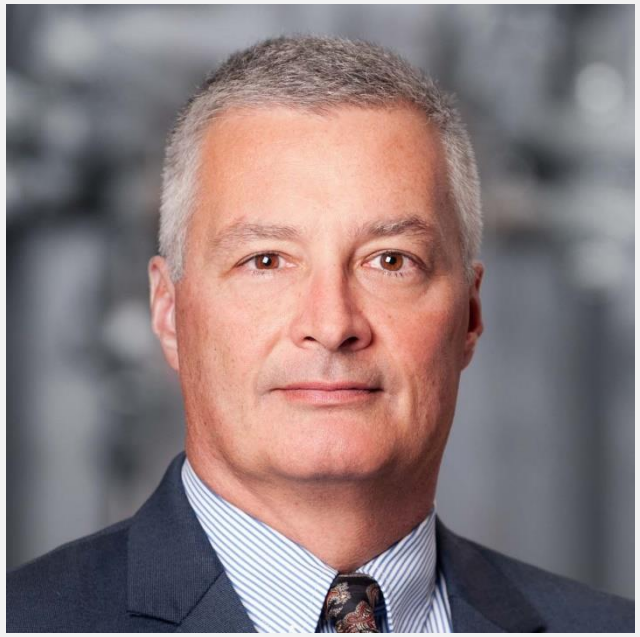
Blasch Precision Ceramics

The StaBlox™ Reformer Flue Gas Tunnel System

BLASCH PRECISION CERAMICS

Where your ideas take SHAPE in CERAMIC

Jeffrey Bolebruch



Vice President of Sales

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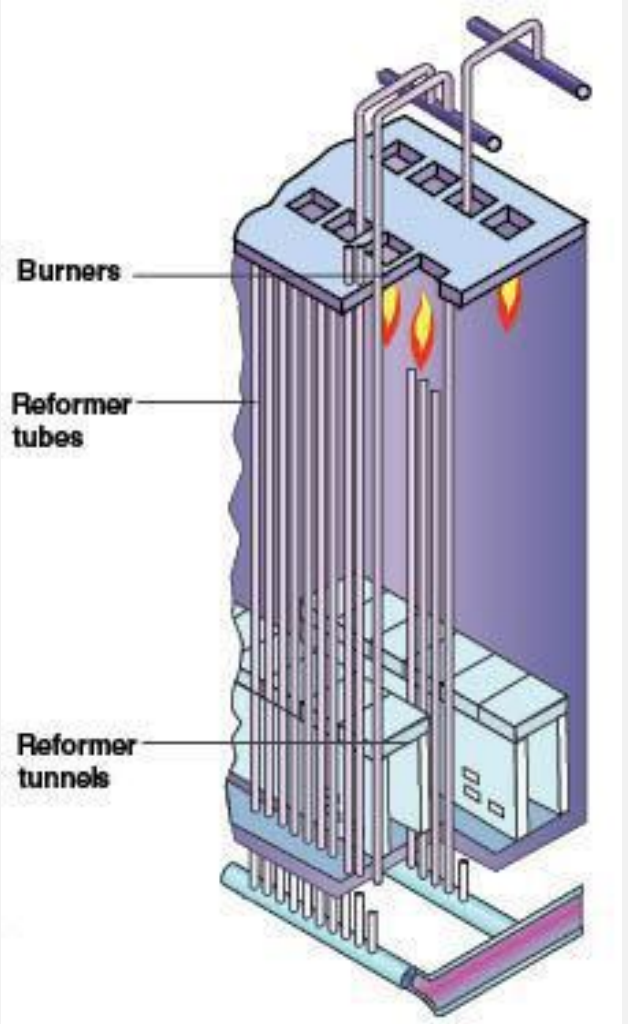
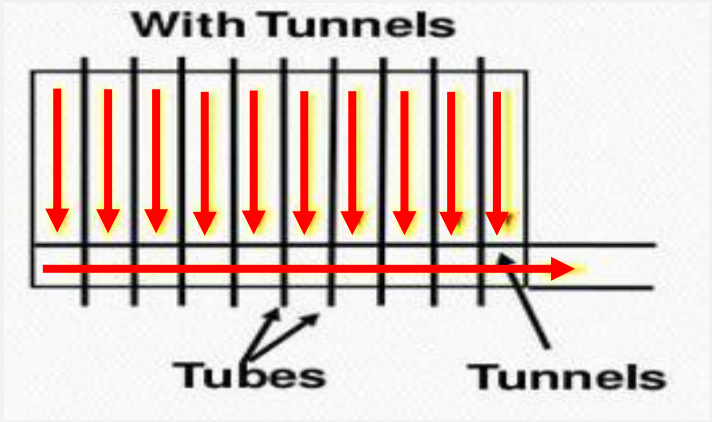
Introduction

