



Specialists in Thermal Applications

www.furnxpert.com

FurnXpert Refractory Heat Loss software offers the ability to run Heat Loss calculations through multiple layers of refractory. The results constitute temperature profile from the hot surface to the cold surface, Junction Temperatures, Heat Flux and Heat Storage. The analysis can be performed on a straight or curved surfaces. Transient analysis to determine temperature rise with time can also be performed with the Transient module.

We have come up with a new module *FurnXpert Insulation Design* which extends the software to perform insulation design for various applications. The design criteria takes into account safe outside skin temperatures, target heat flow rate, energy savings, and economics.

The presentation is prepared to demonstrate the capabilities and features of Insulation Design Software. The slide indexing are as follows

Slide 4 - 6 – The over view of the original software

Slide 7 – The over view of the new module

Slide 8 – 9 - Cases for Target Outside Temperature – Criteria 1.

Slide 10 – 11 – Cases for Target Heat Flow Rate – Criteria 2.

Slide 12 – Case for Fuel Costs and Savings – Criteria 3.

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File Edit Tools Help

Home Tab Calculation Results Pr

Click to work from a created file

Unit System Metric Watt

Accuracy High

Select Unit System – Only before creating a new Analysis

Gas Convection on Hot Side

Check this to enable Gas Convection On Hot Side

SETUP FURNACES
SIMULATE FURNACES

furnXPRT

CompAS Controls, Inc.
P O Box 61825
Sunnyvale, CA 94085
Ph: (724) 388-0577
info@furnxpert.com

www.furnxpert.com

FurnXPRT is a desktop software that simplifies the job of SETTING UP and SIMULATING industrial furnaces. The software has been developed to aid process engineers and furnace operators configure their furnaces, select parts, and run what-if analysis to determine the best furnace operating parameters.

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Or Start a New Analysis

ANALYSIS # [] CUSTOMER [] EQUIPMENT []
ENG. INITIALS [] LOCATION [] DATE []

Unit: Metric Watt | Analysis #: | Company: | Project:

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File Edit Tools Help

Home Tab

Click to save project in a file

INPUTS

For Forced convection put velocity of air. Emissivity default value is 0.92

Curved and Straight wall can be analyzed in the same form just by changing selection

Hot and Cold Side Temperatures

Click Calculate

Enter Data or by selecting a existing file the fields will be automatically populated

Refractory List

| Ref Name | Manufacturer | Product Class | Max Lim | D |
|-------------------------|--------------|---------------|---------|----|
| 1 B & W SR 99 (3300F) | B & W | Firebrick | 1815 | 30 |
| 2 B & W 80 | B & W | Firebrick | 1538 | 22 |
| 3 H.W. Super Duty Alamo | Harbison Wa | Firebrick | 1427 | 23 |

Results

| | H-Temp °C | C-Temp °C | A-Temp °C | H-Loss watt/m ² | H-Storage MJ/m ² |
|-------|-----------|-----------|-----------|----------------------------|-----------------------------|
| 1 | 1315 | 1292 | | | 10 |
| 2 | | | | | |
| 3 | | | | | |
| 4 | | | | | |
| 5 | | | | | |
| 6 | | | | | |
| 7 | | | | | |
| 8 | | | | | |
| 9 | | | | | |
| 10 | | | | | |
| Total | | | | | |

Unit: Metric Watt | Analysis #: | Company: | Project:



RESULTS

Plot Shows Temperature Profile in the refractory layers.

Cold Side Info

Surface Name: Wall

Porous Gas: Air

Surface Orientation: Vertical

Natural Convection Forced Convection

Air Velocity: m/s

Emissivity: 0.92

Hot Side Temp: 1315 °C

Ambient Temp: 32 °C

Surface Type

Flat Curved

Inside Radius: 1100 mm

Surface Area: m²

Refractory List

| Item # | Ref Name | Manufacturer | Product Class | Max Lim | D |
|--------|-------------------------|----------------|---------------|---------|----|
| 1 | B & W SR 99 (3300F) | B & W | Firebrick | 1815 | 30 |
| 2 | B & W 80 | B & W | Firebrick | 1538 | 22 |
| 3 | H-W Superduty Alamo | Harbison Wa... | Firebrick | 1427 | 23 |
| 4 | AP Green Empire Hi Duty | AP Green | Firebrick | 1371 | 20 |
| 5 | J-M Bubble Alumina | J-M | Insulati... | 1788 | 12 |

Layer Info

| Thickness mm | Material | # of Layers |
|--------------|-------------------------------------|-------------|
| 2 | 147, Carbon Steel 1.0% Carbon Steel | 1 |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

