

Performance Benchmarking

(Industrial Cases)



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FHinfinity

| NO | CASE | GEOMETRY | PAGE |
|-----------|-------------|--|-------------|
| 1 | #RCS-1T | Cylindrical, Vertical Tube + Convection | 3 |
| 2 | #RS-2T | Cylindrical, Helical Tube | 8 |
| 3 | #R2CS-3T | Cubical (Twin), Horizontal Refractory Backed Tube + Convection | 13 |
| 4 | #RCS-4T | Cubical, Horizontal Central Tube (3 Lane) + Convection | 18 |
| 5 | #RS-5T | Cubical, Horizontal Central Tube (1 Lane, 2 Row) | 23 |
| 6 | #RCS-6T | Cubical, Vertical Refractory Backed Tube + Convection | 28 |
| 7 | #RCS-10T | Cubical, Vertical Central Tube (1 Lane) + Convection | 33 |
| 8 | #R2CS-13T | Cylindrical (Twin), Vertical Tube + Convection + APH | 38 |
| 9 | #R2CS-14T | Cubical (Twin), Horizontal Refractory Backed Tube + Convection + APH | 43 |
| 10 | #RCS-15T | Cubical, Horizontal Refractory Backed Tube + Convection + Inj. Steam | 48 |
| 11 | #CS-16T | Standalone Convection Section | 53 |

FHinfinity[©] CASE #RCS-1T

DEMO CASE #RCS-1T

| | |
|-------------------------------------|------------------------------------|
| ⦿ HEATER GEOMETRY | <i>Radiant + Convection</i> |
| ⦿ FIREBOX TYPE / NO. OF PATH | <i>Cylindrical / Four (4)</i> |
| ⦿ FIREBOX TUBE LAYOUT | <i>Vertical, Refractory Backed</i> |
| ⦿ CONV. LAYOUT / NO. OF T.B. | <i>Triangular / Two (2)</i> |
| ⦿ CONV. TUBE TYPE | <i>Bare - Fin</i> |
| ⦿ BURNER LAYOUT | <i>Up-Fired</i> |
| ⦿ STACK | <i>One (1)</i> |
| ⦿ FAN / APH / TRANSFER LINE | <i>None</i> |
| ⦿ FUEL | <i>Fuel Gas</i> |
| ⦿ NO. OF PROCESS STREAM | <i>One (1)</i> |
| ⦿ PROCESS THERMO. STATE | <i>Vaporizing (Liq. / 2ph.)</i> |
| ⦿ THERMO ENGINE | <i>Aspen Hysys</i> |

Model Specification & Setting:

Radiation to Tube Bank



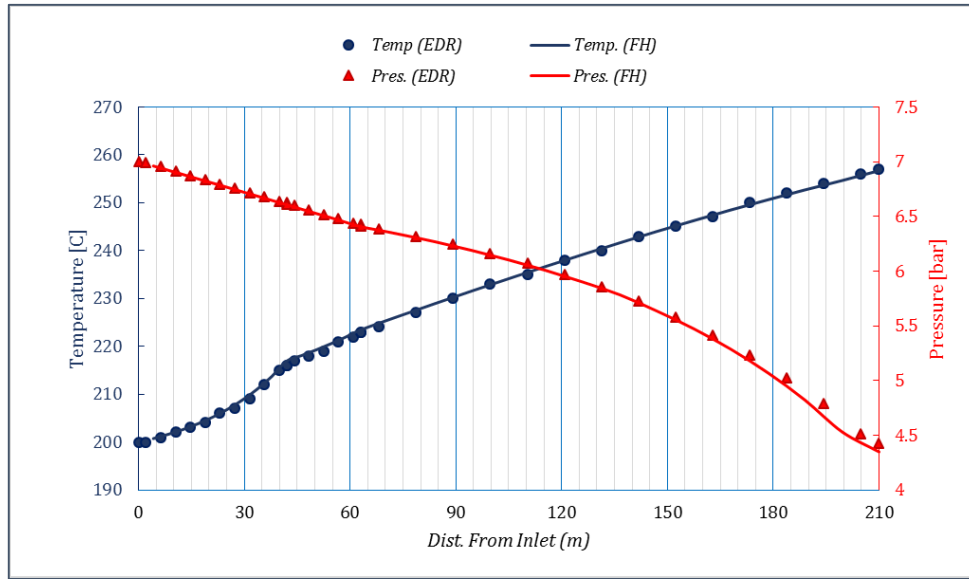
DEMO CASE #RCS-1T - OUTPUT

| | FHinfinity | ASPEN EDR | %ERR. | NOTE |
|---|-------------------|------------------|--------------|-------------|
| Total Heat Absorption [kW] | 10427 | 10430 | ~ 0 | |
| Firebox Duty [kW] | 6716 | 6724 | - 0.1 | |
| Avg. Rad. Sec. Heat Flux Density [W/m2] | 30935 | 30969 | - 0.1 | |
| Process Outlet Temperature [C] | 256.7 | 257 | (- 0.3) | 1 |
| Process Side Pressure Drop [bar] | 2.65 | 2.58 | (0.07) | 1 |
| Heater Efficiency [%] | 84.6 | 84.7 | - 0.1 | |
| Flue Gas Temp. Leaving Heater [C] | 314 | 311 | (3) | 1 |
| Bridgewall Temperature [C] | 899 | 896 | (3) | 1 |
| Draft at Arch [in WC] | 0.32 | 0.29 | (0.03) | 1 |
| Max. Flue Gas Mass Velocity [kg/m2.s] | 3.7 | 3.7 | 0 | |
| Ratio of Peak to Mean Heat Flux [-] | 1.92 | 1.92 | 0 | |
| Adiabatic Flame Temperature [C] | 1891 | 1889 | (2) | 1 |

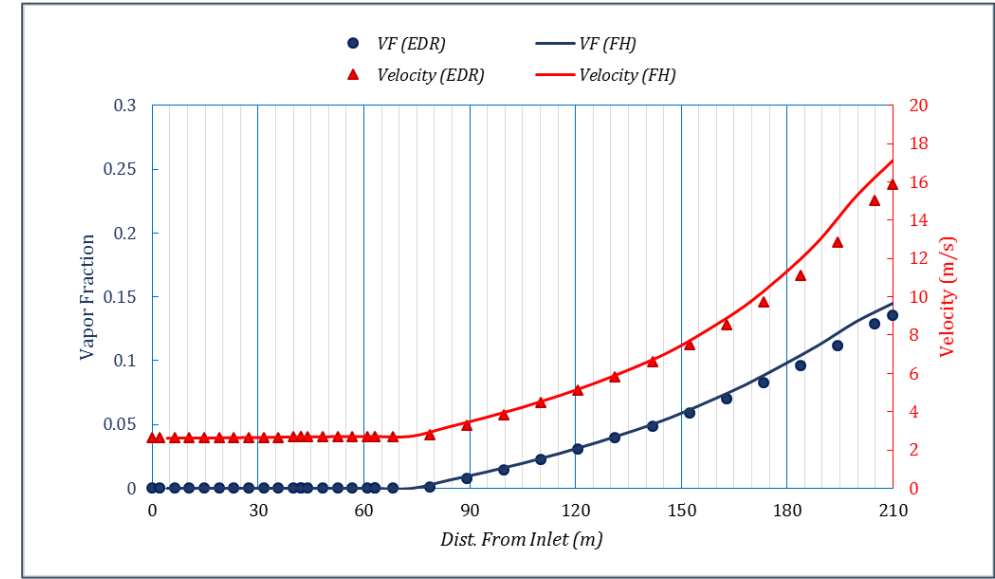
NOTES:

(1) Absolute Error

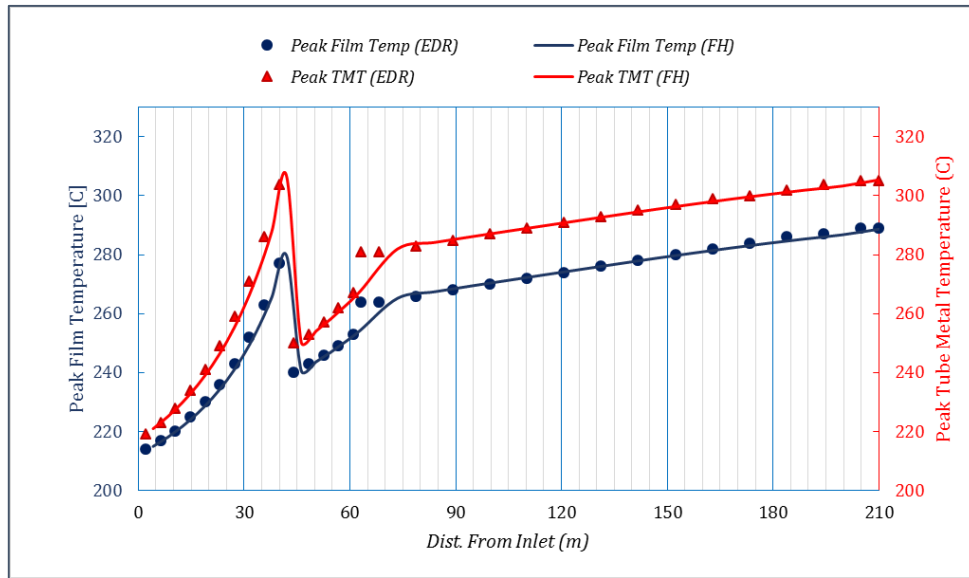
TEMPERATURE & PRESSURE



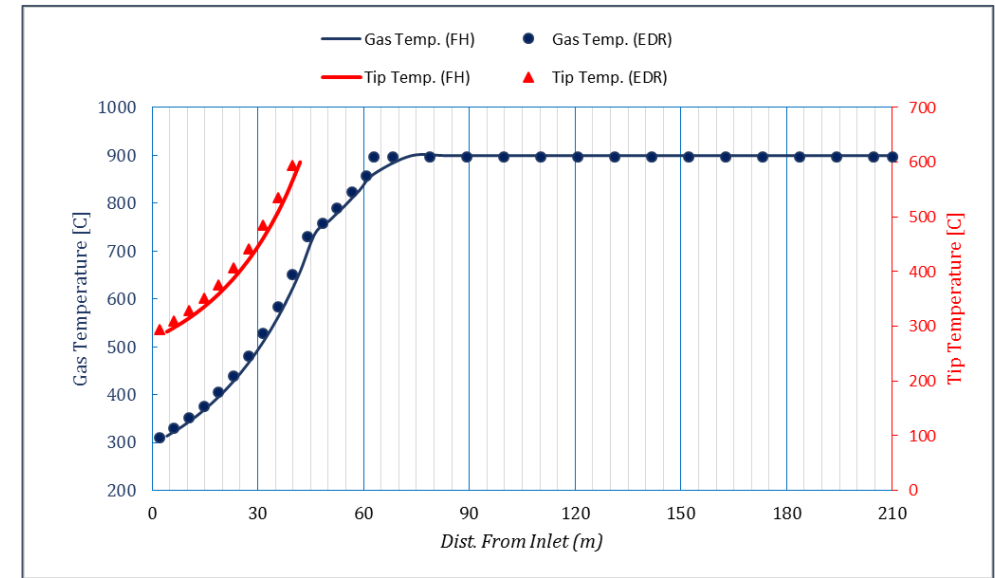
VELOCITY & VAPOR FRACTION



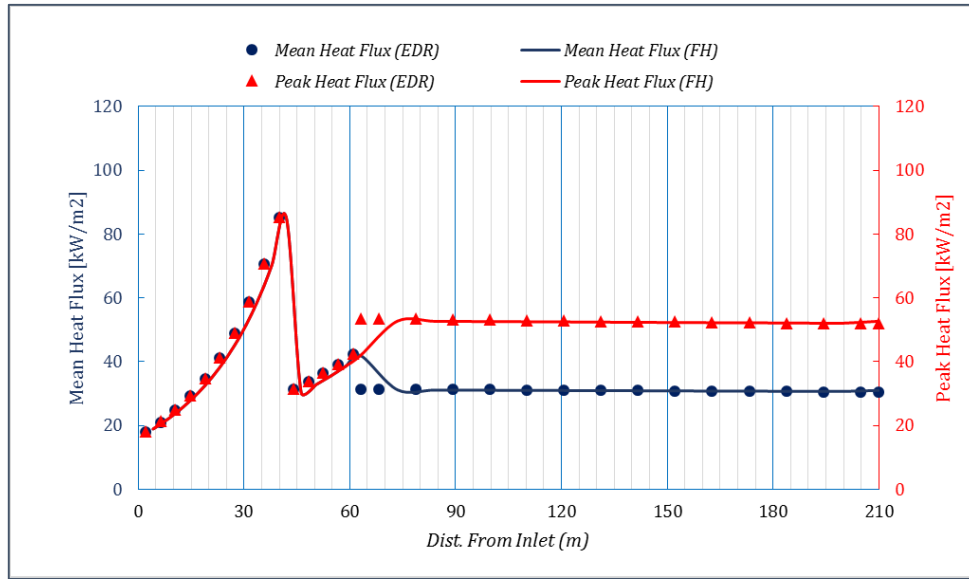
TUBE TEMPERATURES



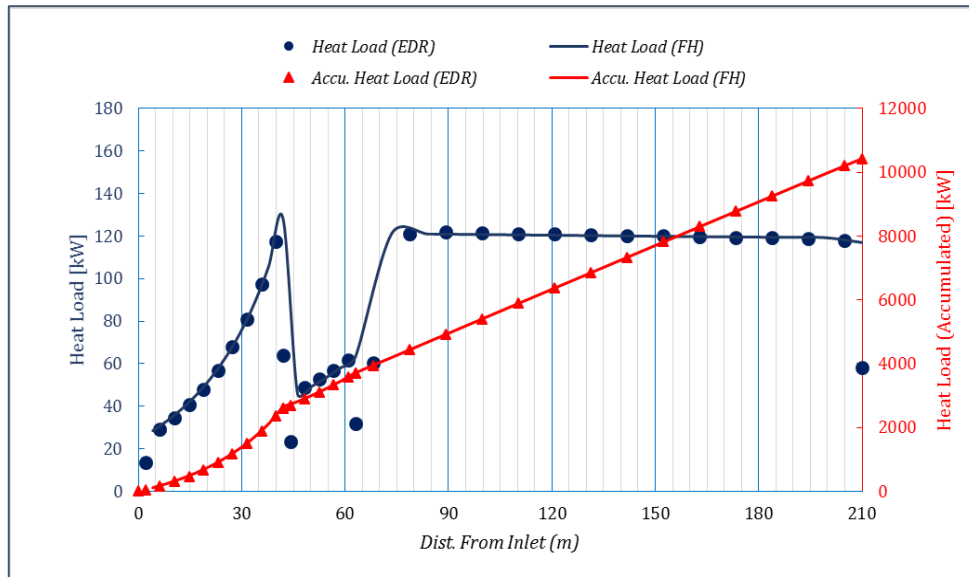
GAS TEMP. & TIP TEMP.



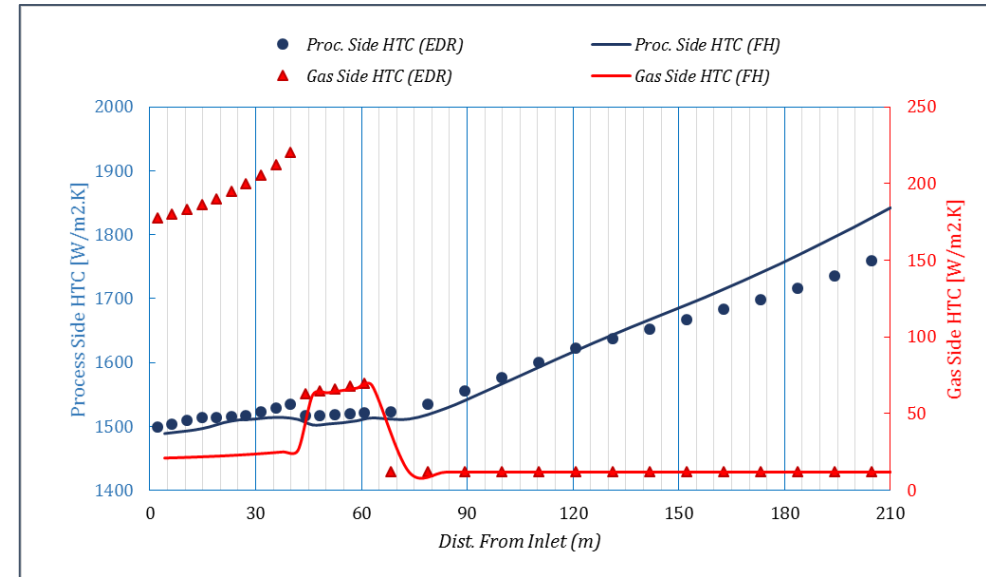
HEAT FLUXES



HEAT LOAD



HEAT TRANSFER COEF.



FHinfinity[©] CASE #RS-2T

| | |
|-------------------------------------|-----------------------------------|
| ⦿ HEATER GEOMETRY | <i>Radiant Only</i> |
| ⦿ FIREBOX TYPE / NO. OF PATH | <i>Cylindrical / One (1)</i> |
| ⦿ FIREBOX TUBE LAYOUT | <i>Helical, Refractory Backed</i> |
| ⦿ CONV. LAYOUT / NO. OF T.B. | <i>None</i> |
| ⦿ CONV. TUBE TYPE | <i>None</i> |
| ⦿ BURNER LAYOUT | <i>Up-Fired</i> |
| ⦿ STACK | <i>One (1)</i> |
| ⦿ FAN / APH / TRANSFER LINE | <i>None</i> |
| ⦿ FUEL | <i>Fuel Oil (+ Atm. Steam)</i> |
| ⦿ NO. OF PROCESS STREAM | <i>One (1)</i> |
| ⦿ PROCESS THERMO. STATE | <i>All Vapor</i> |
| ⦿ THERMO ENGINE | <i>User Input Data</i> |

Model Specification & Setting:

None

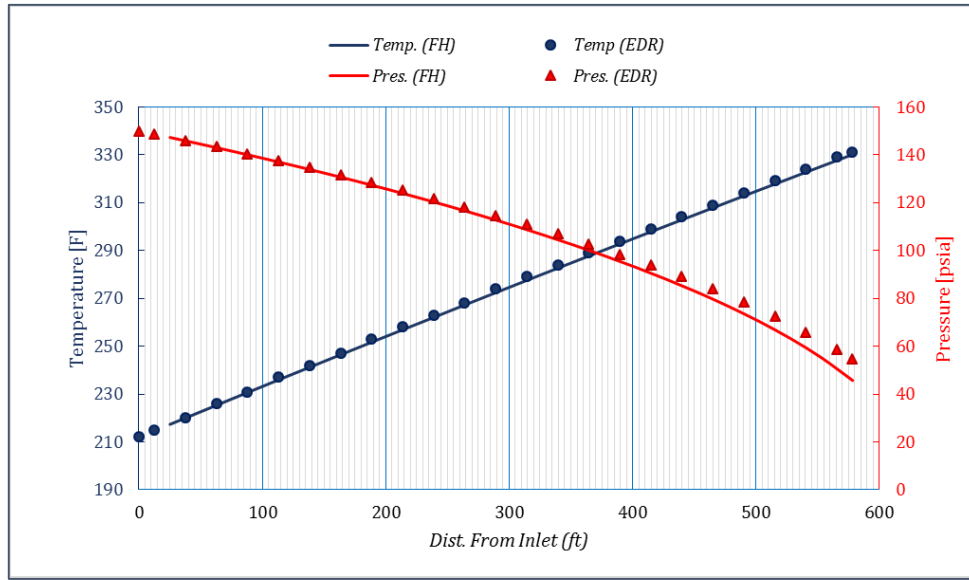


| | FHinfinity | ASPEN EDR | % ERR. | NOTE |
|---|-------------------|------------------|---------------|-------------|
| Total Heat Absorption [MM Btu/hr] | 2.42 | 2.45 | - 1.2 | |
| Firebox Duty [MM Btu/hr] | 2.42 | 2.45 | - 1.2 | |
| Avg. Rad. Sec. Heat Flux Density [Btu/hr.ft2] | 3554 | 3595 | - 1.1 | |
| Process Outlet Temperature [F] | 330.1 | 331 | (- 0.9) | 1 |
| Process Side Pressure Drop [Psi] | 104.3 | 95.3 | (9) | 1 |
| Heater Efficiency [%] | 69.9 | 70.7 | - 1.1 | |
| Flue Gas Temp. Leaving Heater [F] | 1052 | 1033 | (19) | 1 |
| Bridgewall Temperature [F] | 1052 | 1033 | (19) | 1 |
| Draft at Arch [in WC] | - 0.34 | - 0.334 | (~ 0) | 1 |
| Max. Flue Gas Mass Velocity [lb/ft2.s] | N/A | N/A | N/A | |
| Ratio of Peak to Mean Heat Flux [-] | 1.917 | 1.92 | ~ 0 | |
| Adiabatic Flame Temperature [F] | 3258 | 3251 | (7) | 1 |