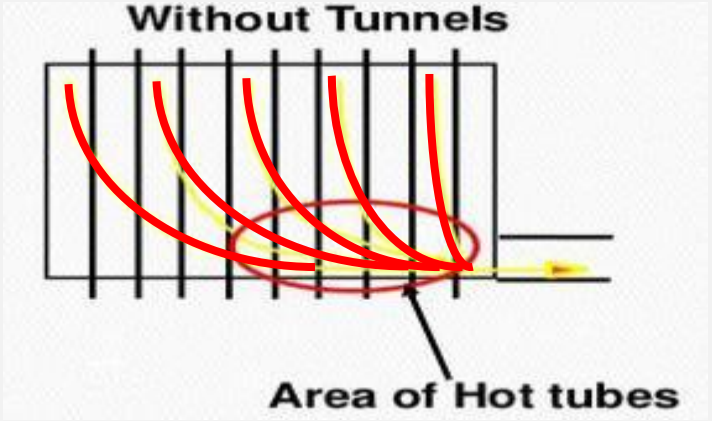
Radiant Section Components

- Catalyst Tubes
  - Reform: H2O(g) + CH_4 -> CO + $3H_2$
  - Arranged in rows
- Arch Burners (top mounted)
  - Produce flue gas (exhaust)
    - Radiation
    - Convection
  - Arranged in rows
- Tunnels (coffins)
  - Collect flue gas through engineered openings
  - Transport flue gas to convection section





Introduction

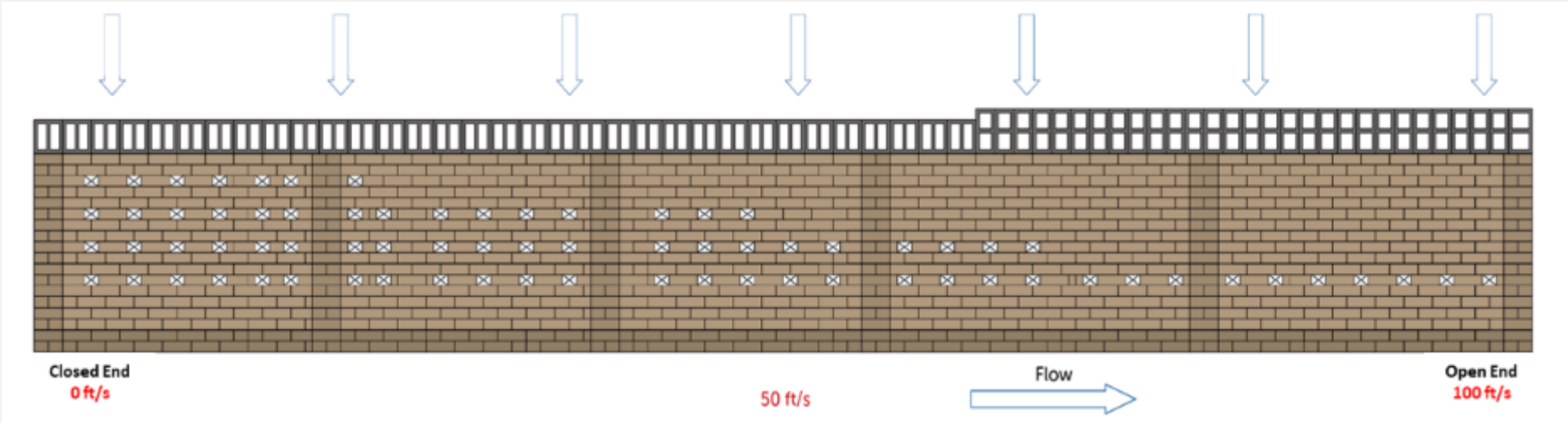


Tunnels

- Transport flue gas out of radiant section
- Essential for uniform flow
- Produce downward flow and more uniform heat transfer

Characteristics of Flue Gas Flow

- Uniform incremental flow along length of tunnels
- However, there is a gradual increase in:
  - In-tunnel velocity
  - Cross-wall static pressure differential
- Therefore, a gradual decrease in open area is required



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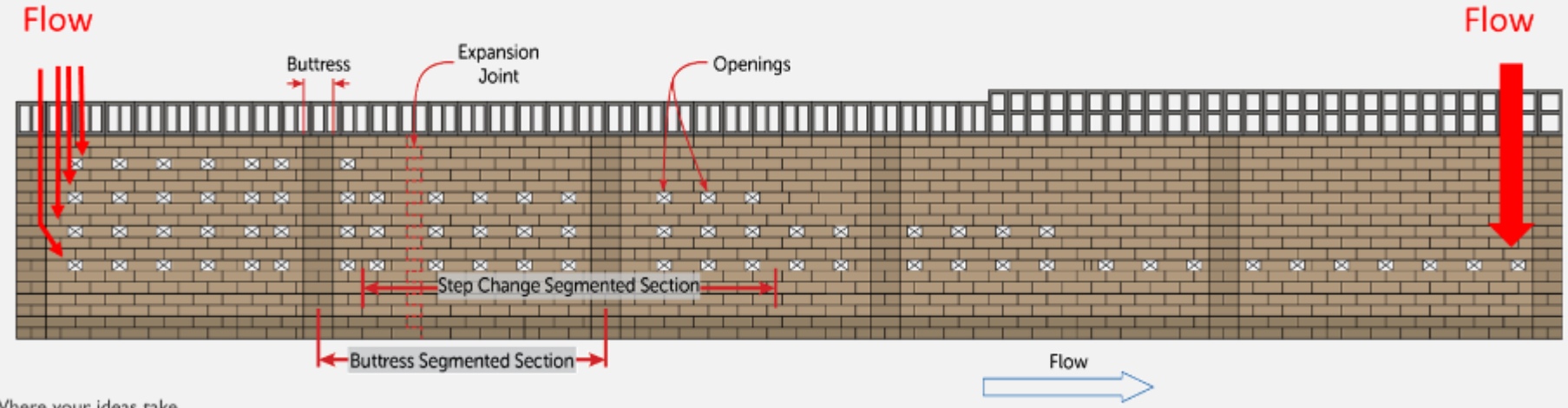
Non-Ideal Physical Features

