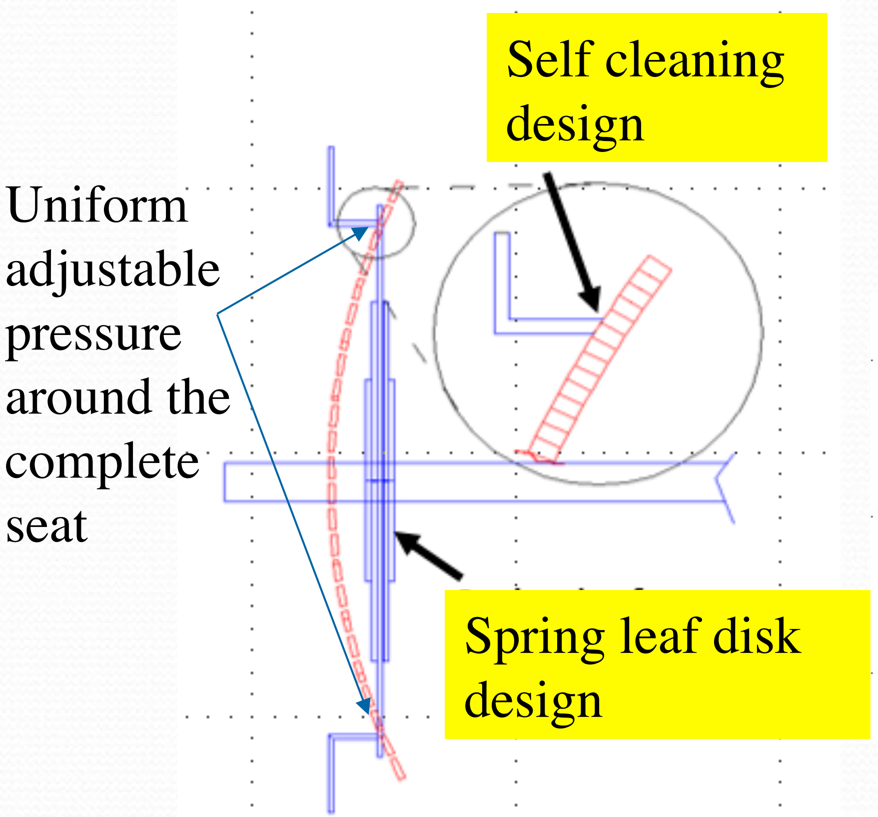
5. Flow Control Valve Failures

Butterfly Valve

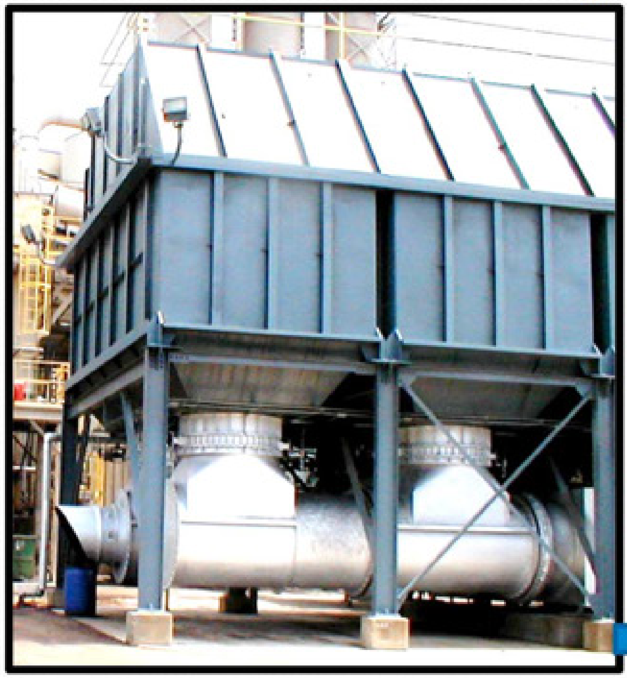


Poppet Valve

Horizontal shaft

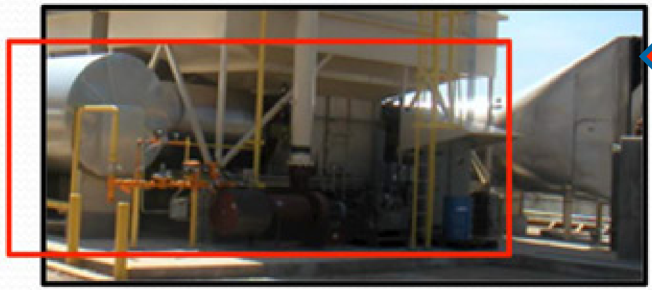


Replace hydraulic butterfly valves with pneumatic Poppet valves



Slide poppet valve assembly under heat exchange chambers

From this to this or this



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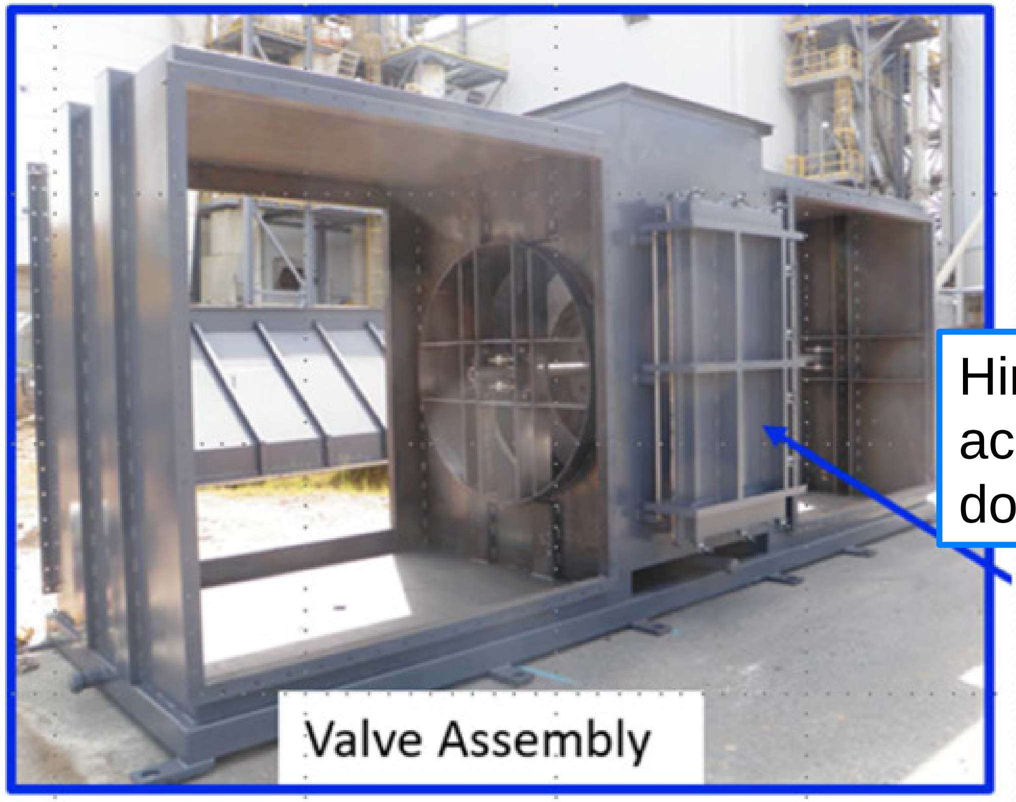
Easy Access for inspection and/or maintenance of Flow Control Valves



Existing seven (7) chamber single combustion chamber, hydraulic butterfly valve RTO up graded to a MCC (multi-combustion chamber) RTO design.

Several new features were added to reduce the overall operating costs and improve reliable uptime operation. Original **104,000 wSCFM** with 95% DRE, tested at **152,000 wSCFM** at 96.7% DRE on CO and VOCs.

- Replaced and/or repair needed components identified from inspection.
- Replaced hydraulic butterfly with pneumatic poppet valves
- Replaced media cold face support
- Added flow distribution nozzles with uniform air distribution
- Add on line bake out system, no production down time
- Added thermal Energy alignment for Energy savings

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Existing seven (7) chamber single combustion chamber RTO up graded to a six (6) chamber MCC (multi-combustion chamber) RTO

From this 7 chamber

To this 6 chamber MCC

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Combustion chamber converted to the MCC RTO Design

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Up graded burner system

From this

To this – with ground level controls

Individual combustion chamber control- uniform temperature with fuel savings

RTO/RCO **<u>on line bake out</u>** can be schedule on a frequency requirement based on the specific RTO needs rather than on available process down time.