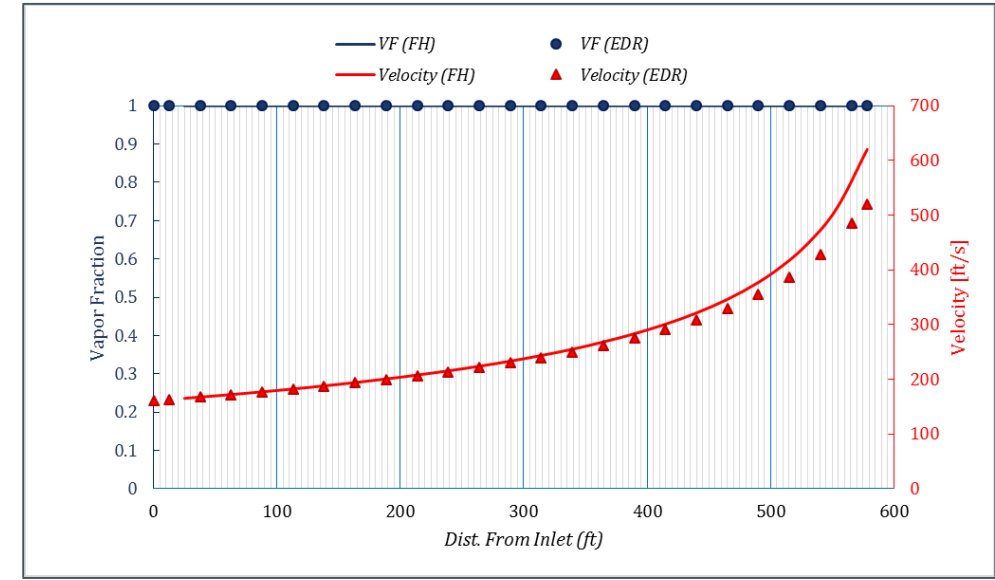
NOTES:

(1) Absolute Error

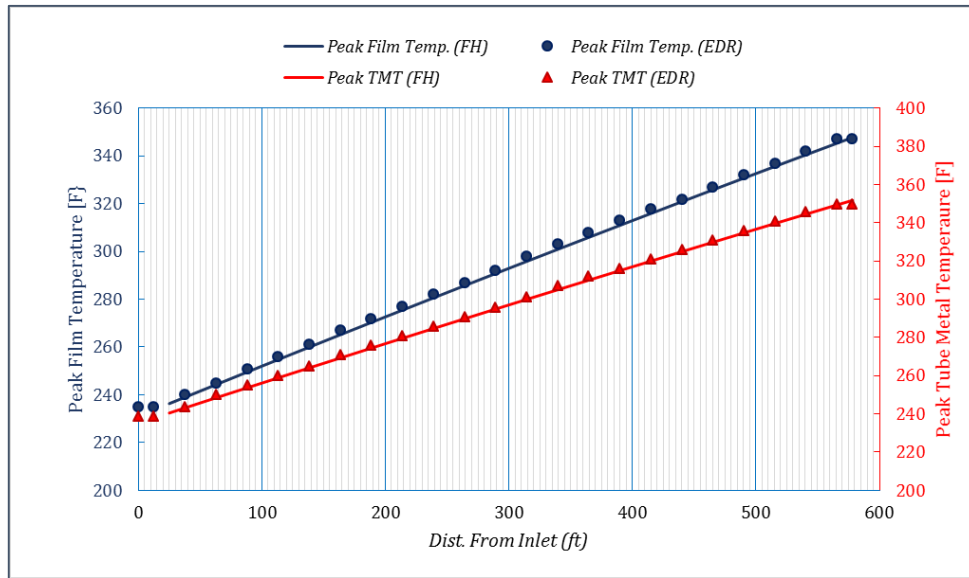
TEMPERATURE & PRESSURE



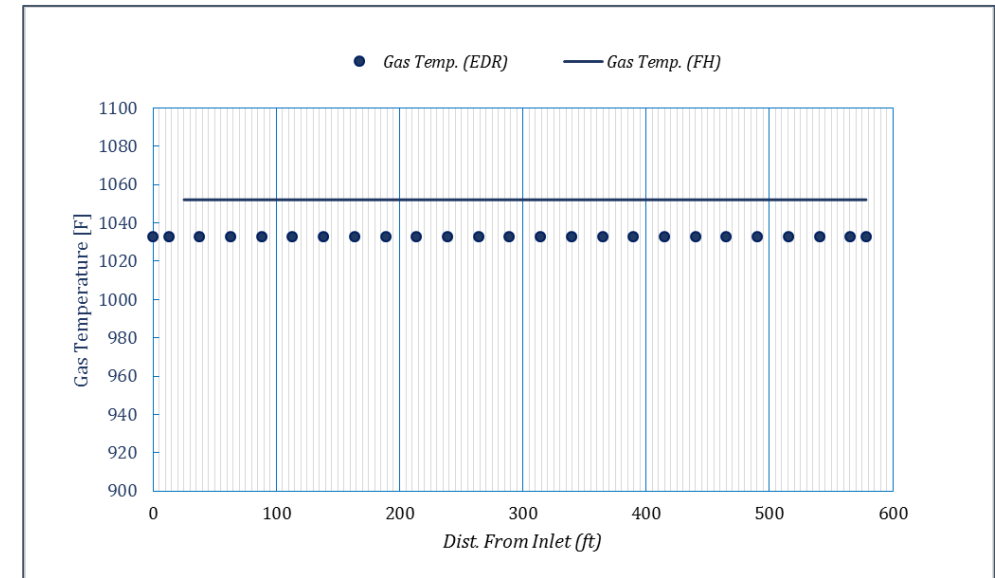
VELOCITY & VAPOR FRACTION



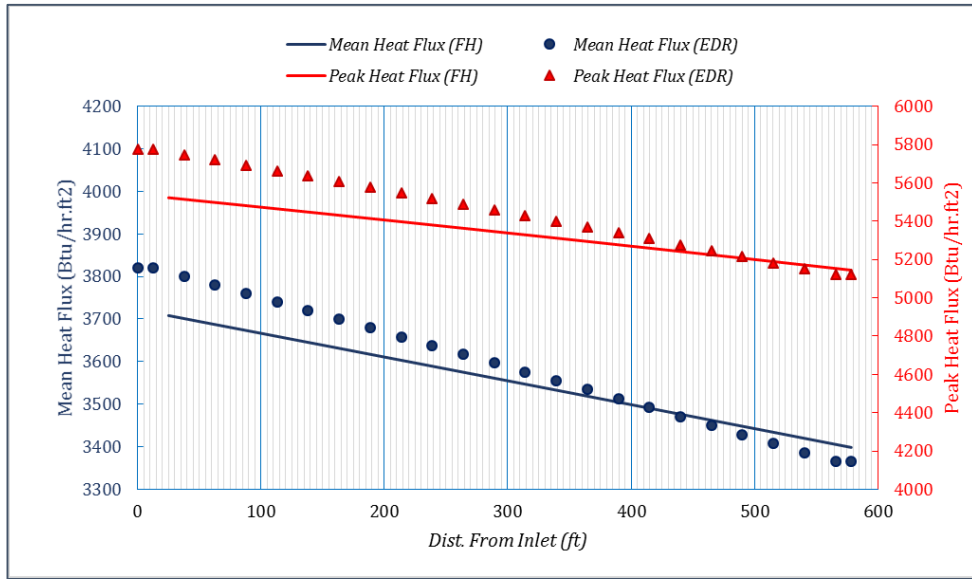
TUBE TEMPERATURES



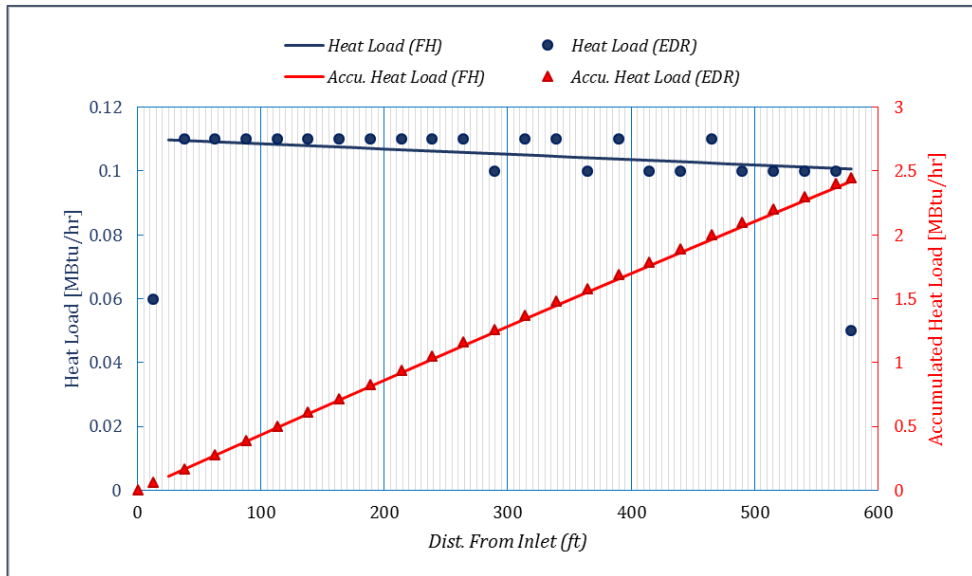
GAS TEMP.



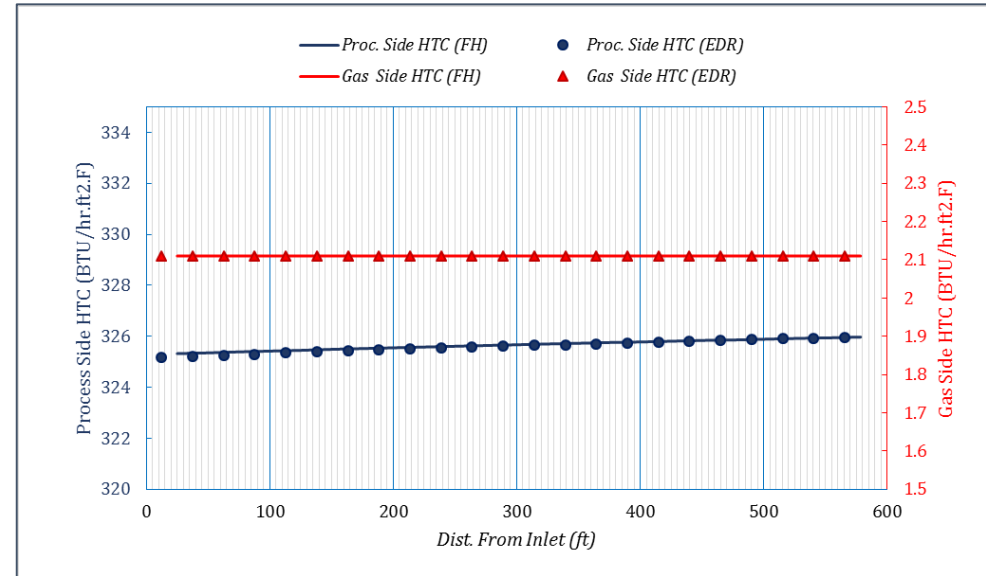
HEAT FLUXES



HEAT LOAD



HEAT TRANSFER COEF.



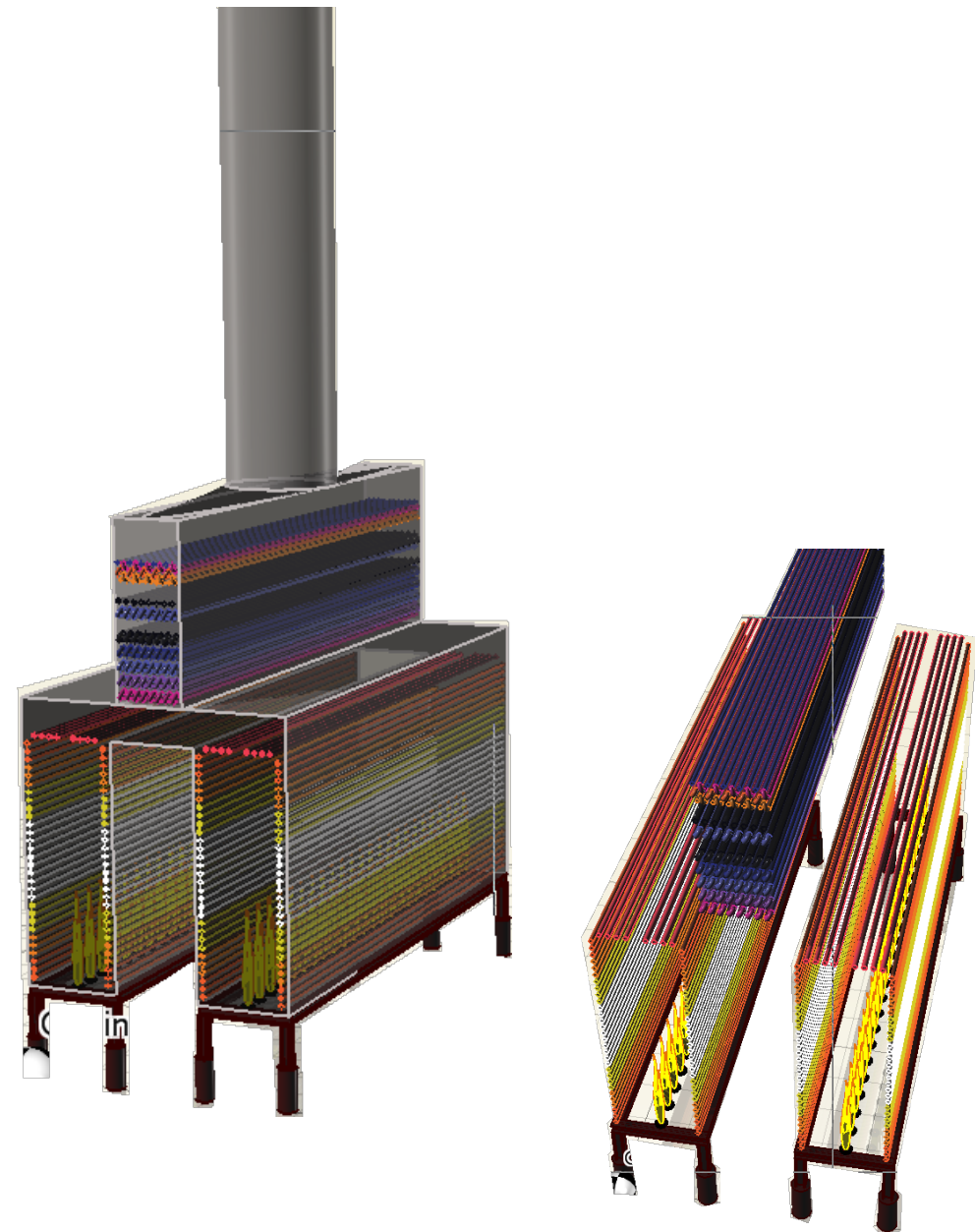
FHinfinity[©] CASE #R2CS-3T

DEMO CASE #R2CS-3T

- **HEATER GEOMETRY** *Radiant (Twin) + Convection*
- **FIREBOX TYPE / NO. OF PATH** *Cubical / Eight (8)*
- **FIREBOX TUBE LAYOUT** *Horiz., Ref. Back. (+ Roof Tube)*
- **CONV. LAYOUT / NO. OF T.B.** *Triangular / Three (3)*
- **CONV. TUBE TYPE** *Bare - Stud - Bare*
- **BURNER LAYOUT** *Up-Fired*
- **STACK** *One*
- **FAN / APH / TRANSFER LINE** *None*
- **FUEL** *Fuel Oil (+ Atm. Steam)*
- **NO. OF PROCESS STREAM** *Two (2)*
- **PROCESS THERMO. STATE** *All Vap. & Vaporizing (Liq/2ph.)*
- **THERMO ENGINE** *Aspen Hysys*

Model Specification & Setting:

- Radiation to Tube Bank*



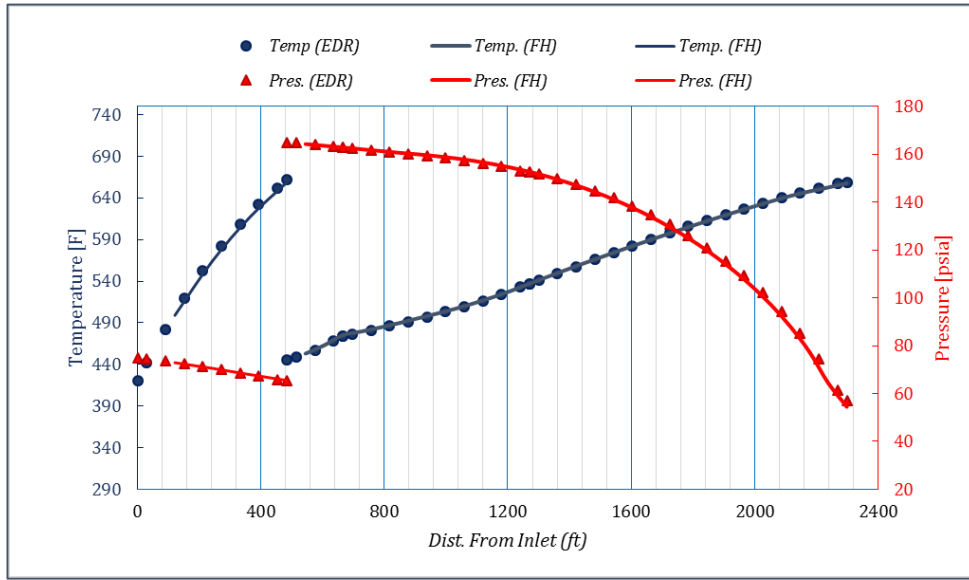
DEMO CASE #R2CS-3T - OUTPUT

| | FHinfinity | ASPEN EDR | % ERR. | NOTE |
|---|-------------------|------------------|---------------|-------------|
| Total Heat Absorption [MM Btu/hr] | 206.9 | 207.1 | - 0.1 | |
| Firebox Duty [MM Btu/hr] | 129.3 | 129.6 | - 0.2 | |
| Avg. Rad. Sec. Heat Flux Density [Btu/hr.ft2] | 10884 | 10908 | - 0.2 | |
| Process Outlet Temperature [F] | 657.8 | 659 | (- 1.2) | 1 |
| Process Side Pressure Drop [Psi] | 110.6 / 9.5 | 108.1 / 9.8 | (2.5 / - 0.3) | 1 |
| Heater Efficiency [%] | 79.7 | 79.9 | - 0.3 | |
| Flue Gas Temp. Leaving Heater [F] | 749 | 743 | (6) | 1 |
| Bridgewall Temperature [F] | 1727 | 1720 | (7) | 1 |
| Draft at Arch [in WC] | -0.93 | -0.96 | (-0.03) | 1 |
| Max. Flue Gas Mass Velocity [lb/ft2.s] | 0.67 | 0.66 | 1.5 | |
| Ratio of Peak to Mean Heat Flux [-] | 1.90 | 1.90 | ~ 0 | |
| Adiabatic Flame Temperature [F] | 3327 | 3311 | (16) | 1 |