- Openings
  - Large increments
  - Large step changes
- "No flow" regions
  - Buttresses
  - Expansion joints
- Non-uniform base course flow



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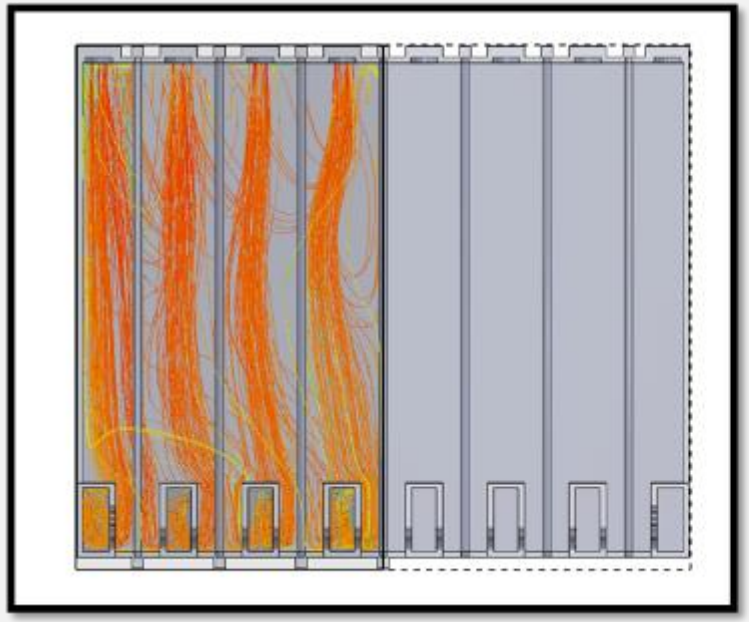
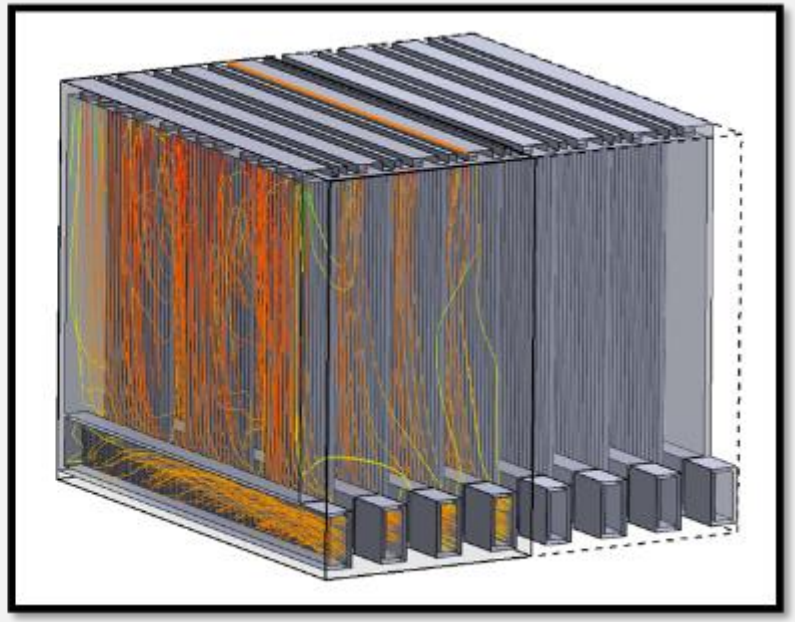
Modeled Effects of a Single Missing Tunnel

All Tunnels Present

Results - Reforming Furnace with all tunnels

Flow trajectories from the CFD results show that a reforming furnace operating with all tunnels will have a flow field covering the entire furnace, as designed. This theoretical reforming furnace could benefit from burner and tunnel port balancing to optimize the overall furnace profile.