Results

| | H-Temp °C | C-Temp °C | A-Temp °C | H-Loss watt/m ² | H-Storage MJ/m ² |
|----|-----------|-----------|-----------|----------------------------|-----------------------------|
| 1 | 1315 | 1292 | | | 10 |
| 2 | | | | | |
| 3 | | | | | |
| 4 | | | | | |
| 5 | | | | | |
| 6 | | | | | |
| 7 | | | | | |
| 8 | | | | | |
| 9 | | | | | |
| 10 | | | | | |

For Each Layers the results show Hot Side, Cold Side and Heat Loss and Heat Storage

Overall Heat Loss and Heat Storage

327,524 10



The design criteria - Currently 3 – will be extended to more

Design Criteria

Target Design Temp

Fuel Type

Heat Content

Heating Efficiency % Yearly Operation

Hot Side Temp °F

Ambient Temp °F

Number of Cases

Base Material Info

Material

Thickness in

Surface Orientation

Flat Curved

Inside Radius

Cold Side Info

Air Velocity

Emissivity

Layer Info

| | Thickness | | Material | # of Layers | |
|----|----------------------|----------------------------|----------------------|----------------------|---------------------------------------|
| 1 | <input type="text"/> | <input type="checkbox"/> V | <input type="text"/> | <input type="text"/> | <input type="button" value="Select"/> |
| 2 | <input type="text"/> | <input type="checkbox"/> V | <input type="text"/> | <input type="text"/> | <input type="button" value="Select"/> |
| 3 | <input type="text"/> | <input type="checkbox"/> V | <input type="text"/> | <input type="text"/> | <input type="button" value="Select"/> |
| 4 | <input type="text"/> | <input type="checkbox"/> V | <input type="text"/> | <input type="text"/> | <input type="button" value="Select"/> |
| 5 | <input type="text"/> | <input type="checkbox"/> V | <input type="text"/> | <input type="text"/> | <input type="button" value="Select"/> |
| 6 | <input type="text"/> | <input type="checkbox"/> V | <input type="text"/> | <input type="text"/> | <input type="button" value="Select"/> |
| 7 | <input type="text"/> | <input type="checkbox"/> V | <input type="text"/> | <input type="text"/> | <input type="button" value="Select"/> |
| 8 | <input type="text"/> | <input type="checkbox"/> V | <input type="text"/> | <input type="text"/> | <input type="button" value="Select"/> |
| 9 | <input type="text"/> | <input type="checkbox"/> V | <input type="text"/> | <input type="text"/> | <input type="button" value="Select"/> |
| 10 | <input type="text"/> | <input type="checkbox"/> V | <input type="text"/> | <input type="text"/> | <input type="button" value="Select"/> |

| | Case | Insulation thickness [in] | Surface Temperature [°F] | Heat Flow [btu/hr/ft²] | Efficiency [%] | Cost [\$ /ft²/yr] | Savings [\$ /ft²/yr] |
|---|------|---------------------------|--------------------------|------------------------|----------------|-------------------|----------------------|
| * | | | | | | | |

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File Edit Tools Help

Home Tab Calculation Results Property Data Design

Design Criteria: Target Cold Side Temperature

Target Design Temp: 150 F Target Heat Loss: [] btu/ft²/hr

Fuel Type: [] Heat Content: [] Heating Efficiency: []

Hot Side Temp: 800 F Ambient Temp: 70 F

Number of Cases: 50

Cold Side Info: Air Velocity: 0 ft/s Emissivity: 0.92

Base Material Info: Material: Carbon Steel Thickness: 0.025 in Surface Orientation: Vertical

Insulation Layers Selection. Layer 1 Varying

| Layer | Thickness [in] | Material | # of Layers |
|-------|----------------|--------------------------------------|-------------|
| 1 | 1.25 | 126, AP Green block mix, Light Casta | 2 |
| 2 | 0.25 | 130, Kaiser plastic ram T9, Plastics | |
| 3 | | | |
| 4 | | | |
| 5 | | | |
| 6 | | | |
| 7 | | | |
| 8 | | | |
| 9 | | | |
| 10 | | | |