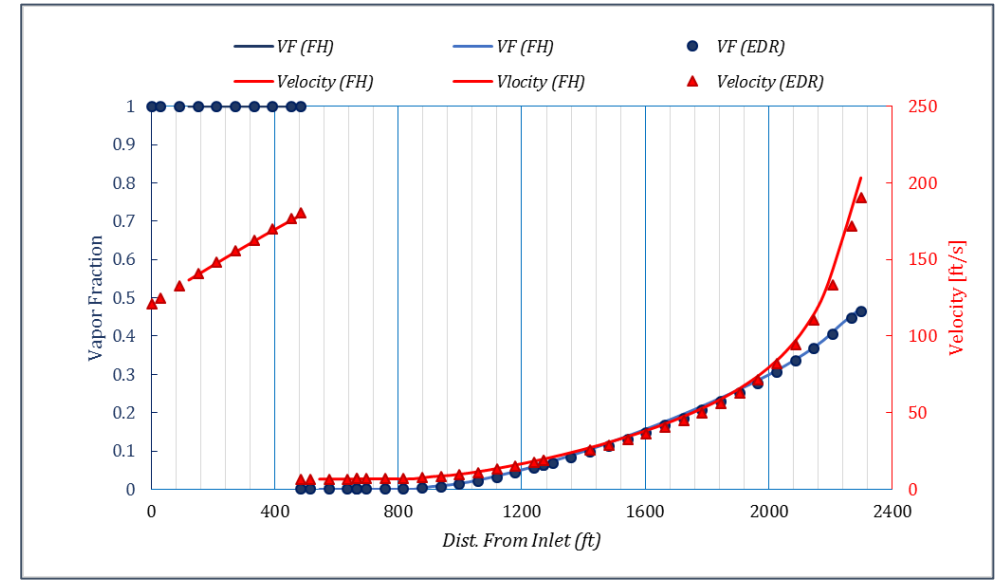
NOTES:

(1) Absolute Error

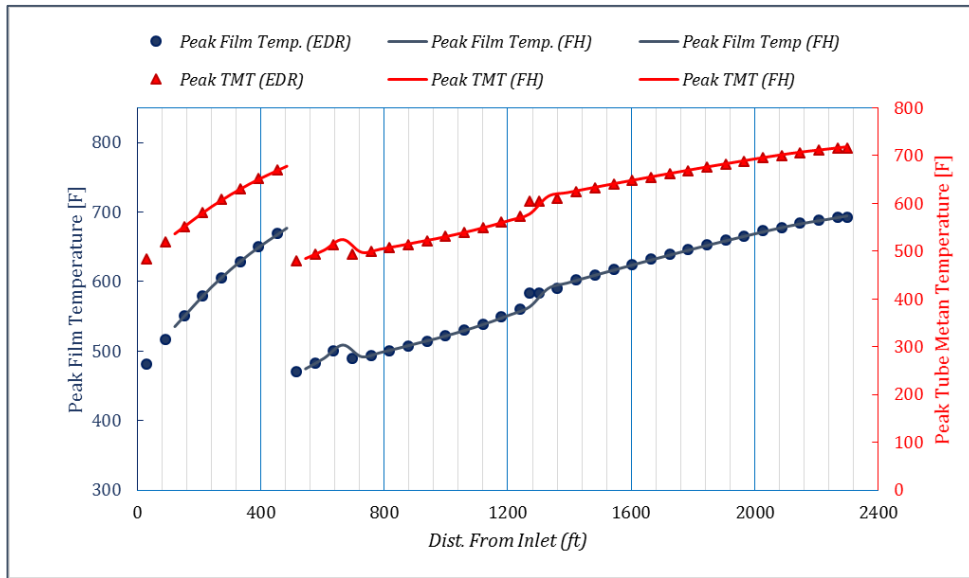
TEMPERATURE & PRESSURE



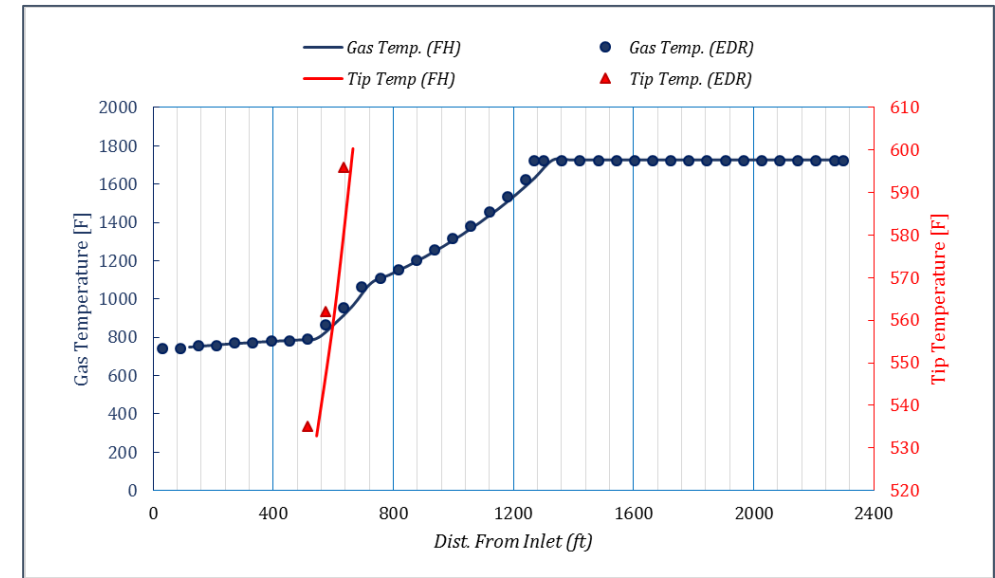
VELOCITY & VAPOR FRACTION



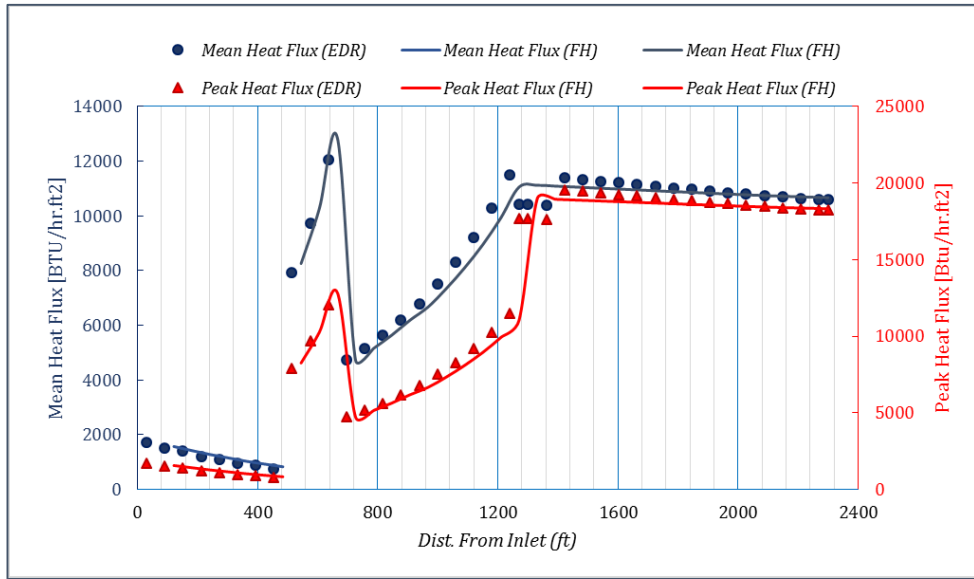
TUBE TEMPERATURES



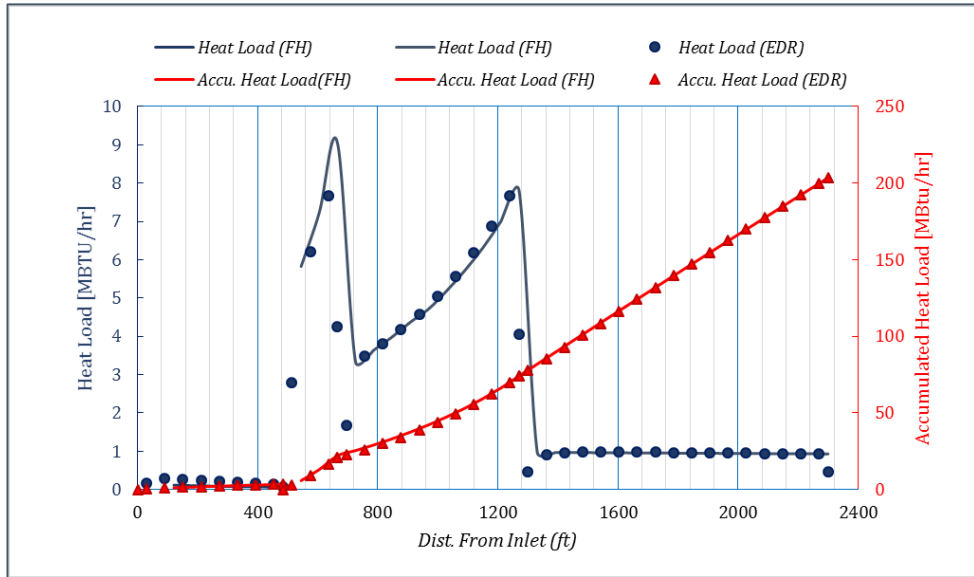
GAS TEMP. & TIP TEMP.



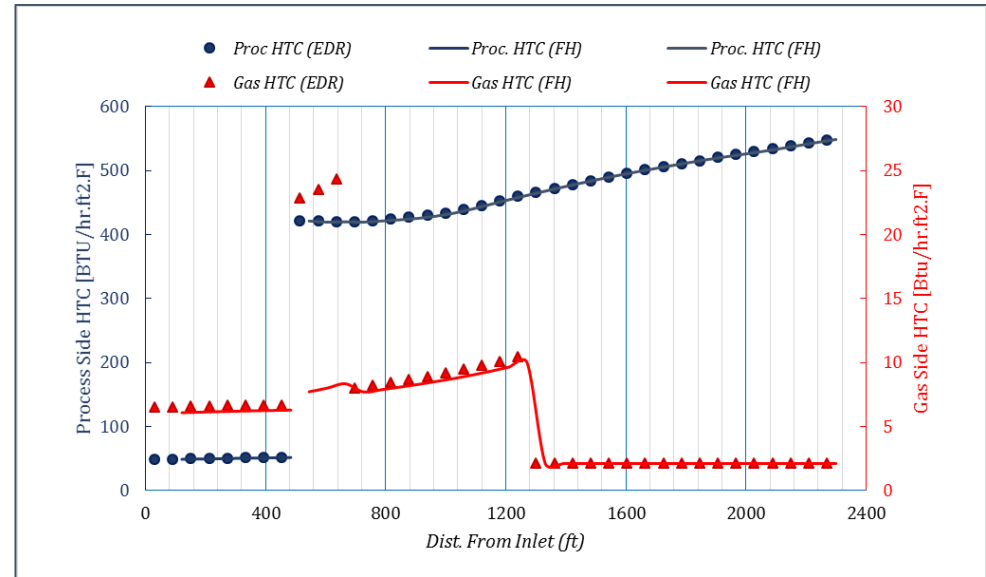
HEAT FLUXES



HEAT LOAD



HEAT TRANSFER COEF.

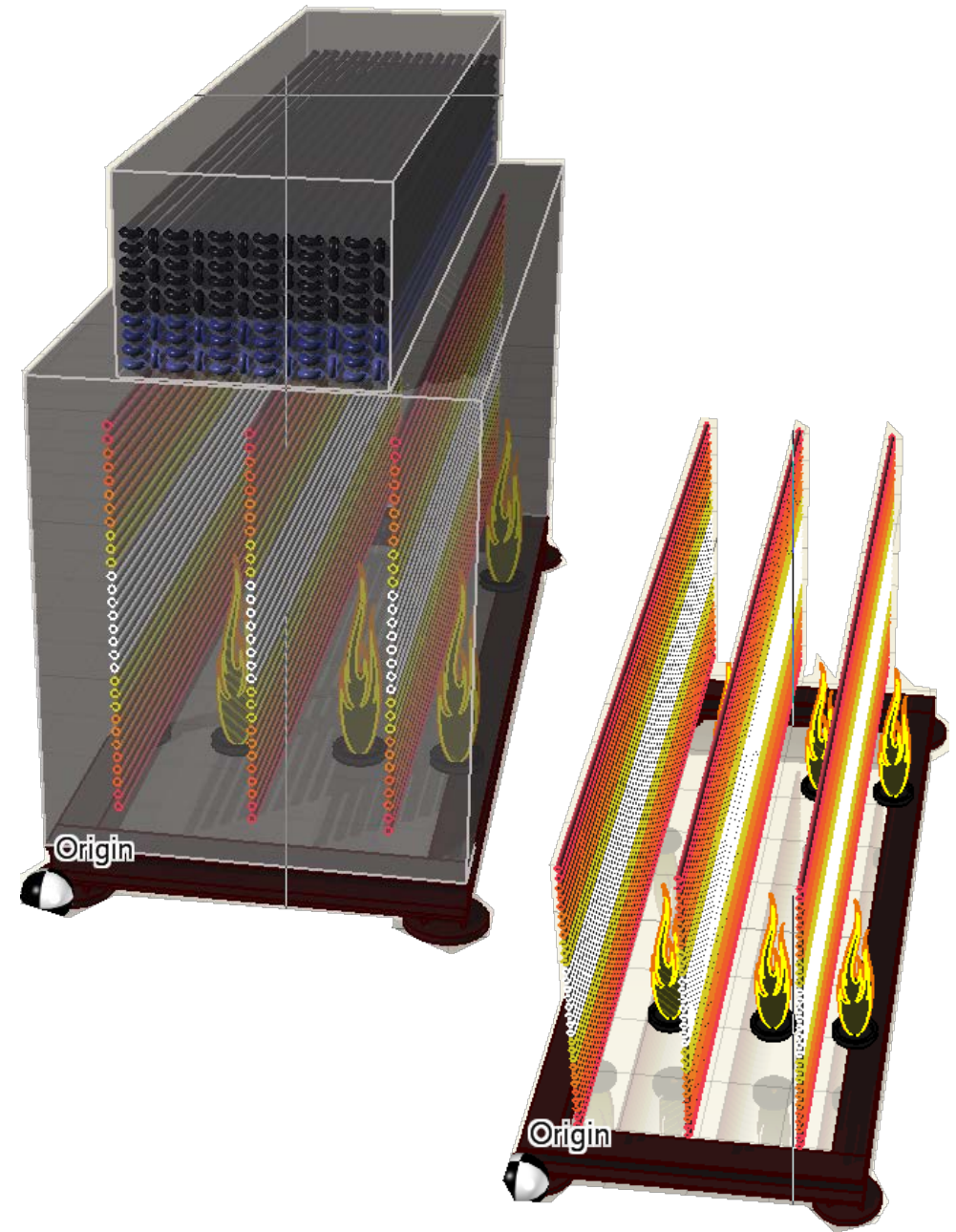


FHinfinity[©] CASE #RCS-4T

| | |
|-------------------------------------|-------------------------------------|
| ⦿ HEATER GEOMETRY | <i>Radiant + Convection</i> |
| ⦿ FIREBOX TYPE / NO. OF PATH | <i>Cubical / Six (6)</i> |
| ⦿ FIREBOX TUBE LAYOUT | <i>Horizontal, Central (3 Lane)</i> |
| ⦿ CONV. LAYOUT / NO. OF T.B. | <i>Rectangular / One (1)</i> |
| ⦿ CONV. TUBE TYPE | <i>Bare</i> |
| ⦿ BURNER LAYOUT | <i>Up-Fired</i> |
| ⦿ STACK | <i>None</i> |
| ⦿ FAN / APH / TRANSFER LINE | <i>None</i> |
| ⦿ FUEL | <i>Fuel Gas</i> |
| ⦿ NO. OF PROCESS STREAM | <i>One (1)</i> |
| ⦿ PROCESS THERMO. STATE | <i>Vaporizing (2ph. / 2ph.)</i> |
| ⦿ THERMO ENGINE | <i>Aspen Hysys</i> |

Model Specification & Setting:

- Radiation to Tube Bank*
- Hottel Parameter*
- Fouling Factor*



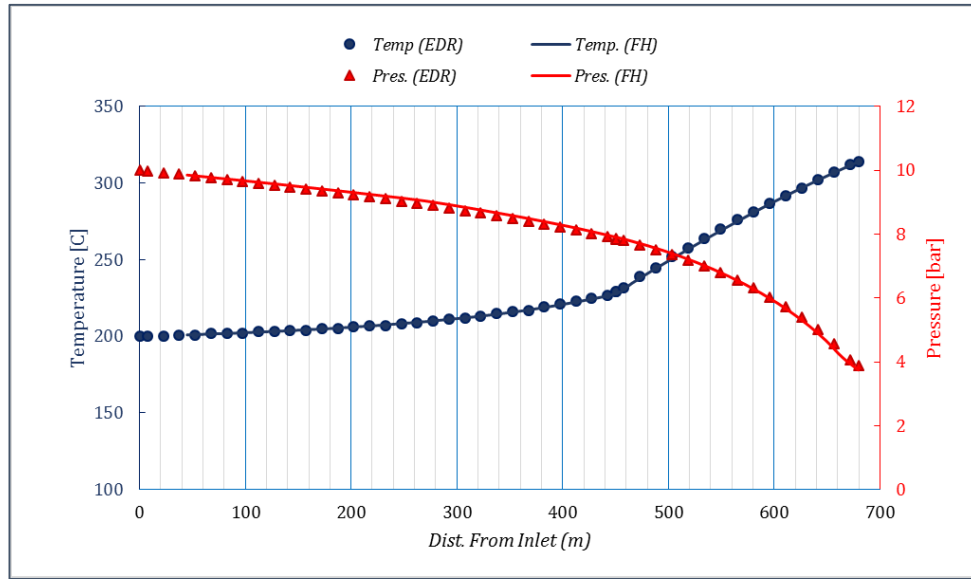
DEMO CASE #RCS-4T - OUTPUT

| | FHinfinity | ASPEN EDR | % ERR. | NOTE |
|---|-------------------|------------------|---------------|-------------|
| Total Heat Absorption [kW] | 19620 | 19758 | - 0.7 | |
| Firebox Duty [kW] | 15234 | 15063 | 1.1 | |
| Avg. Rad. Sec. Heat Flux Density [W/m2] | 31426 | 31072 | 1.1 | |
| Process Outlet Temperature [C] | 314 | 314 | (0) | 1 |
| Process Side Pressure Drop [bar] | 6.2 | 6.1 | (0.1) | 1 |
| Heater Efficiency [%] | 86 | 85.9 | 0.1 | |
| Flue Gas Temp. Leaving Heater [C] | 307 | 300 | (7) | 1 |
| Bridgewall Temperature [C] | 706 | 710 | (- 4) | 1 |
| Draft at Arch [in WC] | N/A | N/A | N/A | 1 |
| Max. Flue Gas Mass Velocity [kg/m2.s] | 0.35 | 0.35 | 0 | |
| Ratio of Peak to Mean Heat Flux [-] | 1.23 | 1.23 | 0 | |
| Adiabatic Flame Temperature [C] | 1972 | 1961 | (11) | 1 |