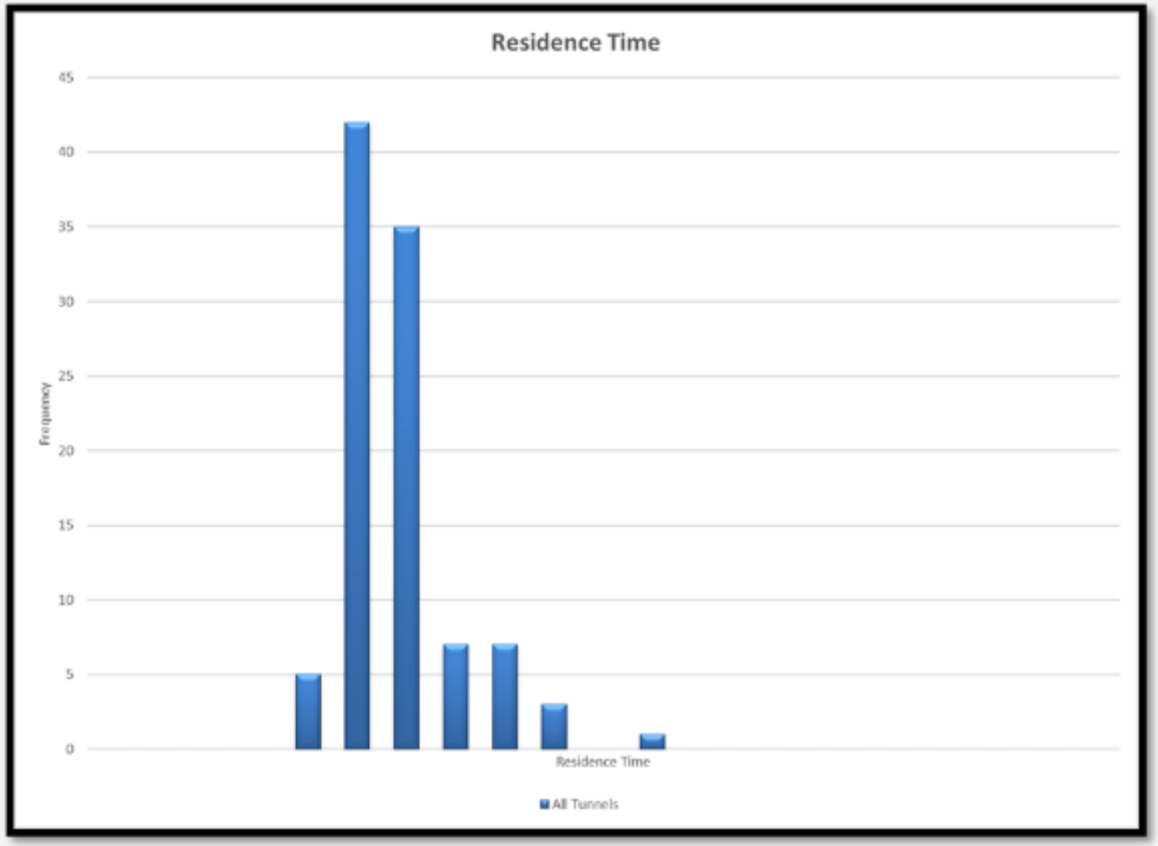




All Tunnels Present

Results - Reforming Furnace with all tunnels

Uniform residence time is an important aspect of furnace efficiency, as total heat transfer is dependent on time. This graph shows a histogram of the time it takes specific particles to travel from the burners overtop of the outside tunnel row to the furnace exit.



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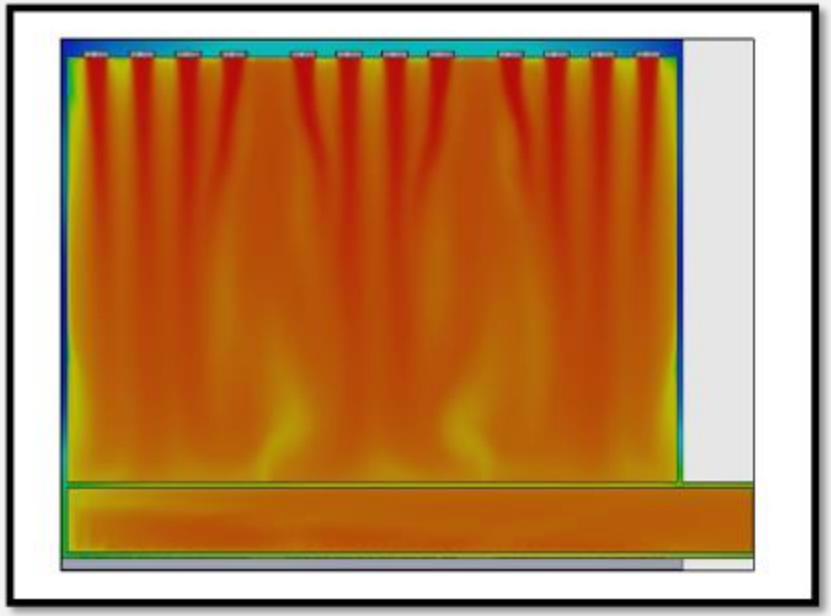
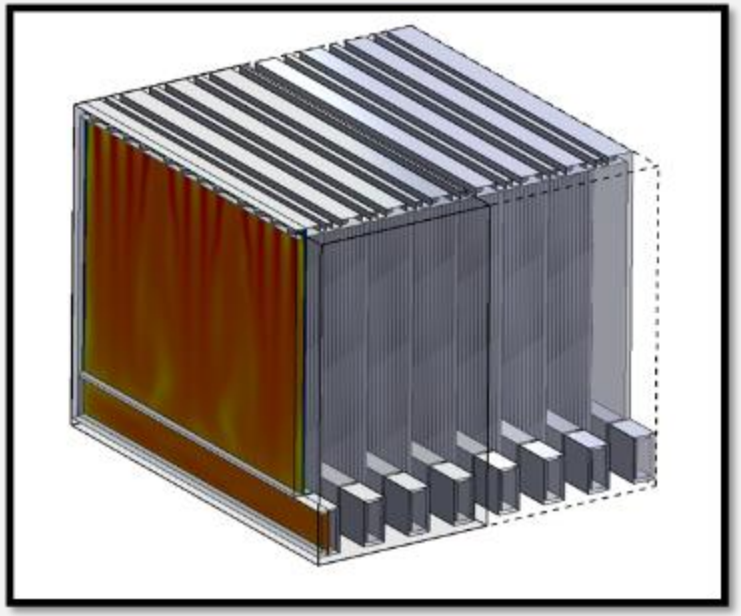
All Tunnels Present