Base Material Info: Flat (selected) Curved

Results

| Case | Insulation thickness [in] | Surface Temperature [°F] | Heat Flow [btu/hr/ft ²] | Efficiency [%] | Cost [\$ /ft ² /yr] | Savings [\$ /ft ² /yr] |
|------|---------------------------|--------------------------|-------------------------------------|----------------|--------------------------------|-----------------------------------|
| 1 | 0.025 | 626 | 2,992 | 0 | - | - |
| 2 | 1.250 | 172 | 246 | 92 | - | - |
| 3 | 1.500 | 160 | 210 | 93 | - | - |
| 4 | 1.750 | 150 | 183 | 94 | - | - |
| 5 | 2.000 | 143 | 163 | 95 | - | - |

Unit: English | Analysis #: | Company: | Project:

Criteria 1: Target cold side temperature

Insulation Layers Selection. Layer 1 Varying

Design Criteria: Target Cold Side Temperature

Target Design Temp: 150 F

Target Cold Side Temp

Hot Side & Ambient Temp

Hot Side Temp: 800 F

Ambient Temp: 70 F

Cold Side Info: Air Velocity: 0 ft/s Emissivity: 0.92

Base Material Info: Material: Carbon Steel Thickness: 0.025 in Surface Orientation: Vertical

Base Material Info

Results

Target Reached

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File Edit Tools Help

Home Tab Calculation Results Property Data Plot Design

Design Criteria: Target Cold Side Temperature

Target Design Temp: 150 °F

Fuel Type:
Heat Content:
Heating Efficiency:

Hot Side Temp: 800 °F

Ambient Temp: 70 °F

Number of Cases: 50

Cold Side Info: Air Velocity: 0 ft/s, Emissivity: 0.92

Base Material Info: Material: Carbon Steel, Thickness: 0.025 in, Surface Orientation: Vertical

Insulation Layers Selection. Layer

| Layer | Thickness [in] | Material | # of Layers |
|-------|----------------|--------------------------------------|-------------|
| 1 | 1.25 | 126, AP Green block mix, Light Casta | 2 |
| 2 | 0.25 | 130, Kaiser plastic ram T9, Plastics | |
| 3 | | | |
| 4 | | | |
| 5 | | | |
| 6 | | | |
| 9 | | | |
| 10 | | | |

Calculate

Results

| Case | Insulation thickness [in] | Surface Temperature [°F] | Heat Flow [btu/hr/ft²] | Efficiency [%] | Cost [\$ /ft²/yr] | Savings [\$ /ft²/yr] |
|------|---------------------------|--------------------------|------------------------|----------------|-------------------|----------------------|
| 27 | 6.500 | 153 | 192 | 94 | - | - |
| 28 | 6.750 | 153 | 190 | 94 | - | - |
| 29 | 7.000 | 152 | 189 | 94 | - | - |
| 30 | 7.250 | 152 | 187 | 94 | - | - |
| 31 | 7.500 | 151 | 185 | 94 | - | - |
| 32 | 7.750 | 150 | 184 | 94 | - | - |
| 33 | 8.000 | 150 | 182 | 94 | - | - |

Unit: English | Analysis #: | Company: | Project:

Criteria 1: Target cold side temperature

Insulation Layers Selection. Layer

Target Cold Side Temp

Hot Side & Ambient Temp

Base Material Info

Results

Target Reached

Design Criteria: Target Heat Flow Rate

Calculate

Target Design Temp: °F

Target Heat Loss: btu/ft²/hr

Material Cost: \$/Mcf

Target Cold Side Temp

Hot Side & Ambient Temp

Hot Side Temp: °F

Ambient Temp: °F

Cold Side Info

Air Velocity: ft/s

Emissivity:

Base Material Info

Material: Carbon Steel

Thickness: in

Surface Orientation:

Flat Curved

Inside Radius:

Layer Info

| Thickness | Material | # of Layers |
|---|--|-------------|
| 1: <input type="text" value="1.25"/> in | <input checked="" type="checkbox"/> V 126, AP Green block mix, Light Casta | 2 |
| 2: <input type="text" value="0.25"/> | <input type="checkbox"/> V 130, Kaiser plastic ram T9, Plastics | |
| 3: <input type="text"/> | <input type="checkbox"/> V | |
| 4: <input type="text"/> | <input type="checkbox"/> V | |
| 5: <input type="text"/> | <input type="checkbox"/> V | |
| 6: <input type="text"/> | <input type="checkbox"/> V | |
| 7: <input type="text"/> | <input type="checkbox"/> V | |
| 8: <input type="text"/> | <input type="checkbox"/> V | |
| 9: <input type="text"/> | <input type="checkbox"/> V | |
| 10: <input type="text"/> | <input type="checkbox"/> V | |