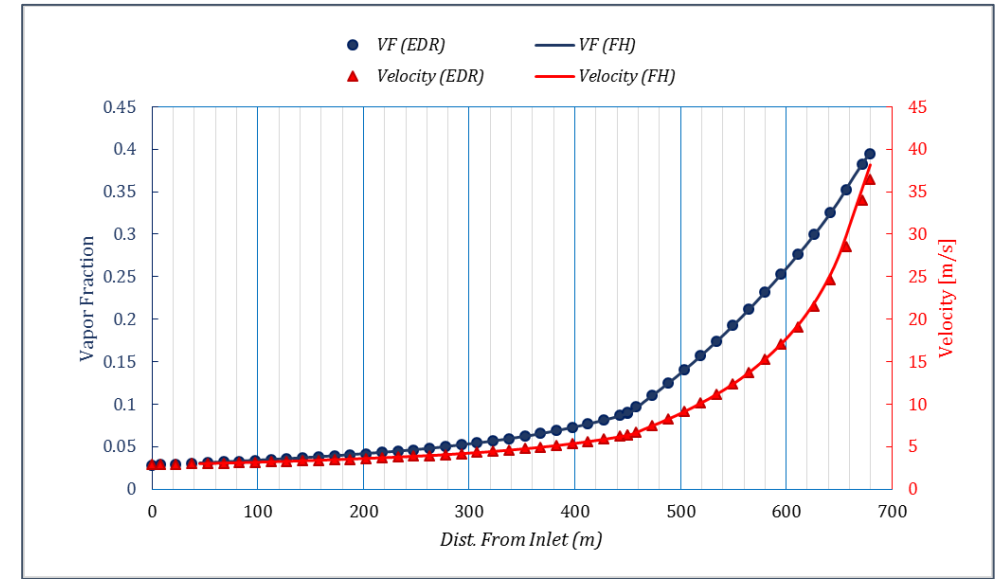
NOTES:

(1) Absolute Error

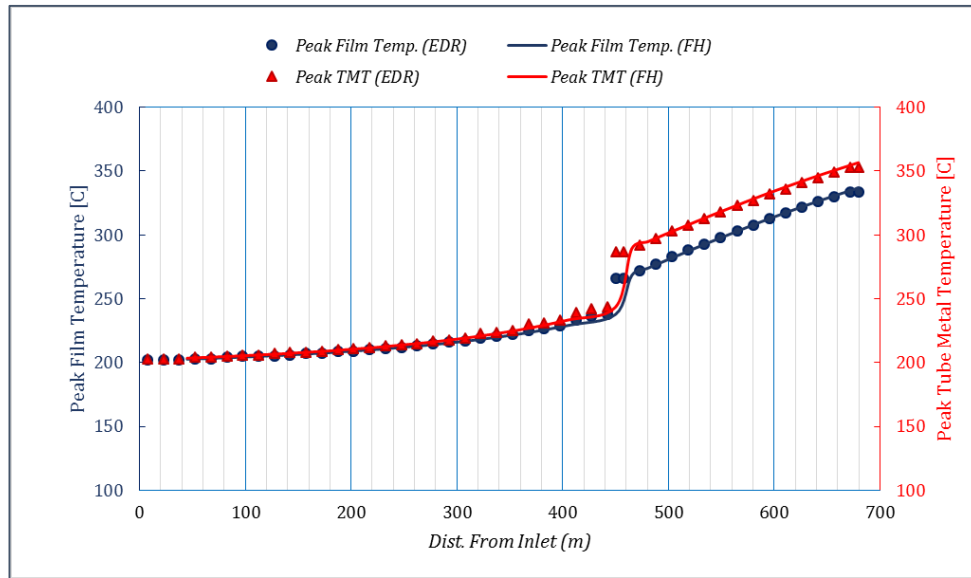
TEMPERATURE & PRESSURE



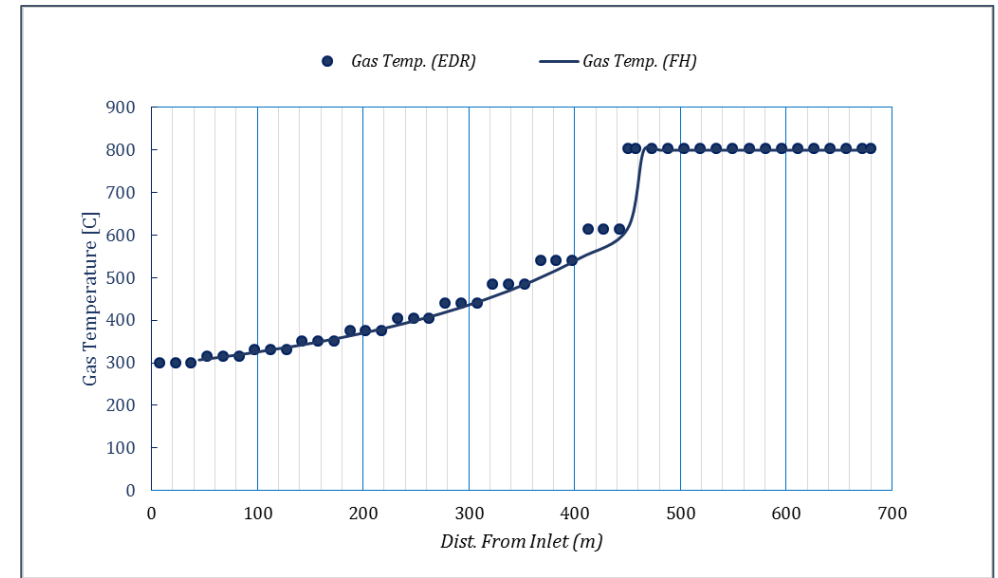
VELOCITY & VAPOR FRACTION



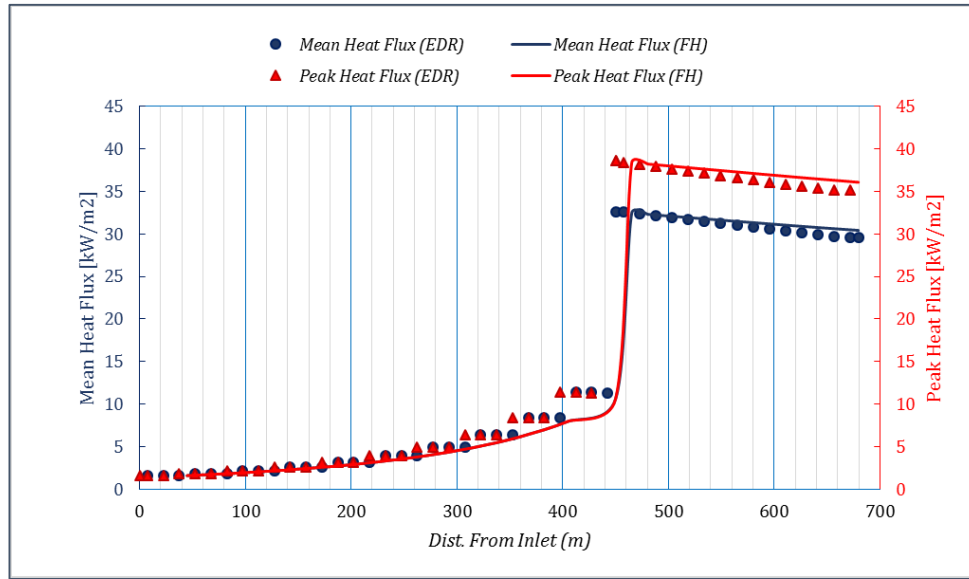
TUBE TEMPERATURES



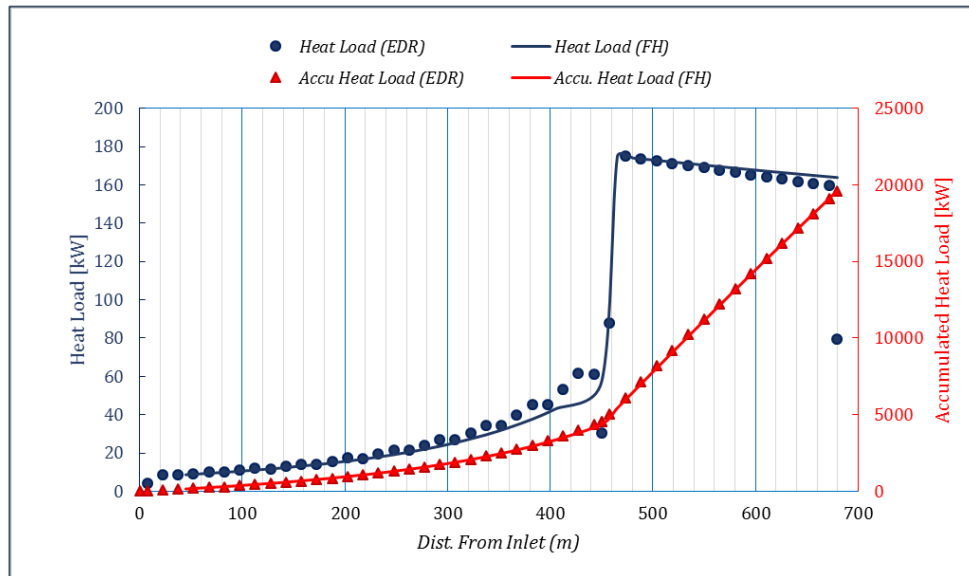
GAS TEMP.



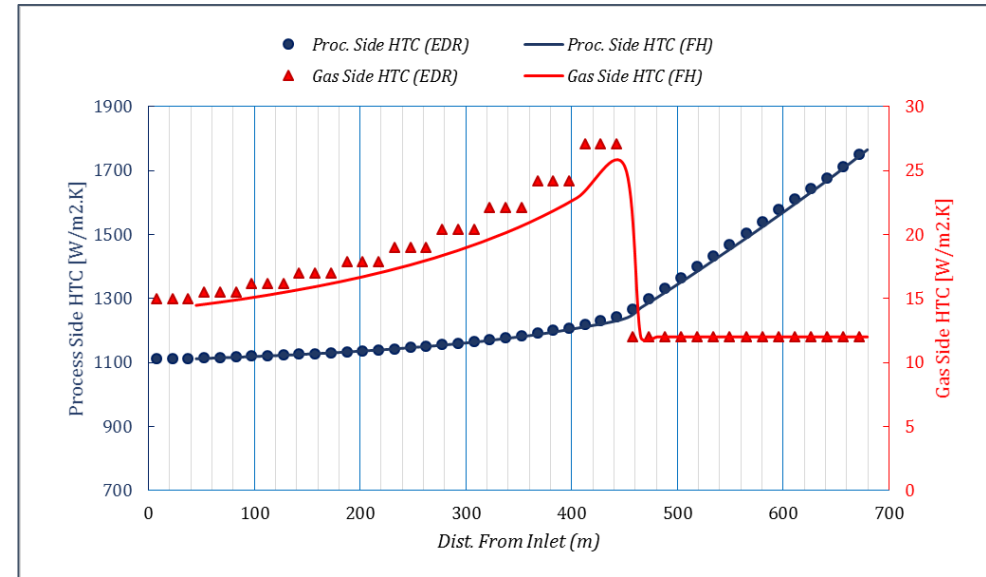
HEAT FLUXES



HEAT LOAD



HEAT TRANSFER COEF.



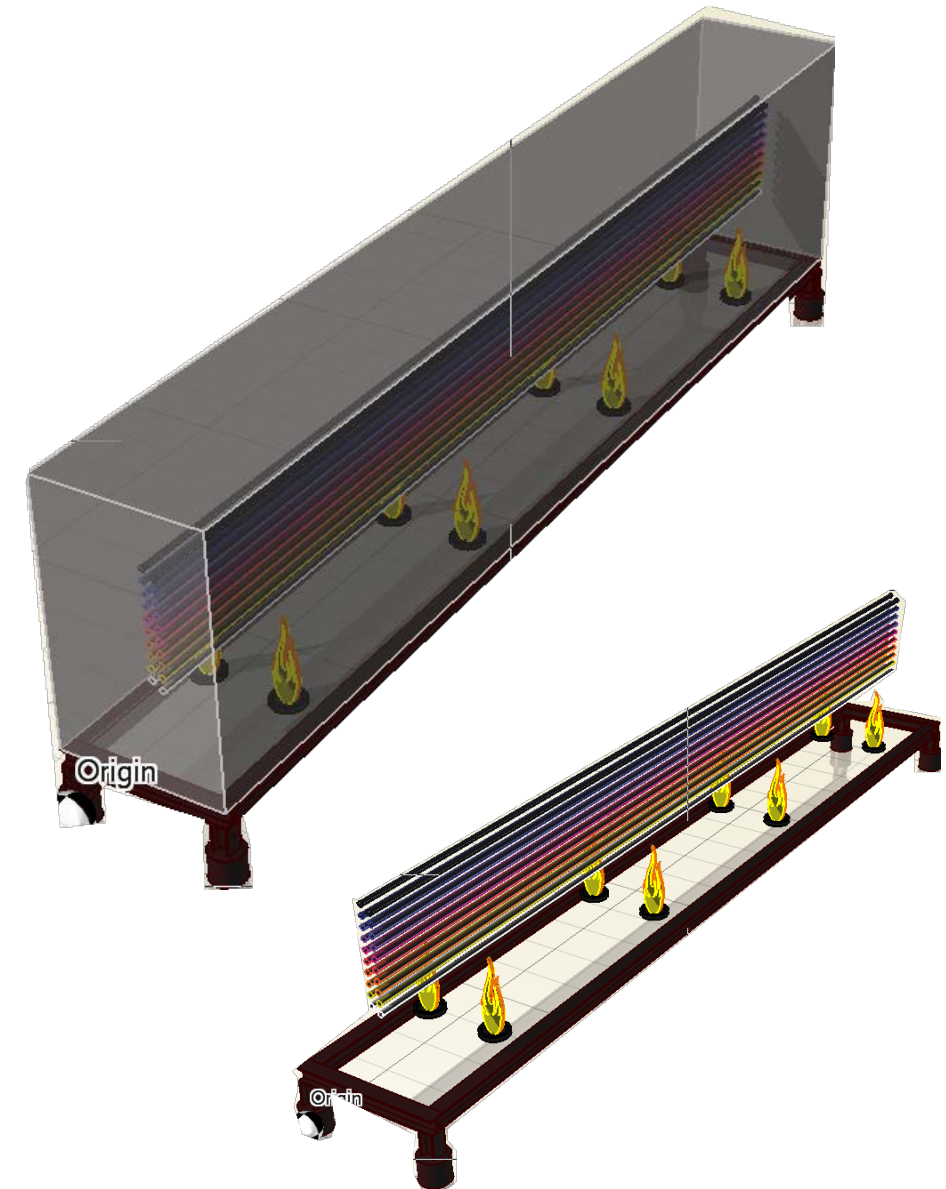
FHinfinity[©] CASE #RS-5T

DEMO CASE #RS-5T

| | |
|-------------------------------------|--|
| ⦿ HEATER GEOMETRY | <i>Radiant Only</i> |
| ⦿ FIREBOX TYPE / NO. OF PATH | <i>Cubical / Two (2)</i> |
| ⦿ FIREBOX TUBE LAYOUT | <i>Horiz., Central (1 Lane – 2Row)</i> |
| ⦿ CONV. LAYOUT / NO. OF T.B. | <i>None</i> |
| ⦿ CONV. TUBE TYPE | <i>None</i> |
| ⦿ BURNER LAYOUT | <i>Up-Fired</i> |
| ⦿ STACK | <i>None</i> |
| ⦿ FAN / APH / TRANSFER LINE | <i>None</i> |
| ⦿ FUEL | <i>Fuel Gas</i> |
| ⦿ NO. OF PROCESS STREAM | <i>One (1)</i> |
| ⦿ PROCESS THERMO. STATE | <i>Vaporizing (2ph. / 2ph.)</i> |
| ⦿ THERMO ENGINE | <i>User Input Data</i> |

Model Specification & Setting:

Fouling Factor



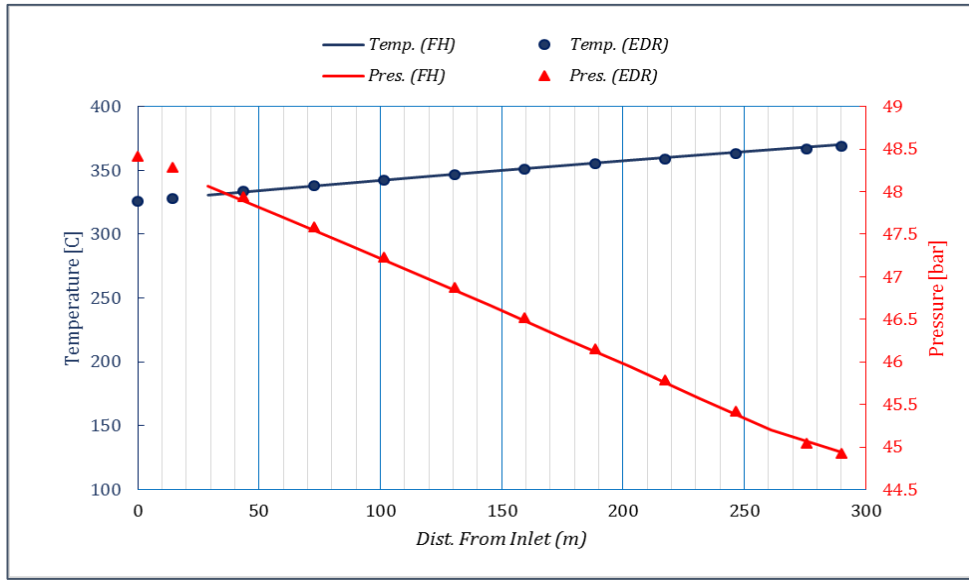
DEMO CASE #RS-5T - OUTPUT

| | FHinfinity | ASPEN EDR | % ERR. | NOTE |
|---|-------------------|------------------|---------------|-------------|
| Total Heat Absorption [kW] | 8968 | 8808 | 1.8 | |
| Firebox Duty [kW] | 8968 | 8808 | 1.8 | |
| Avg. Rad. Sec. Heat Flux Density [W/m2] | 28816 | 28513 | 1.1 | |
| Process Outlet Temperature [C] | 370 | 369 | (1) | 1 |
| Process Side Pressure Drop [bar] | 3.5 | 3.5 | (~ 0) | 1 |
| Heater Efficiency [%] | 65.2 | 64.1 | 1.7 | |
| Flue Gas Temp. Leaving Heater [C] | 716 | 740 | (- 24) | 1 |
| Bridgewall Temperature [C] | 716 | 740 | (- 24) | 1 |
| Draft at Arch [in WC] | N/A | N/A | N/A | 1 |
| Max. Flue Gas Mass Velocity [kg/m2.s] | N/A | N/A | N/A | |
| Ratio of Peak to Mean Heat Flux [-] | 1.95 | 1.92 | 1.5 | |
| Adiabatic Flame Temperature [C] | 1941 | 1937 | (4) | 1 |

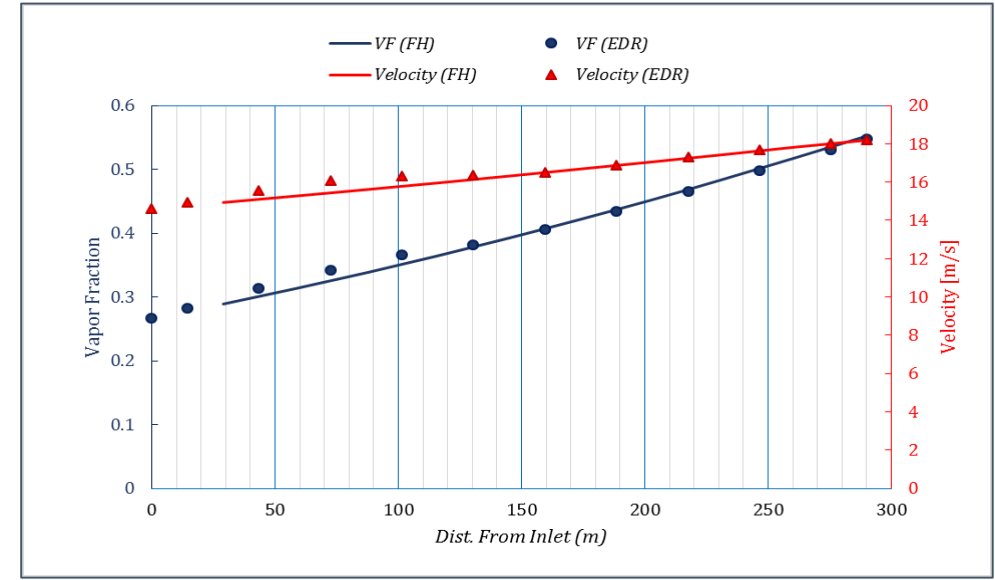
NOTES:

(1) Absolute Error

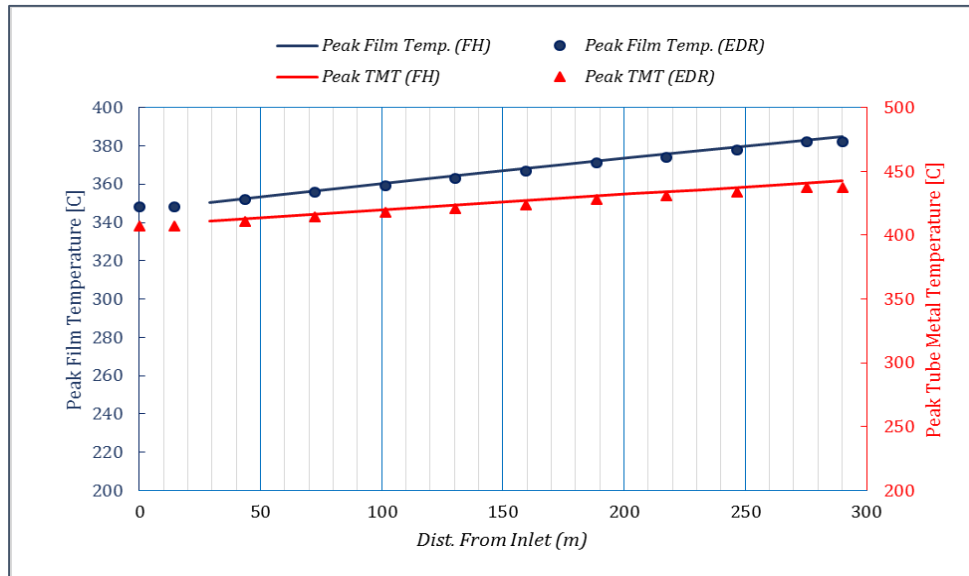
TEMPERATURE & PRESSURE



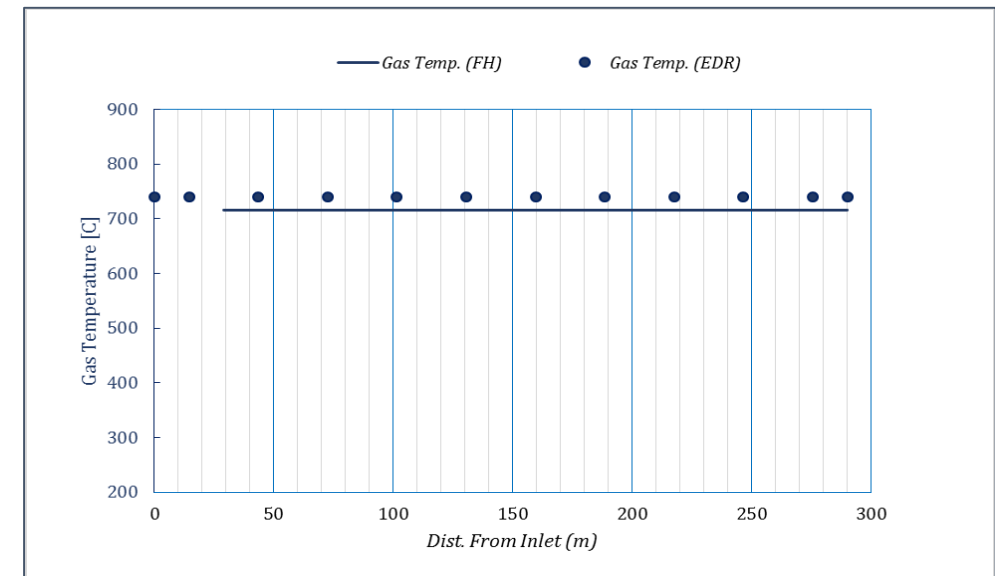
VELOCITY & VAPOR FRACTION



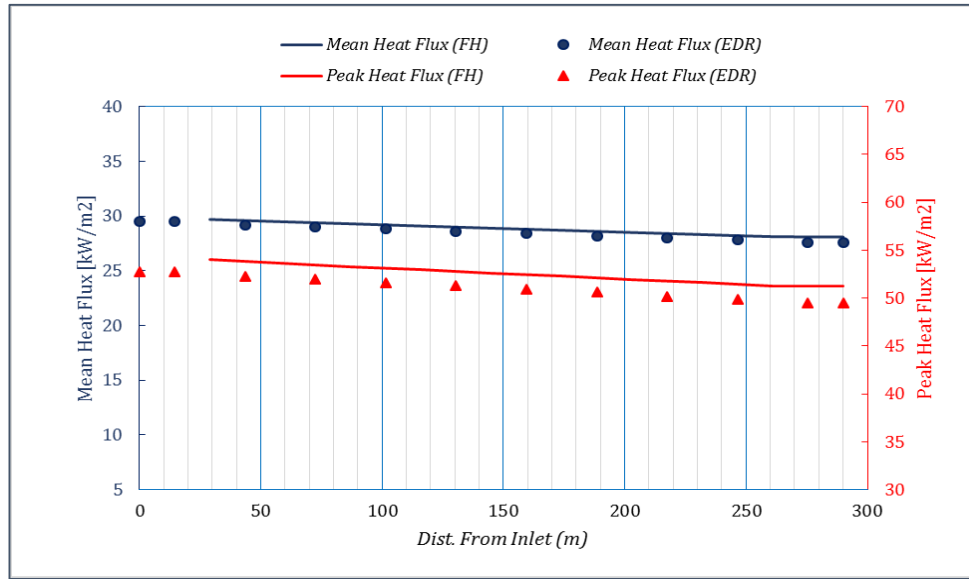
TUBE TEMPERATURES



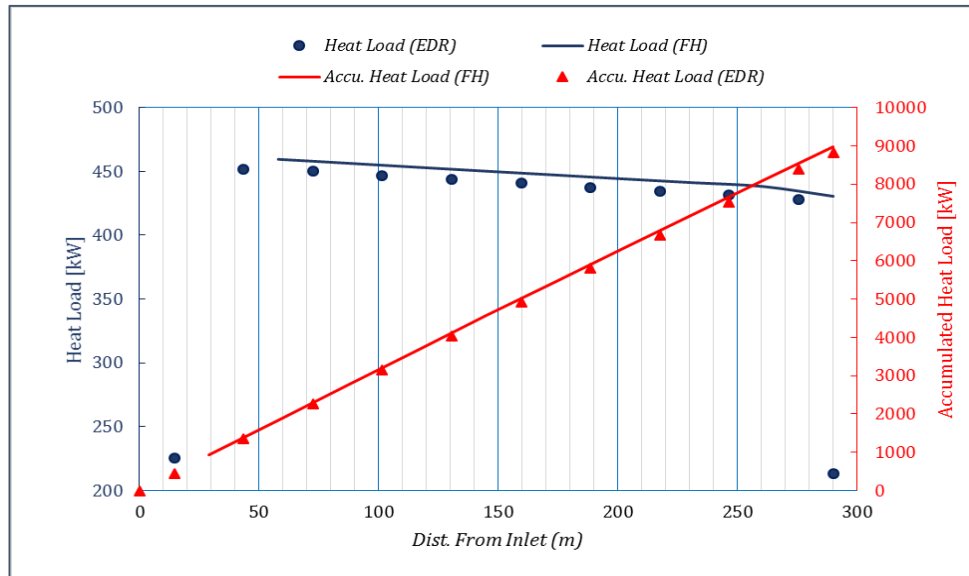
GAS TEMP.



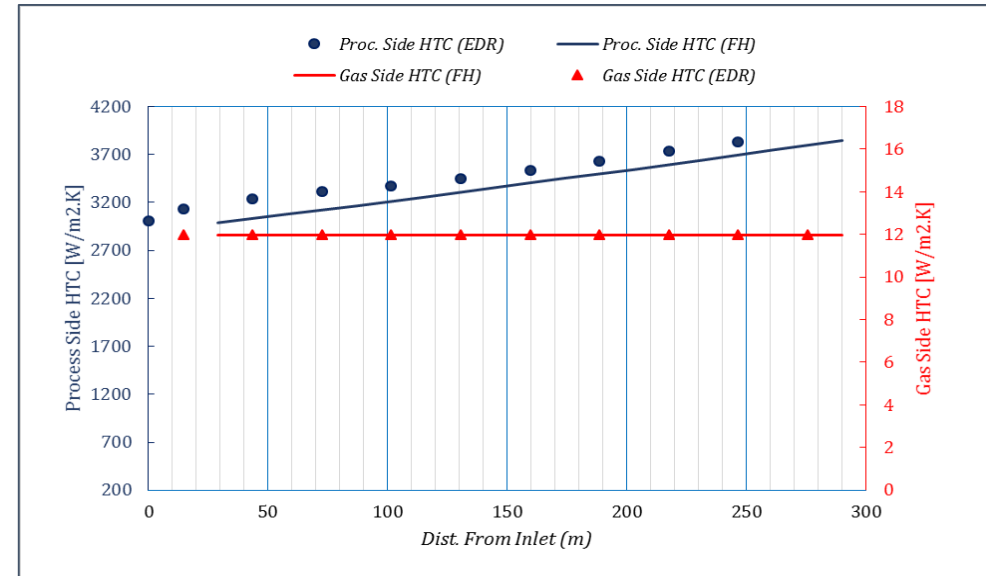
HEAT FLUXES



HEAT LOAD



HEAT TRANSFER COEF.



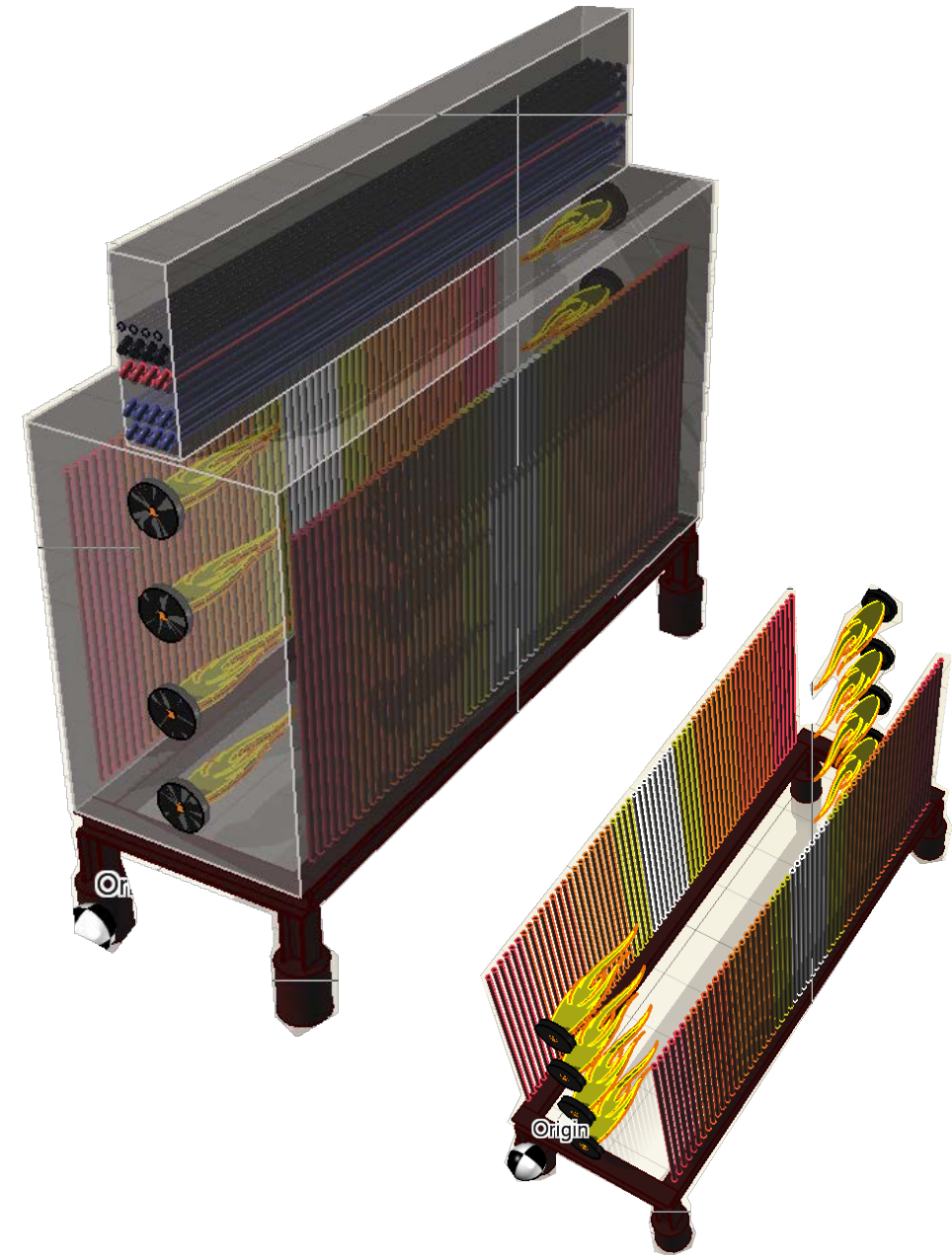
FHinfinity[©] CASE #RCS-6T

DEMO CASE #RCS-6T

| | |
|-------------------------------------|------------------------------------|
| ⦿ HEATER GEOMETRY | <i>Radiant + Convection</i> |
| ⦿ FIREBOX TYPE / NO. OF PATH | <i>Cubical / Four (4)</i> |
| ⦿ FIREBOX TUBE LAYOUT | <i>Vertical, Refractory Backed</i> |
| ⦿ CONV. LAYOUT / NO. OF T.B. | <i>Triangular / Two (2)</i> |
| ⦿ CONV. TUBE TYPE | <i>Bare - Fin</i> |
| ⦿ BURNER LAYOUT | <i>Endwall-Fired</i> |
| ⦿ STACK | <i>None</i> |
| ⦿ FAN / APH / TRANSFER LINE | <i>None</i> |
| ⦿ FUEL | <i>Fuel Gas</i> |
| ⦿ NO. OF PROCESS STREAM | <i>One (1)</i> |
| ⦿ PROCESS THERMO. STATE | <i>Vaporizing (2ph. / Vap.)</i> |
| ⦿ THERMO ENGINE | <i>Aspen Hysys</i> |

Model Specification & Setting:

Hottel Parameter

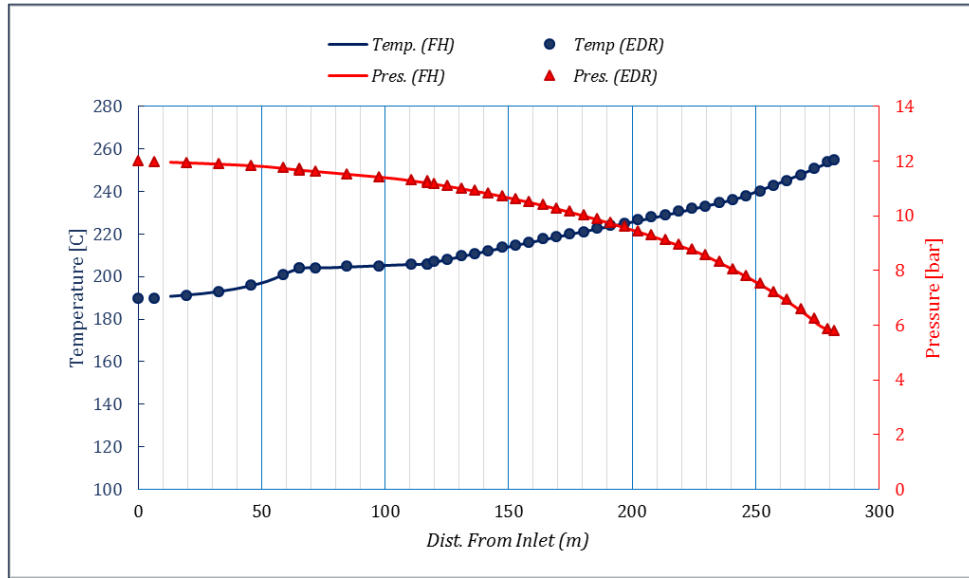


| | FHinfinity | ASPEN EDR | % ERR. | NOTE |
|--|-------------------|------------------|---------------|-------------|
| Total Heat Absorption [kW] | 10634 | 10660 | - 0.2 | |
| Firebox Duty [kW] | 7671 | 7703 | - 0.4 | |
| Avg. Rad. Sec. Heat Flux Density [W/m ²] | 30649 | 30777 | - 0.4 | |
| Process Outlet Temperature [C] | 255 | 255 | (~ 0) | 1 |
| Process Side Pressure Drop [bar] | 6.2 | 6.2 | (~ 0) | 1 |
| Heater Efficiency [%] | 87.8 | 88 | - 0.2 | |
| Flue Gas Temp. Leaving Heater [C] | 230.8 | 226 | (4.8) | 1 |
| Bridgewall Temperature [C] | 719.6 | 714 | (5.6) | 1 |
| Draft at Arch [in WC] | N/A | N/A | N/A | |
| Max. Flue Gas Mass Velocity [kg/m ² .s] | 1.27 | 1.27 | 0 | |
| Ratio of Peak to Mean Heat Flux [-] | 1.92 | 1.92 | 0 | |
| Adiabatic Flame Temperature [C] | 1890 | 1887 | (3) | 1 |

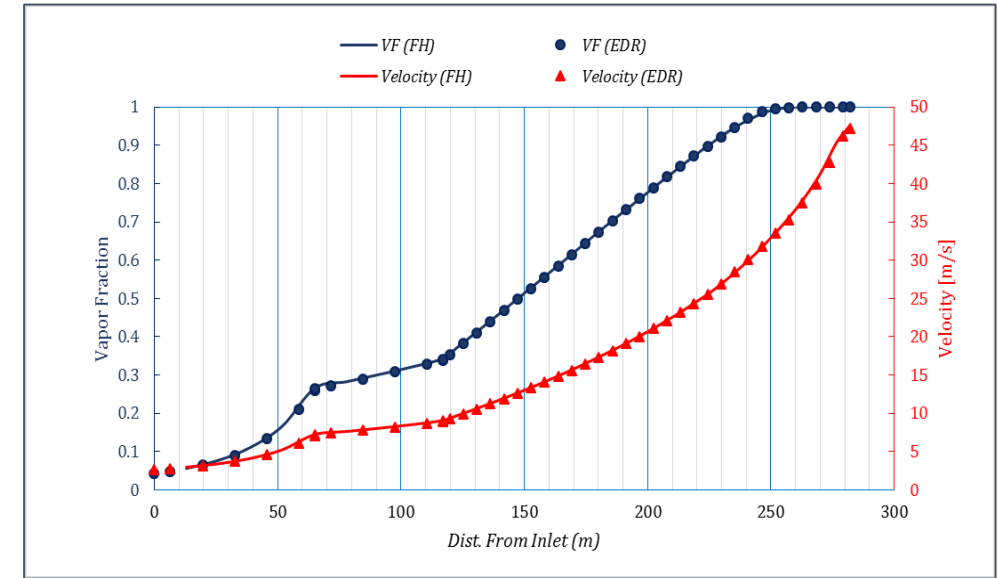
NOTES:

(1) Absolute Error

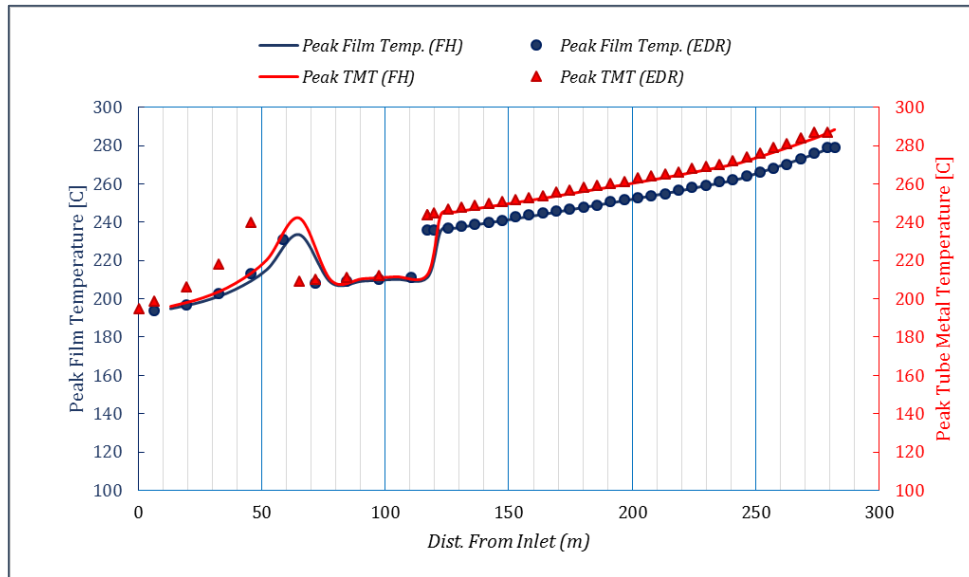
TEMPERATURE & PRESSURE



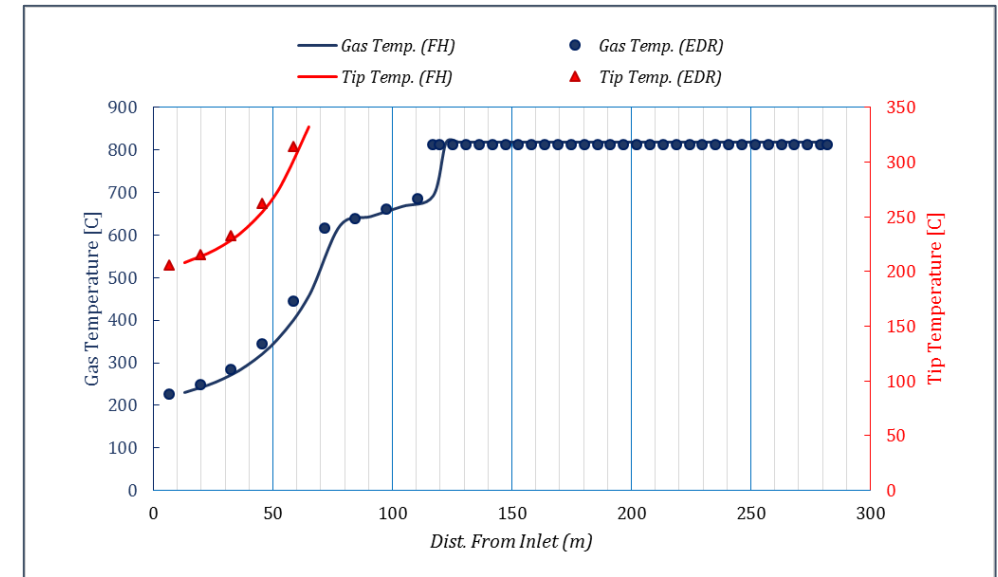
VELOCITY & VAPOR FRACTION



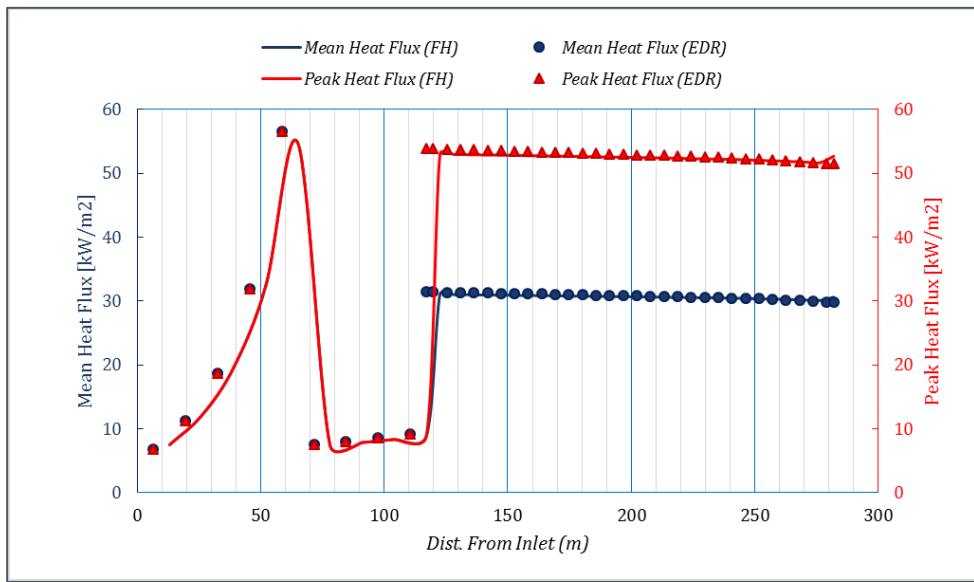
TUBE TEMPERATURES



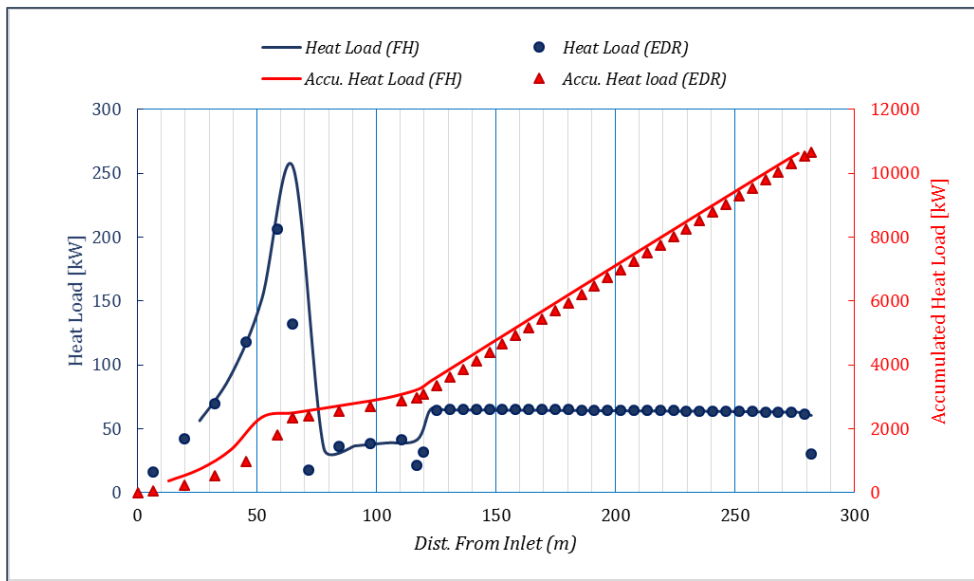
GAS TEMP. & TIP TEMP.



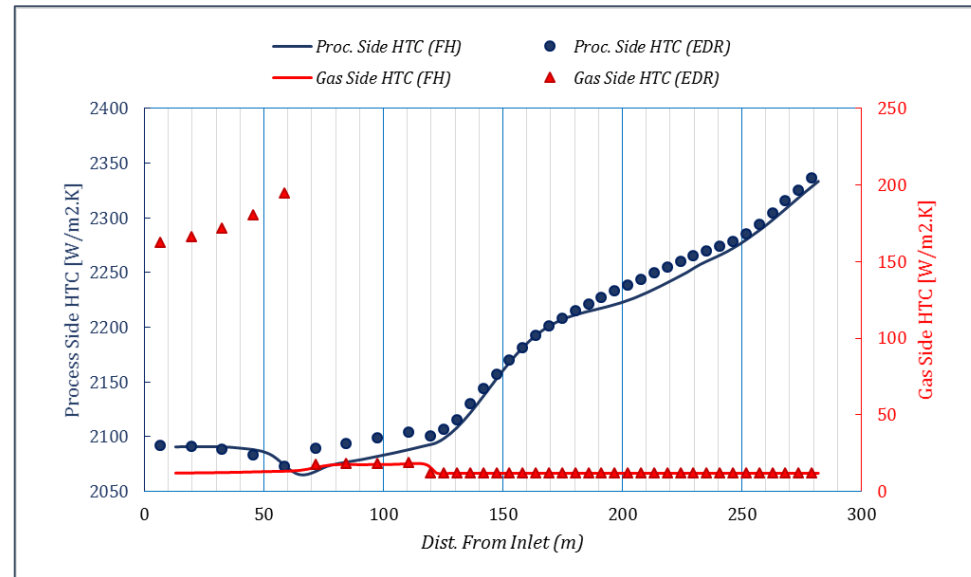
HEAT FLUXES



HEAT LOAD



HEAT TRANSFER COEF.



FHinfinity[©] CASE #RCS-10T

DEMO CASE #RCS-10T

| | |
|-------------------------------------|---|
| ⦿ HEATER GEOMETRY | <i>Radiant + Convection</i> |
| ⦿ FIREBOX TYPE / NO. OF PATH | <i>Cubical / Six (6)</i> |
| ⦿ FIREBOX TUBE LAYOUT | <i>Vertical, Central (1 Lane)</i> |
| ⦿ CONV. LAYOUT / NO. OF T.B. | <i>Rectang. & Triang. / Three (3)</i> |
| ⦿ CONV. TUBE TYPE | <i>Bare - Bare - Bare</i> |
| ⦿ BURNER LAYOUT | <i>Sidewall-Fired</i> |
| ⦿ STACK | <i>None</i> |
| ⦿ FAN / APH / TRANSFER LINE | <i>None</i> |
| ⦿ FUEL | <i>Combination F. Oil & F. Gas</i> |
| ⦿ NO. OF PROCESS STREAM | <i>One (1)</i> |
| ⦿ PROCESS THERMO. STATE | <i>Vaporizing (2ph. / 2ph.)</i> |
| ⦿ THERMO ENGINE | <i>Aspen Hysys</i> |

Model Specification & Setting:

- Tube Bank Interconnection*
- Radiation to Tube Bank*

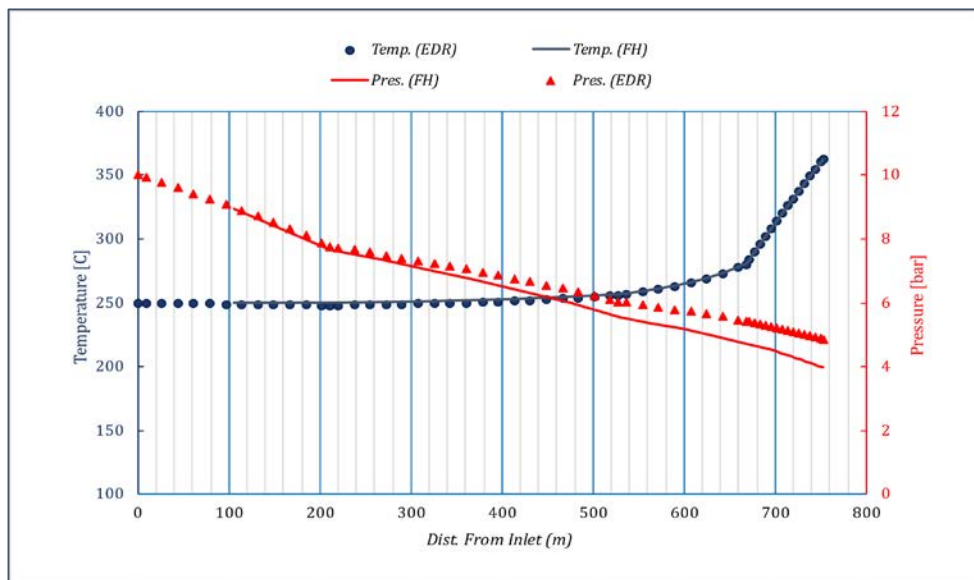


| | FHinfinity | ASPEN EDR | % ERR. | NOTE |
|--|-------------------|------------------|---------------|-------------|
| Total Heat Absorption [kW] | 9813 | 9697 | 1.2 | |
| Firebox Duty [kW] | 6673 | 6771 | - 1.4 | |
| Avg. Rad. Sec. Heat Flux Density [W/m ²] | 35136 | 35652 | - 1.4 | |
| Process Outlet Temperature [C] | 362 | 363 | (~ -1) | 1 |
| Process Side Pressure Drop [bar] | 6 | 5.15 | (0.85) | 1 |
| Heater Efficiency [%] | 85.3 | 84.3 | 1.4 | |
| Flue Gas Temp. Leaving Heater [C] | 271 | 293 | (- 22) | 1 |
| Bridgewall Temperature [C] | 789 | 775 | (14) | 1 |
| Draft at Arch [in WC] | N/A | N/A | N/A | |
| Max. Flue Gas Mass Velocity [kg/m ² .s] | 0.24 | 0.24 | 0 | |
| Ratio of Peak to Mean Heat Flux [-] | 1.23 | 1.23 | ~ 0 | |
| Adiabatic Flame Temperature [C] | 1826 | 1825 | (1) | 1 |

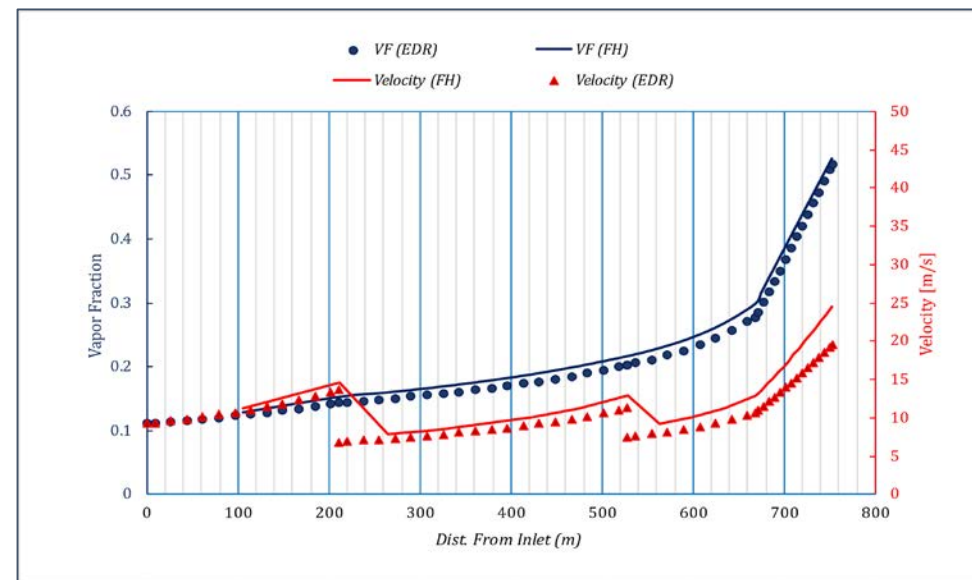
NOTES:

(1) Absolute Error

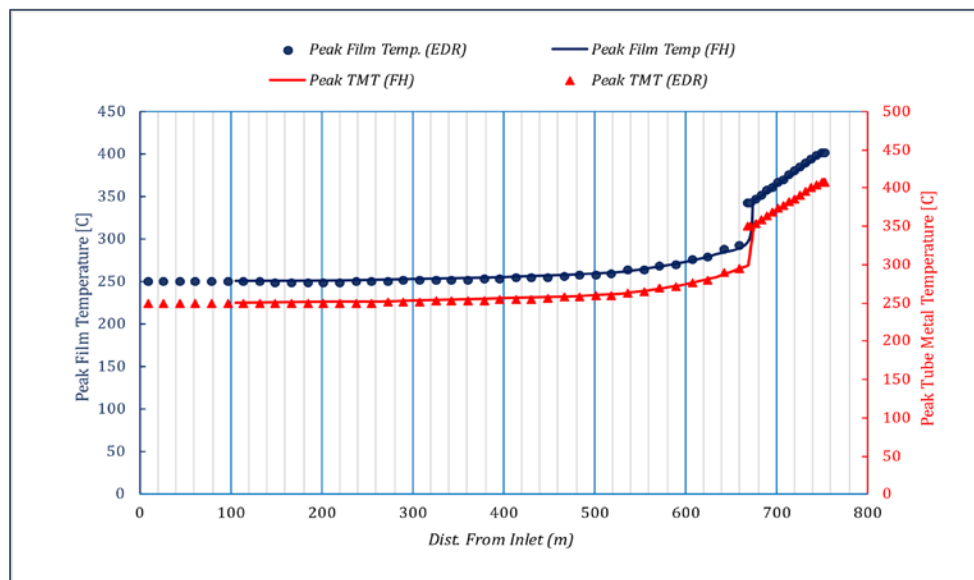
TEMPERATURE & PRESSURE



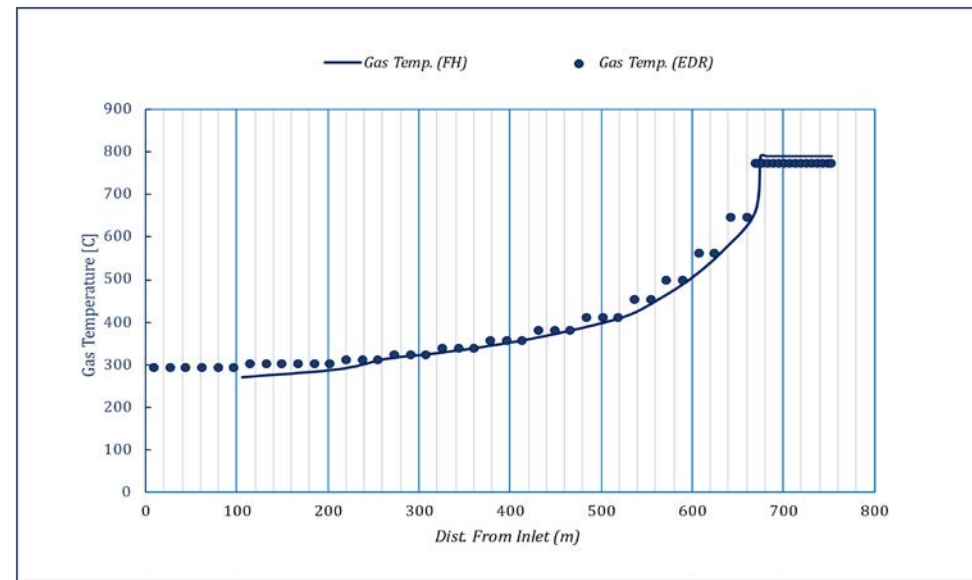
VELOCITY & VAPOR FRACTION



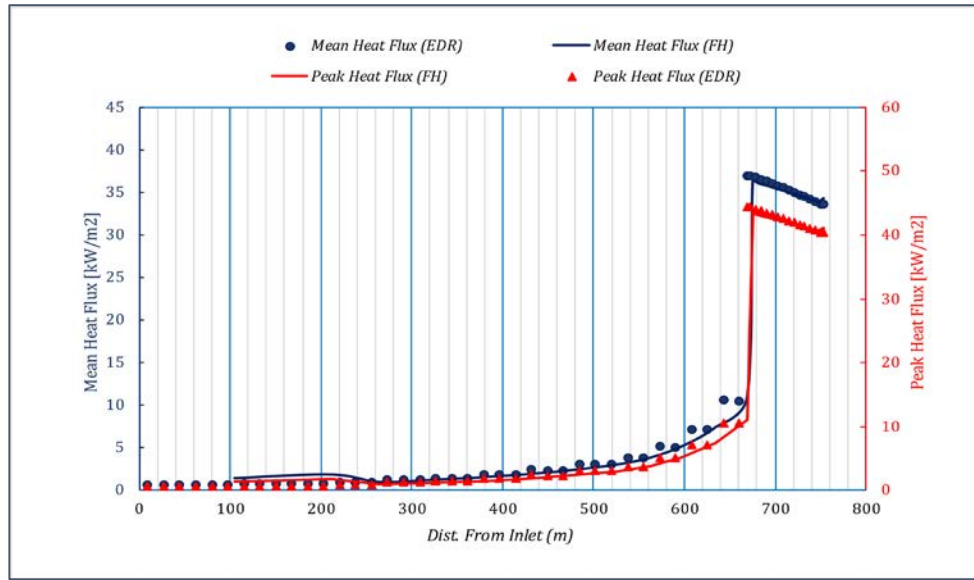
TUBE TEMPERATURES



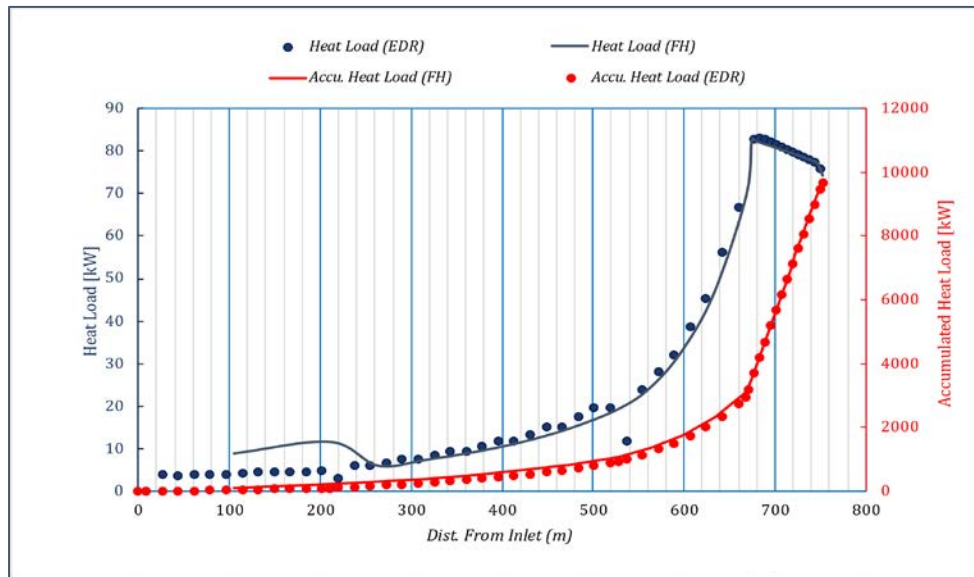
GAS TEMP.