Results - Reforming Furnace with all tunnels

A temperature profile inserted vertically in the middle of the outer tunnel shows the flow field of the burners.





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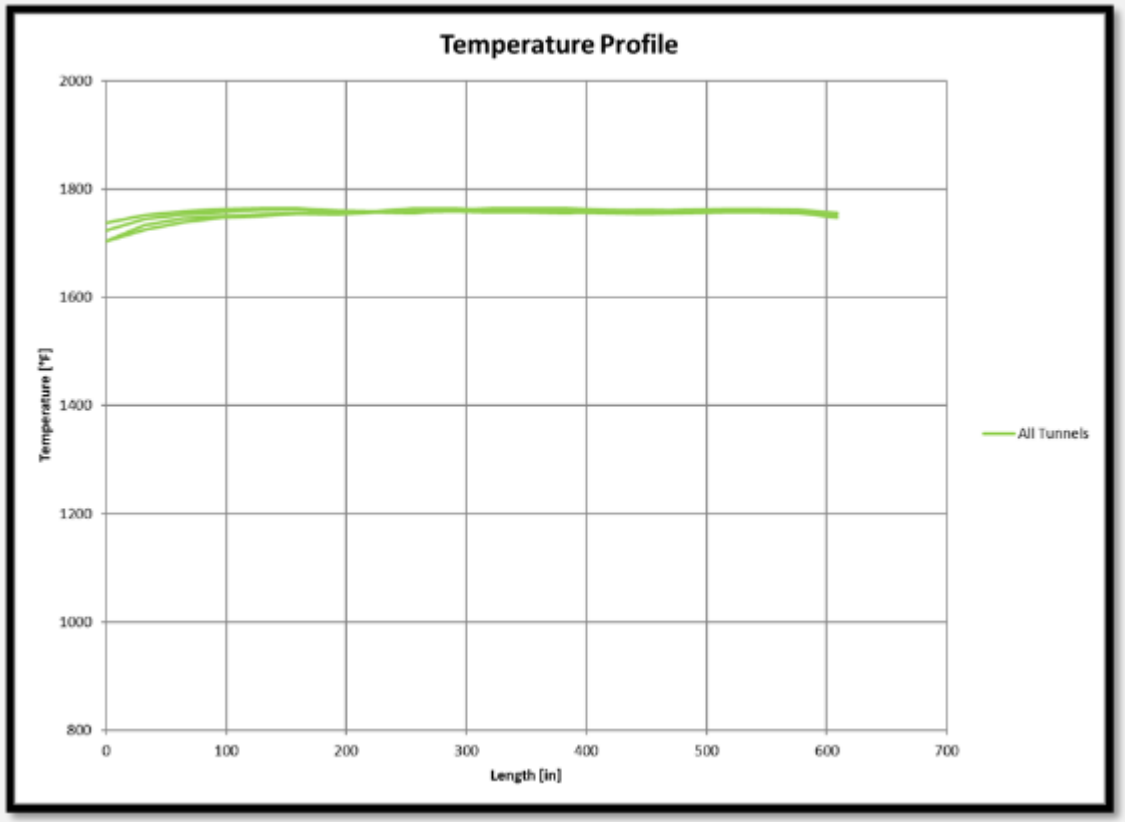
All Tunnels Present

Results - Reforming Furnace with all tunnels

Temperature data points can be taken along the length of the middle of each tunnel, 18in above the furnace floor. This graph shows those data points, with right side of x axis representing the exit of the tunnels.