On Line Bake out;

- provides a **<u>significant savings</u>** in lost production time,
- virtually **<u>eliminate the potential for large accumulations of organic material</u>** in the RTO/RCO,
- essentially **<u>eradicate the associated potential for run-away fires</u>** that typically occur with offline bake outs due to excessive organic build within the RTO/RCO,
- substantially **<u>reduce the energy consumption</u>** that is associated with off line bake out.
- 1/3 of the Bake out exhaust is mixed with the other 2/3 normal flow up the stack

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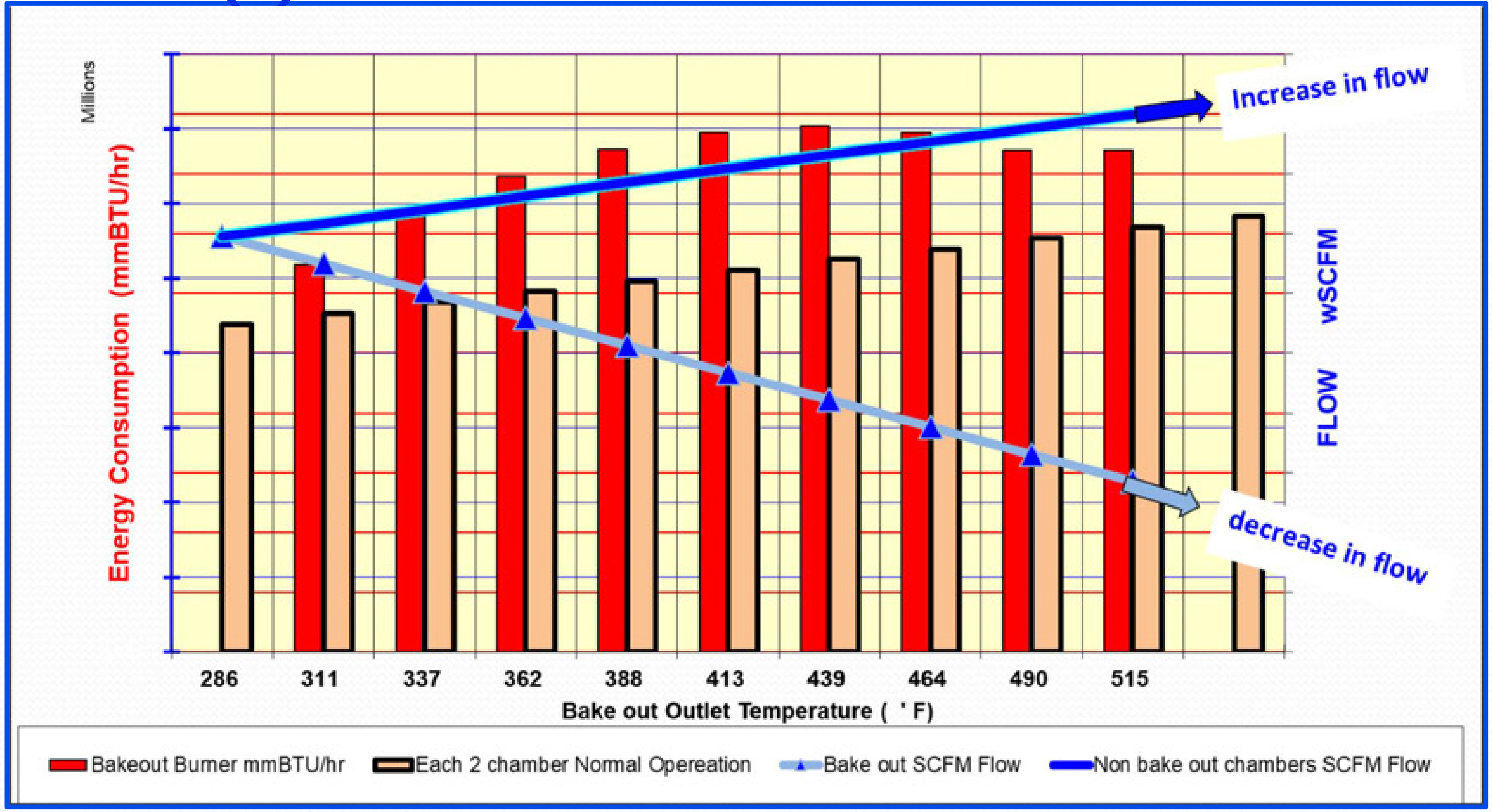
RTO/RCO on line Bake Out
One (1) of the 2 chamber section at a time



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Thanks for your Attention.
If you have specific questions or would like additional information, please see us at our Booth #216 or the NESTEC web site.

407-492-1955

Rpennington@NESTECInc.com

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