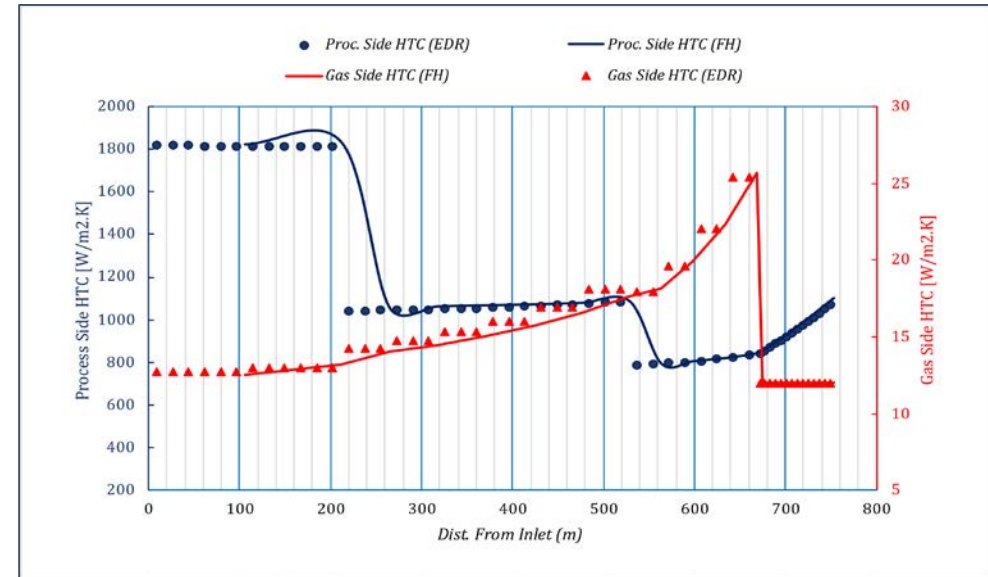
HEAT FLUXES



HEAT LOAD



HEAT TRANSFER COEF.

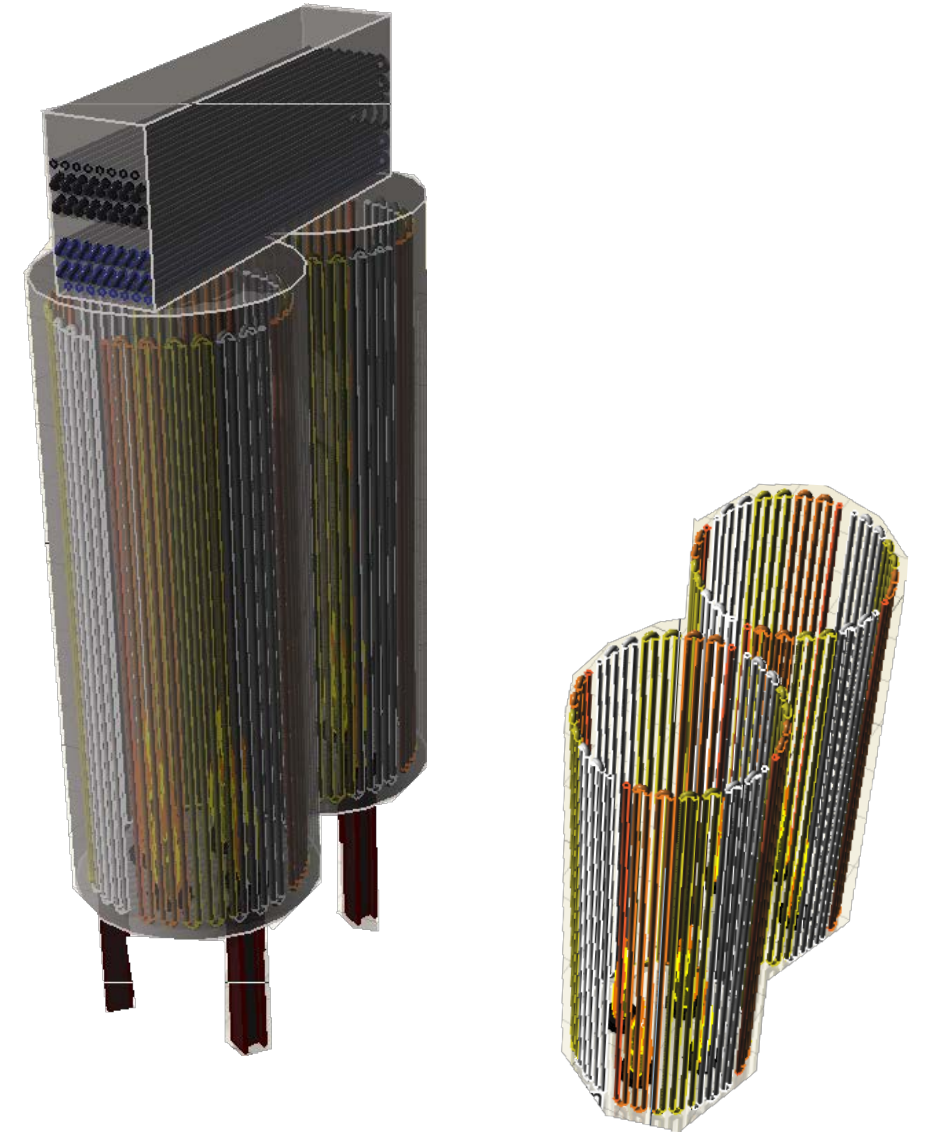


FHinfinity[©] CASE #R2CS-13T

| | |
|-------------------------------------|------------------------------------|
| ⦿ HEATER GEOMETRY | <i>Radiant (Twin) + Convection</i> |
| ⦿ FIREBOX TYPE / NO. OF PATH | <i>Cylindrical / Eight (8)</i> |
| ⦿ FIREBOX TUBE LAYOUT | <i>Vertical, Refractory Backed</i> |
| ⦿ CONV. LAYOUT / NO. OF T.B. | <i>Triangular / One (1)</i> |
| ⦿ CONV. TUBE TYPE | <i>Bare</i> |
| ⦿ BURNER LAYOUT | <i>Up-Fired</i> |
| ⦿ STACK | <i>None</i> |
| ⦿ FAN / APH / TRANSFER LINE | <i>Air Preheater</i> |
| ⦿ FUEL | <i>Fuel Gas</i> |
| ⦿ NO. OF PROCESS STREAM | <i>One (1)</i> |
| ⦿ PROCESS THERMO. STATE | <i>Vaporizing (Liq. / 2ph.)</i> |
| ⦿ THERMO ENGINE | <i>Aspen Hysys</i> |

Model Specification & Setting:

Hottel Parameter

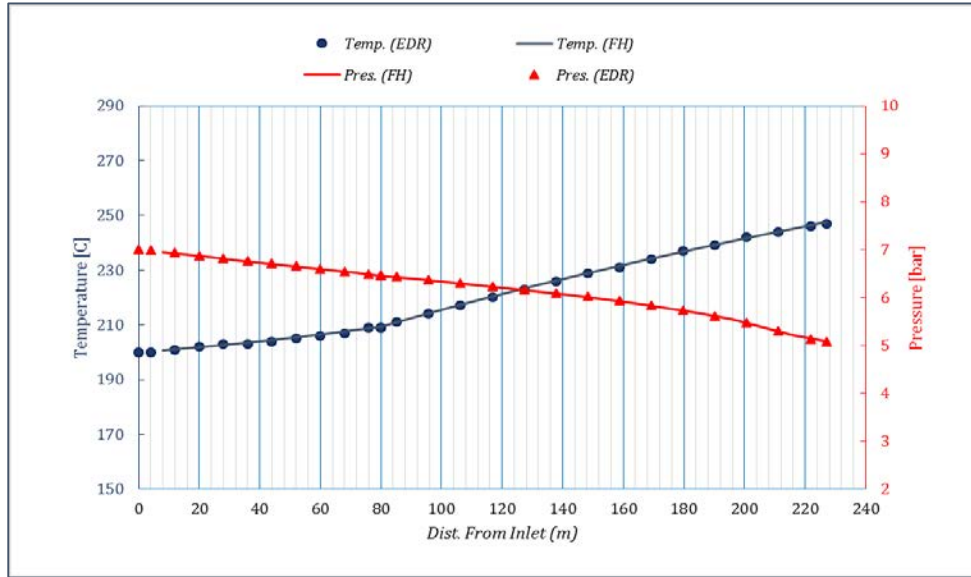


| | FHinfinity | ASPEN EDR | % ERR. | NOTE |
|--|-------------------|------------------|---------------|-------------|
| Total Heat Absorption [kW] | 16837 | 16847 | - 0.06 | |
| Firebox Duty [kW] | 13946 | 13905 | 0.3 | |
| Avg. Rad. Sec. Heat Flux Density [W/m ²] | 32119 | 32024 | 0.3 | |
| Process Outlet Temperature [C] | 248 | 247 | (1) | 1 |
| Process Side Pressure Drop [bar] | 1.9 | 1.9 | (~ 0) | 1 |
| Heater Efficiency [%] | 82.9 | 83 | - 0.1 | |
| Flue Gas Temp. Leaving Heater [C] | 348 (APH) | 343 (APH) | (5) | 1 |
| Bridgewall Temperature [C] | 841 | 840 | (1) | 1 |
| Draft at Arch [in WC] | N/A | N/A | N/A | |
| Max. Flue Gas Mass Velocity [kg/m ² .s] | 1.27 | 1.29 | - 1.5 | |
| Ratio of Peak to Mean Heat Flux [-] | 1.92 | 1.92 | ~ 0 | |
| Adiabatic Flame Temperature [C] | 2090 | 2081 | (9) | 1 |

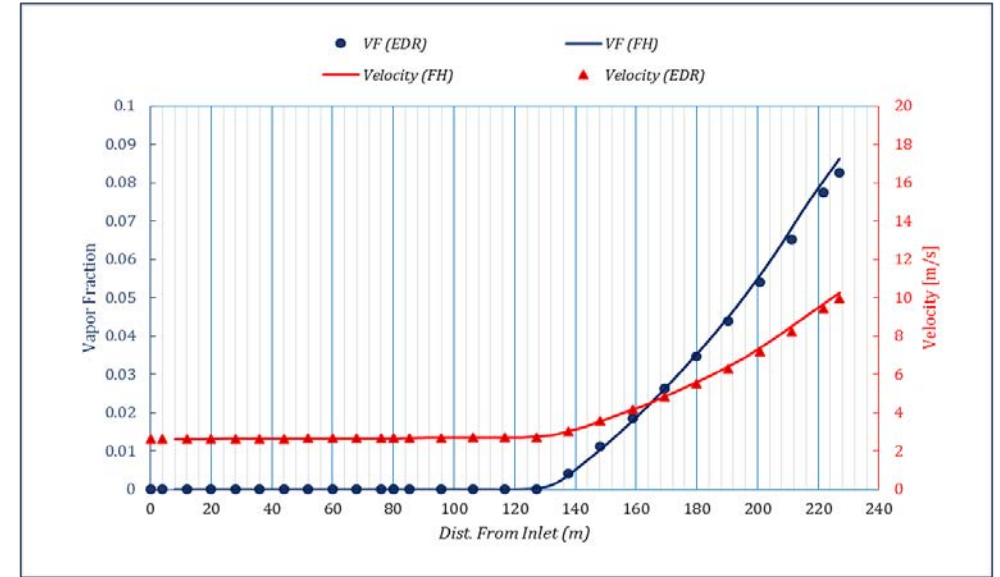
NOTES:

(1) Absolute Error

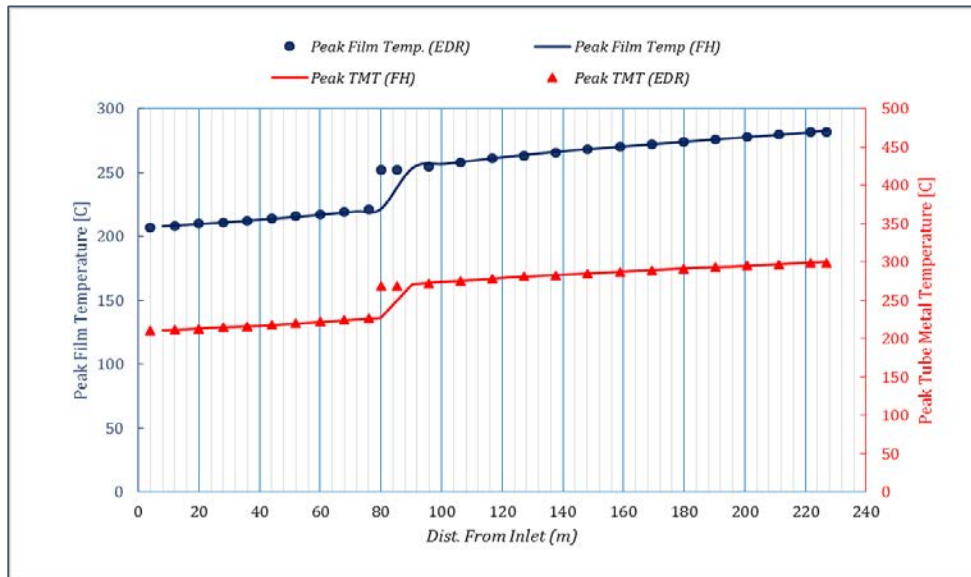
TEMPERATURE & PRESSURE



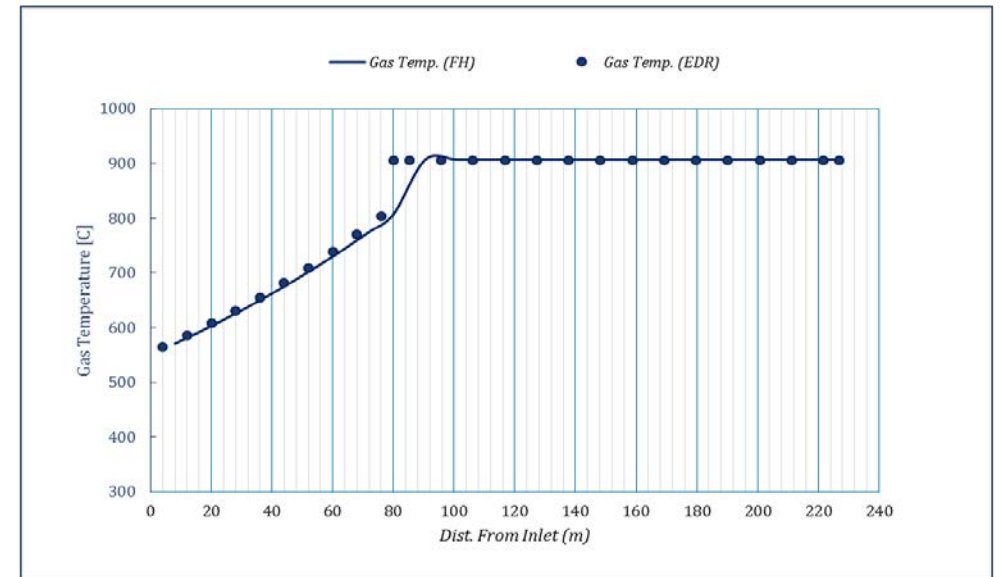
VELOCITY & VAPOR FRACTION



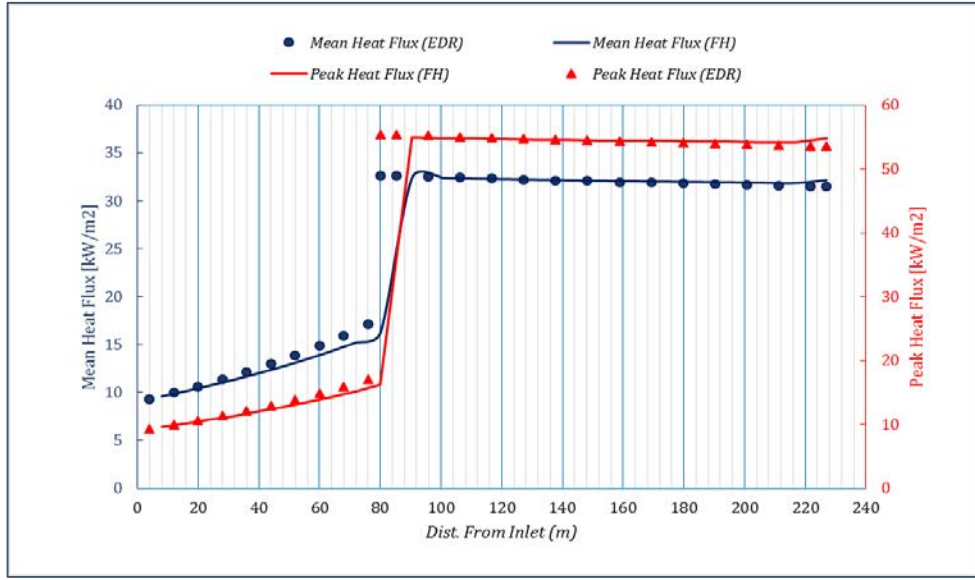
TUBE TEMPERATURES



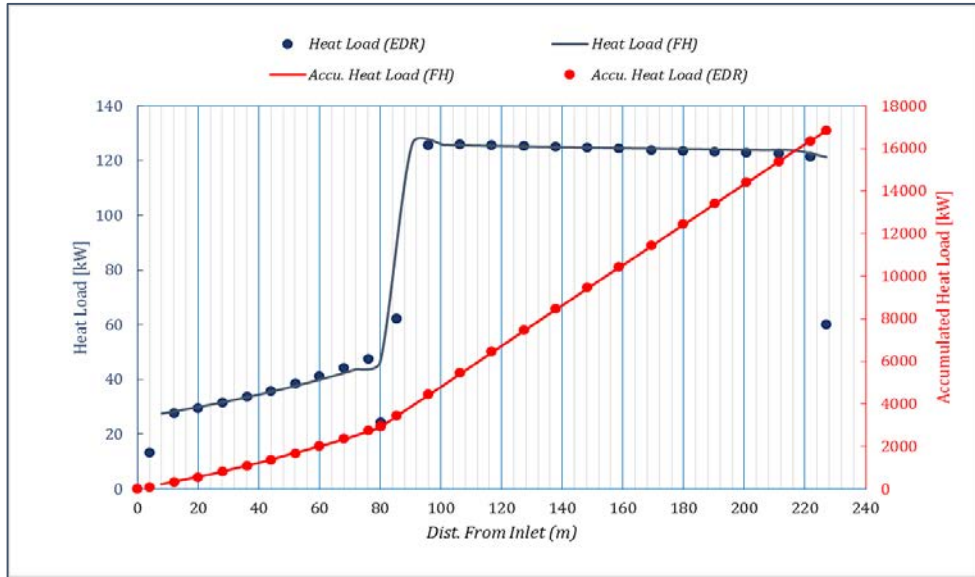
GAS TEMP.