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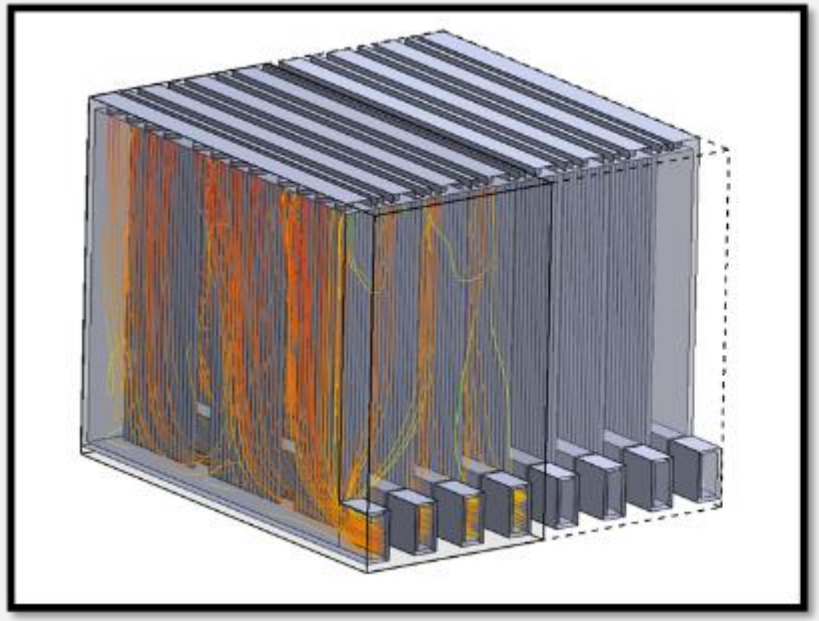
Missing Outer Tunnel

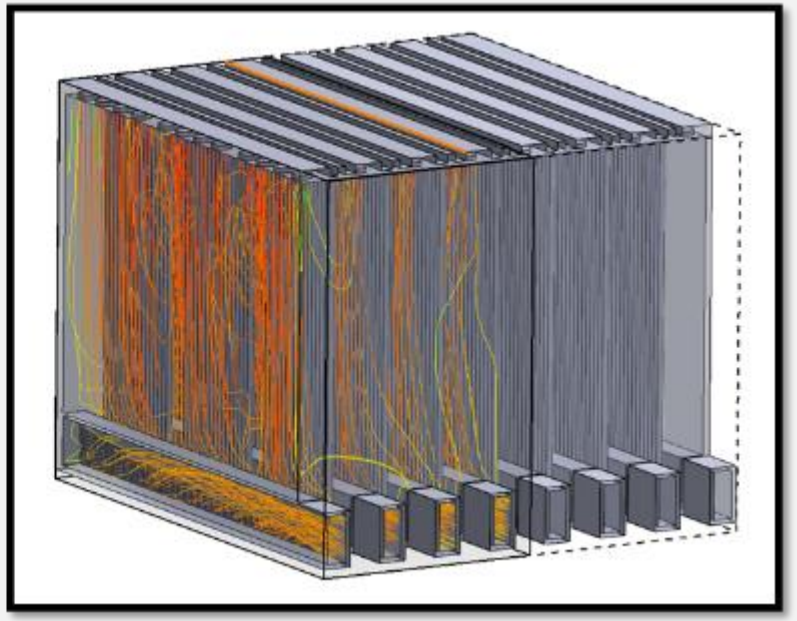
Results - Reforming Furnace without an outer tunnel

Flow trajectories show that a reforming furnace without an outer tunnel will have non uniform flow conditions.