Insulation Layers Selection. Layer 1 Varying

Base Material Info

Results

| Case | Insulation thickness [in] | Surface Temperature [°F] | Heat Flow [btu/hr/ft²] | Efficiency [%] | Cost [\$ /ft²/yr] | Savings [\$ /ft²/yr] |
|------|---------------------------|--------------------------|------------------------|----------------|-------------------|----------------------|
| 2 | 1.250 | 172 | 246 | 92 | -- | -- |
| 3 | 1.500 | 160 | 210 | 93 | -- | -- |
| 4 | 1.750 | 150 | 183 | 94 | -- | -- |
| 5 | 2.000 | 143 | 155 | 95 | -- | -- |
| 6 | 2.250 | 137 | 137 | 96 | -- | -- |
| 7 | 2.500 | 131 | 133 | 96 | -- | -- |
| 8 | 2.750 | 127 | 122 | 96 | -- | -- |

Target Reached



Criteria 2: Target heat flow rate

Insulation Layers Selection. Layer 2 Varying

Design Criteria Target Heat Flow Rate

Calculate

Target Design Temp

Target Heat Loss 125 btu/ft²/hr

Target Cold Side Temp

Hot Side & Ambient Temp

Hot Side Temp 800 °F

Ambient Temp 70 °F

Cold Side Info

Air Velocity 0 ft/s

Emissivity 0.92

Base Material Info

Material Carbon Steel

Flat Curved

Thickness 0.025 in

Inside Radius

Surface Orientation Vertical

Layer Info

Thickness Material # of Layers 2

1 1.25 126 , AP Green block mix , Light Casta

2 0.25 130 , Kaiser plastic ram T9 , Plastics

3

4

5

6

7

8

9

10

Base Material Info

Results

| Case | Insulation thickness [in] | Surface Temperature [°F] | Heat Flow [btu/hr/ft ²] | Efficiency [%] | Cost [\$ /ft ² /yr] | Savings [\$ /ft ² /yr] |
|------|---------------------------|--------------------------|-------------------------------------|----------------|--------------------------------|-----------------------------------|
| 83 | 20.500 | 130 | 129 | 96 | - | - |
| 84 | 20.750 | 130 | 128 | 96 | - | - |
| 85 | 21.000 | 129 | 127 | 96 | - | - |
| 86 | 21.250 | 129 | 126 | 96 | - | - |
| 87 | 21.500 | 129 | 125 | 96 | - | - |
| 88 | 21.750 | 129 | 125 | 96 | - | - |
| 89 | 22.000 | 128 | 125 | 96 | - | - |

Target Reached

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Design Criteria Savings

Calculate

Target Design Temp °F Target Heat Loss btu/ft²/hr

Fuel Type Natural Gas Fuel Cost 5 \$/Mcf

Heat Content 1030 btu/ft³

Operating Efficiency 60

Hot Side Temp 800 °F

Ambient Temp 70 °F

Number of Cases 20

Cold Side Info

Air Velocity 0 ft/s

Emissivity 0.92

Base Material Info

Material Carbon Steel Flat Curved

Thickness 0.025 in Inside Radius

Surface Orientation Vertical

Layer Info

| | Thickness | | Material | # of Layers |
|----|-----------|----------------------------|--|-------------|
| 1 | 1.25 | <input type="checkbox"/> V | 130 , Kaiser plastic ram T9 , Plastics | 2 |
| 2 | 0.25 | <input type="checkbox"/> V | 126 , AP Green block mix , Light Casta | |
| 3 | | <input type="checkbox"/> V | | |
| 4 | | <input type="checkbox"/> V | | |
| 5 | | <input type="checkbox"/> V | | |
| 6 | | <input type="checkbox"/> V | | |
| 7 | | <input type="checkbox"/> V | | |
| 8 | | <input type="checkbox"/> V | | |
| 9 | | <input type="checkbox"/> V | | |
| 10 | | <input type="checkbox"/> V | | |

Results

| Case | Insulation thickness [in] | Surface Temperature [°F] | Heat Flow [btu/hr/ft²] | Efficiency [%] | Cost [\$ /ft²/yr] | Savings [\$ /ft²/yr] |
|------|---------------------------|--------------------------|------------------------|------------------|-------------------|----------------------|
| 1 | 0.025 | 626 | 2,992 | 0 | 194 | 0 |
| 2 | 1.250 | 451 | 1,545 | 48 | 100 | 94 |
| 3 | 0.250 | 293 | 692 | 77 | 45 | 149 |
| * | | | | | | |

Criteria 3: Yearly Cost and Savings

Insulation Layers Selection.

Select Fuel Type

Hot Side & Ambient Temp

Base Material Info

Results