Reforming Furnace without an outer tunnel



Reforming Furnace with all tunnels



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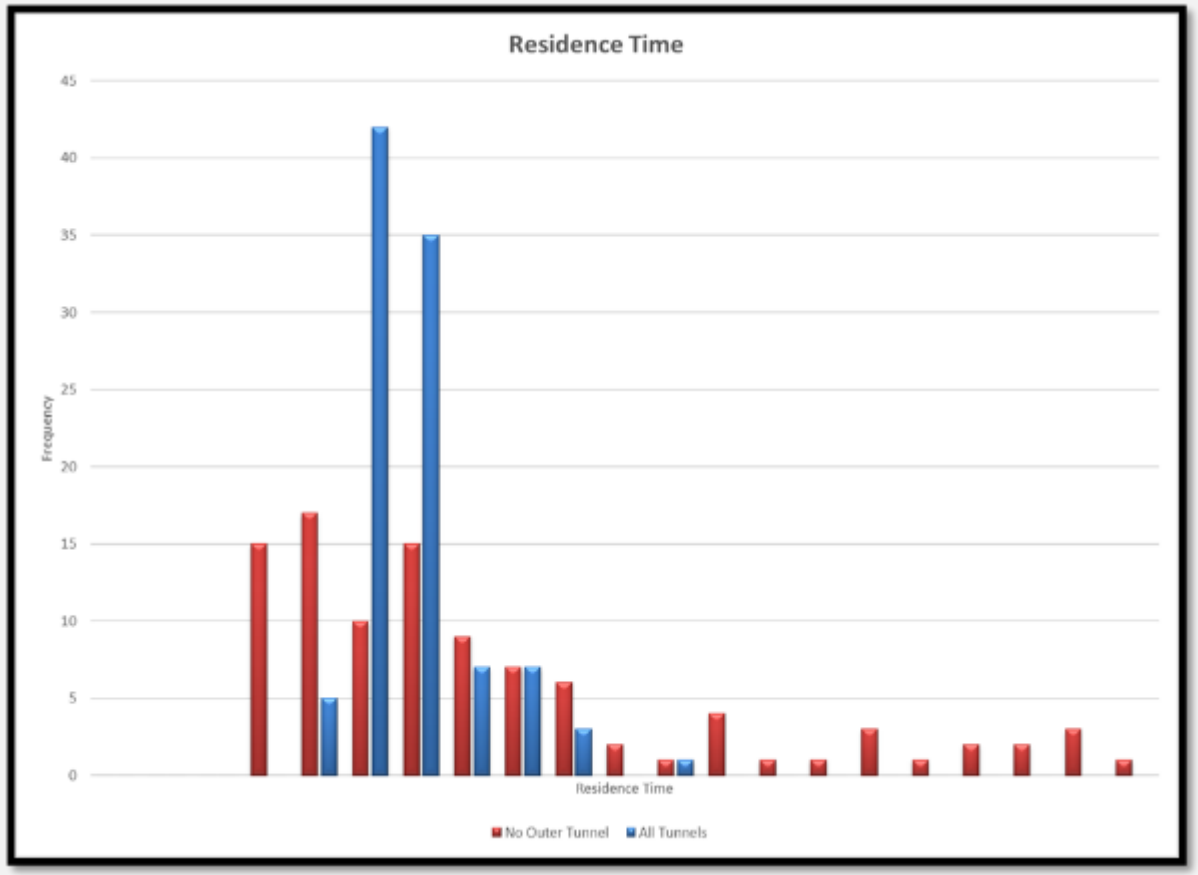
Missing Outer Tunnel

Results - Reforming Furnace without an outer tunnel

The non uniform conditions shown by flow trajectories result in a wider range on a residence time graph



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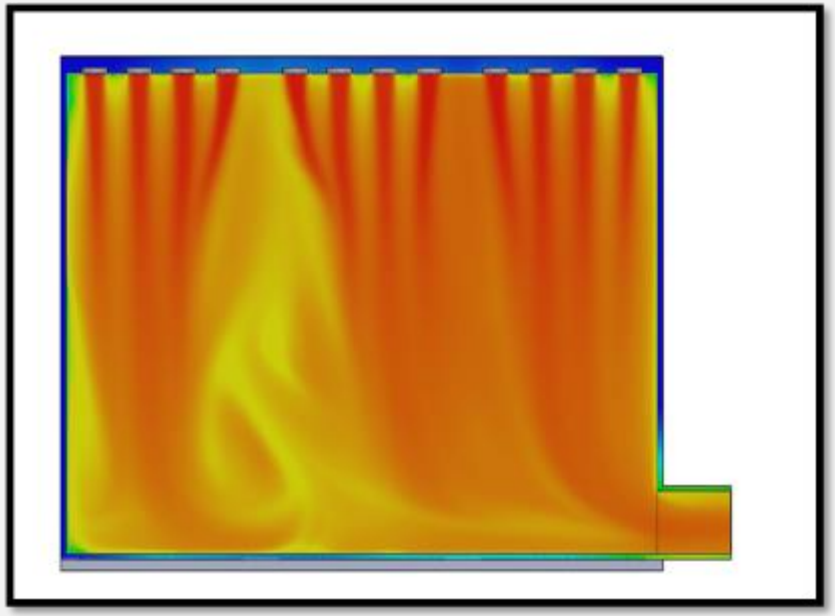
Missing Outer Tunnel

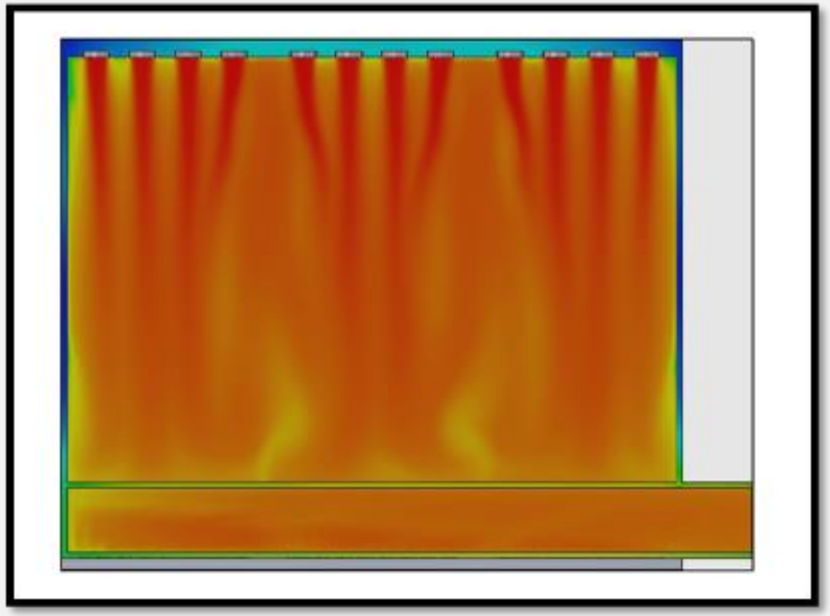
Results - Reforming Furnace with an outer tunnel

A temperature profile inserted vertically in the middle of the outer tunnel shows the flow field of the burners

Reforming Furnace without an outer tunnel



Reforming Furnace with all tunnels



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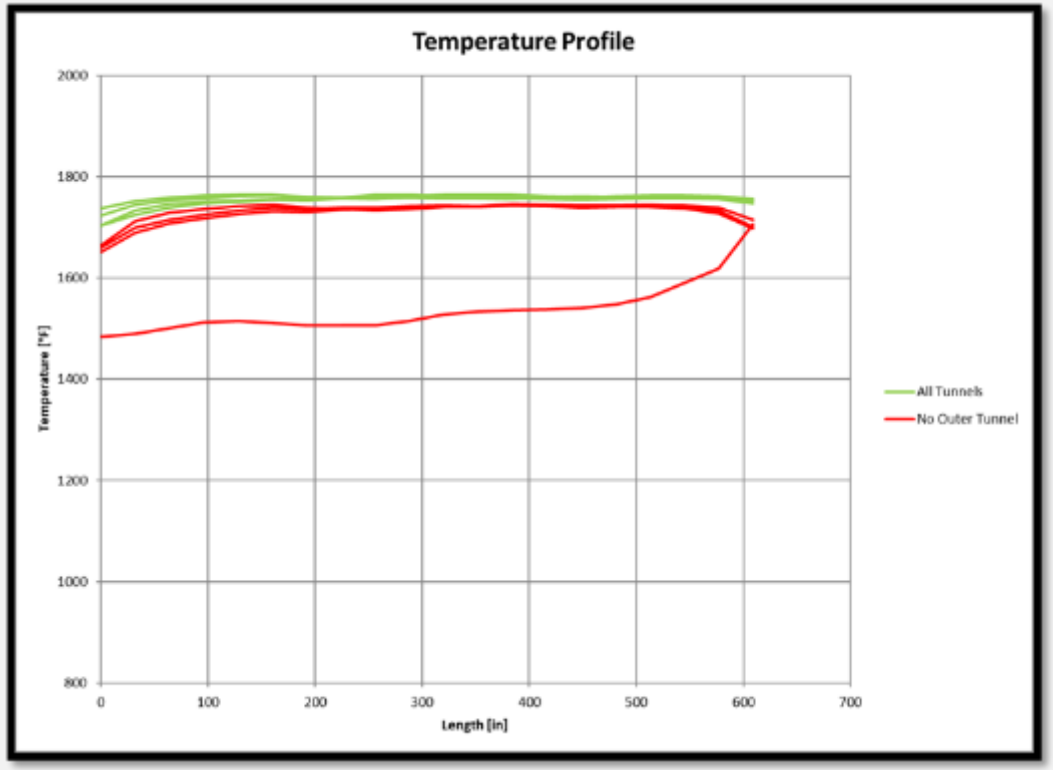
Missing Outer Tunnel

Results

Temperature data points taken along the length of the middle of each tunnel are plotted here. Each line represents one tunnel, with the outlier red line coming from the area where an outer tunnel would be.

Average temperature inside of tunnels with all tunnels intact: 1753 deg. F

Average temperature inside of tunnels without outer tunnel: 1681 deg. F
Average temperature inside of area where outer tunnel would be: 1537 deg. F



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The StaBlox™ Reformer Flue Gas Tunnel System

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StaBlox™ Tunnel System

- Modular stackable components
- Expansion joints built-in
- No mortar necessary
- Consistent hole layout
- Infinitely adaptable
- Variety of materials available
- Skilled bricklayers not required

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Mullite Base Components

- Installed above insulating castable, brick, or silica block layer
- Sets the spacing for the side blocks
- Distributes tunnel load over roughly 5x as much area
- Ties walls together/sets width
- Hollow design reduces mass

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Mullite Side Wall Block

- Strong/lightweight
- No mortar necessary
- Engineered expansion
  - Fiber gaskets in joints
  - Leak tight at design temperature
- Uniformly distributed expansion gaps prevent snaking
- Hollow design reduces mass & thermal stress

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Mullite Hollow Covers

- Strong/lightweight
- No mortar necessary
- Ties together wall blocks
- Shiplap joints prevent leakage
- Built-in walkway support feature
- Hollow design reduces mass and thermal stress

Multiple Orifice Inserts

- Variable opening sizes allow user to match flue gas flow to current configuration
- Modular components flexible design

Reduced Install Time

- No mortar
- Fewer parts
- Lighter system
- Less complex installation – No cutting
- No dry out required
- Reduced critical-path turnaround time

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Thank You!

Questions?

Visit www.blaschceramics.com
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