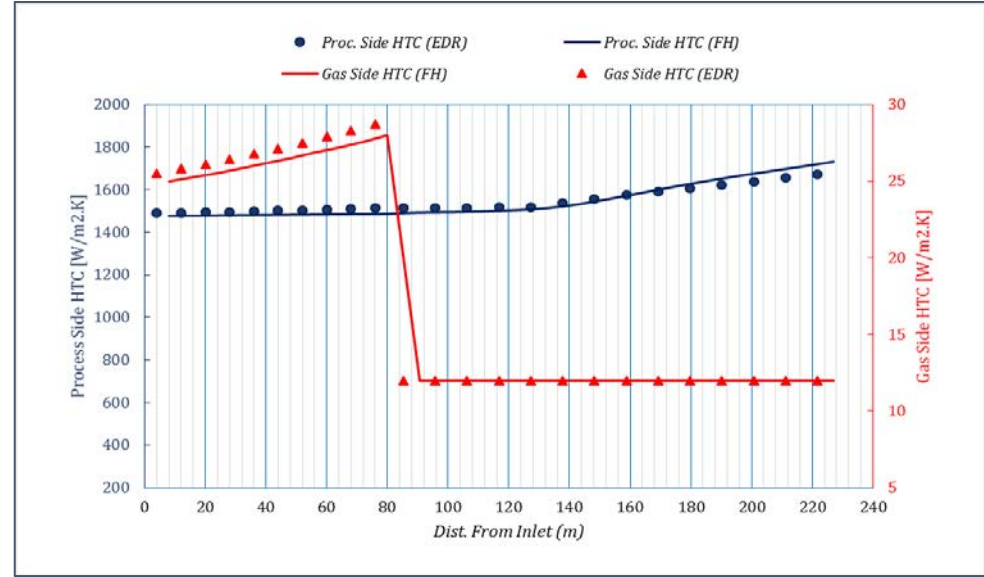
HEAT FLUXES



HEAT LOAD



HEAT TRANSFER COEF.



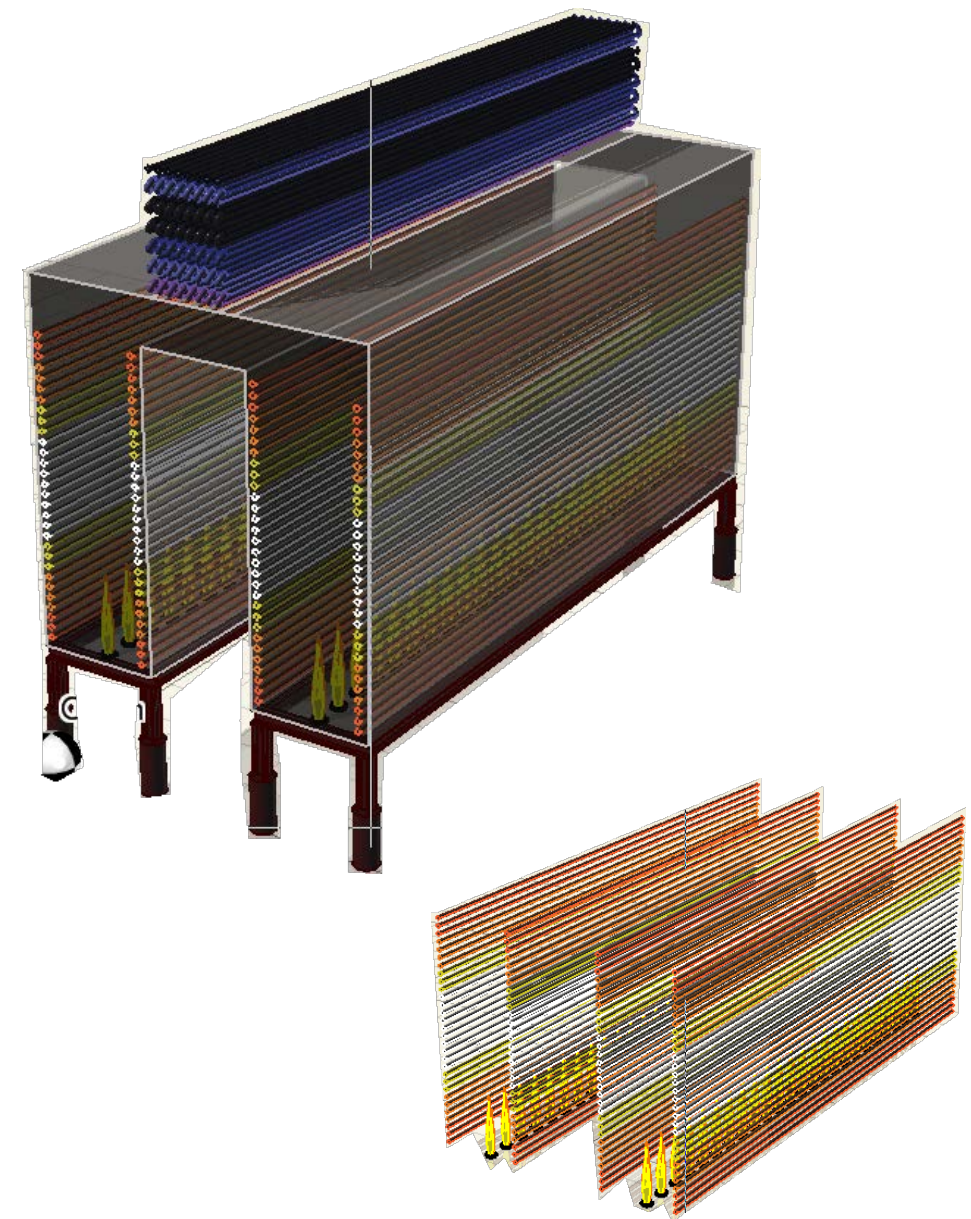
FHinfinity[©] CASE #R2CS-14T

DEMO CASE #R2CS-14T

| | |
|-------------------------------------|--------------------------------------|
| ⦿ HEATER GEOMETRY | <i>Radiant (Twin) + Convection</i> |
| ⦿ FIREBOX TYPE / NO. OF PATH | <i>Cubical / Eight (8)</i> |
| ⦿ FIREBOX TUBE LAYOUT | <i>Horizontal, Refractory Backed</i> |
| ⦿ CONV. LAYOUT / NO. OF T.B. | <i>Triangular / Two (2)</i> |
| ⦿ CONV. TUBE TYPE | <i>Bare – Fin</i> |
| ⦿ BURNER LAYOUT | <i>Up-Fired</i> |
| ⦿ STACK | <i>None</i> |
| ⦿ FAN / APH / TRANSFER LINE | <i>Air Preheater</i> |
| ⦿ FUEL | <i>Fuel Gas</i> |
| ⦿ NO. OF PROCESS STREAM | <i>One (1)</i> |
| ⦿ PROCESS THERMO. STATE | <i>Vaporizing (Liq. / 2ph.)</i> |
| ⦿ THERMO ENGINE | <i>Aspen Hysys</i> |

Model Specification & Setting:

- Shield Duty*
- Hottel Parameter*
- Radiation to Tube Bank*
- Fouling Factor*

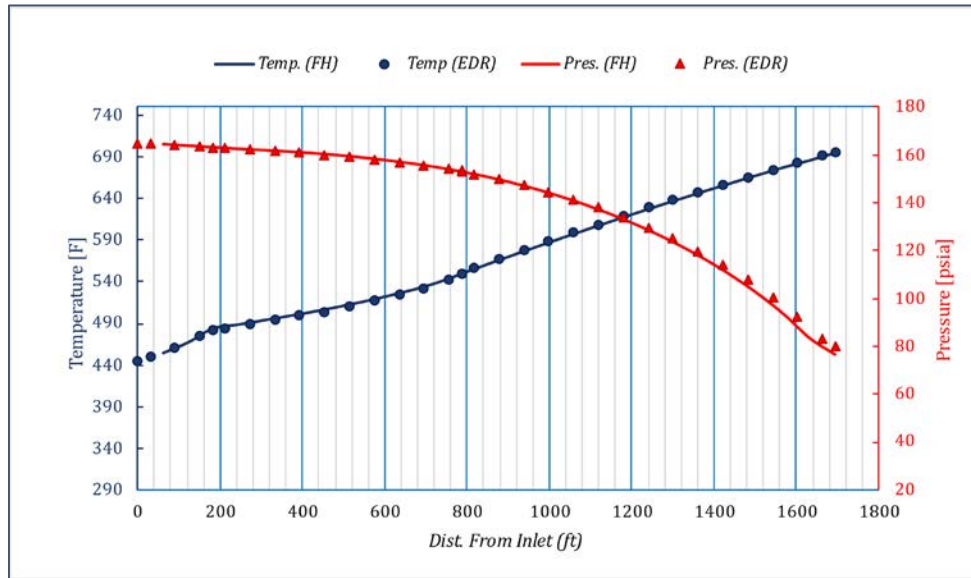


| | FHinfinity | ASPEN EDR | %ERR. | NOTE |
|---|-------------------|------------------|--------------|-------------|
| Total Heat Absorption [MM Btu/hr] | 213.2 | 213.4 | - 0.1 | |
| Firebox Duty [MM Btu/hr] | 134.6 | 135 | - 0.3 | |
| Avg. Rad. Sec. Heat Flux Density [Btu/hr.ft2] | 12836 | 12877 | - 0.3 | |
| Process Outlet Temperature [F] | 695 | 696 | (- 1) | 1 |
| Process Side Pressure Drop [Psi] | 88.8 | 85 | (3.8) | 1 |
| Heater Efficiency [%] | 86 | 86.2 | - 0.2 | |
| Flue Gas Temp. Leaving Heater [F] | 504 (APH) | 493 (APH) | (11) | 1 |
| Bridgewall Temperature [F] | 1715 | 1688 | (27) | 1 |
| Draft at Arch [in WC] | N/A | N/A | N/A | |
| Max. Flue Gas Mass Velocity [lb/ft2.s] | 0.44 | 0.44 | ~ 0 | |
| Ratio of Peak to Mean Heat Flux [-] | 1.9 | 1.91 | - 0.5 | |
| Adiabatic Flame Temperature [F] | 3459 | 3453 | (6) | 1 |

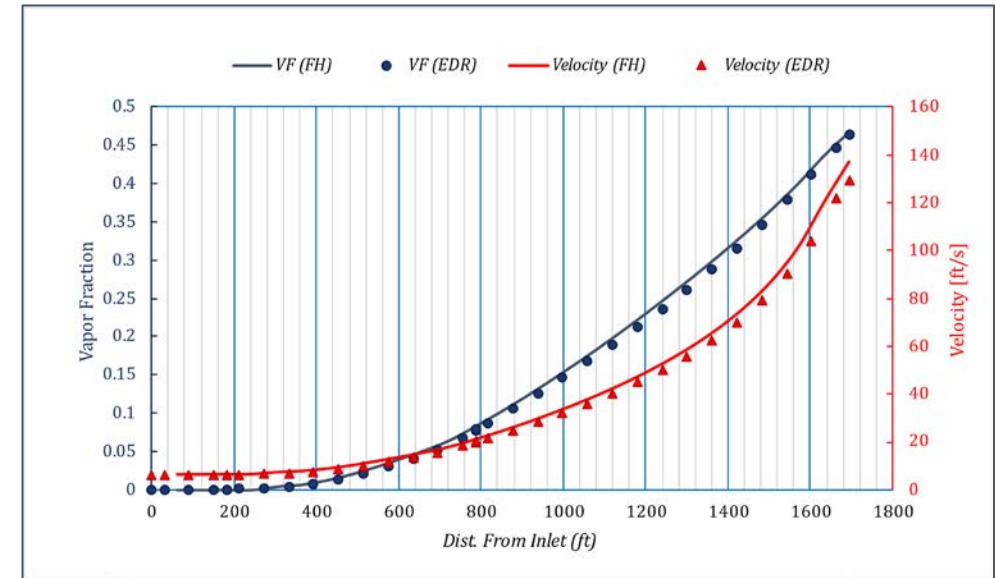
NOTES:

(1) Absolute Error

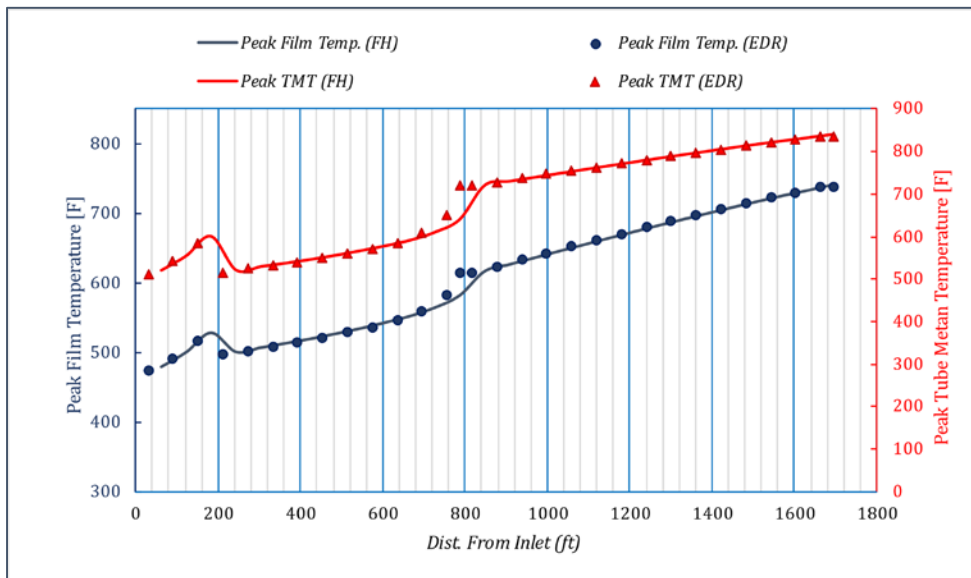
TEMPERATURE & PRESSURE



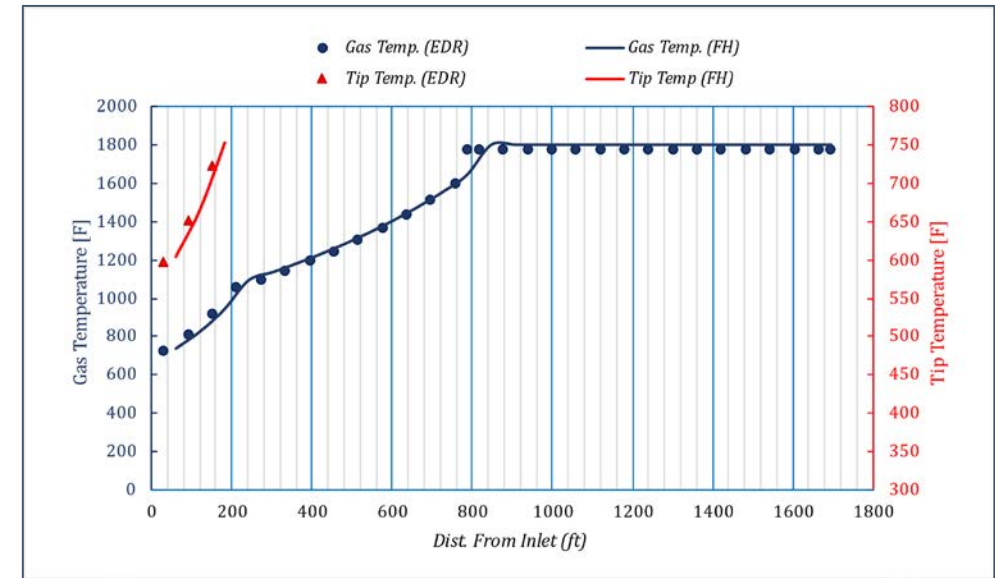
VELOCITY & VAPOR FRACTION



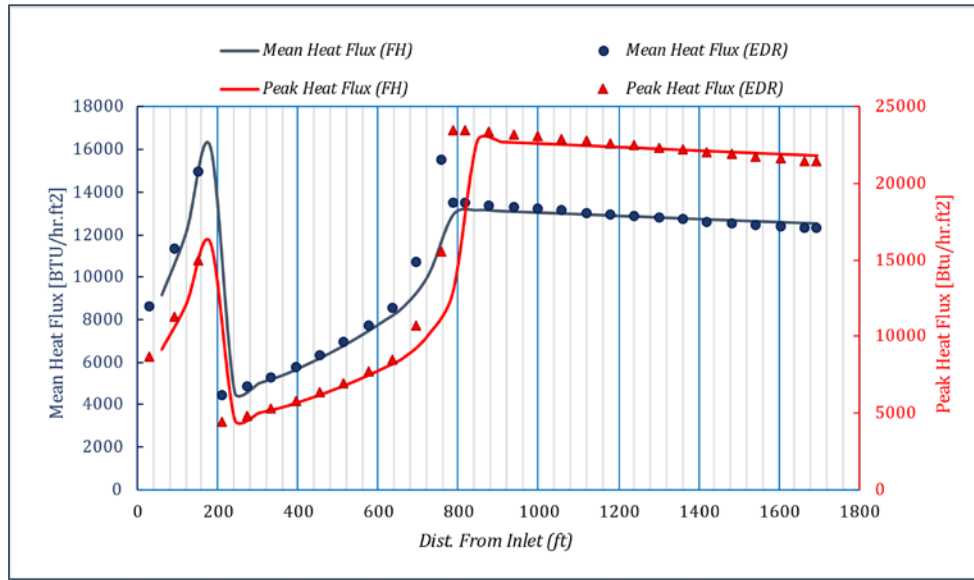
TUBE TEMPERATURES



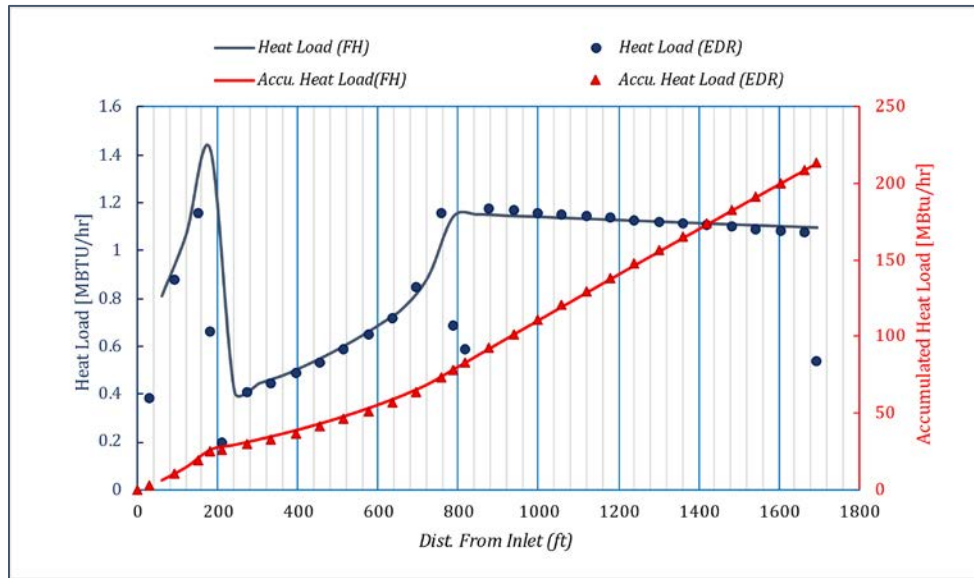
GAS TEMP. & TIP TEMP.



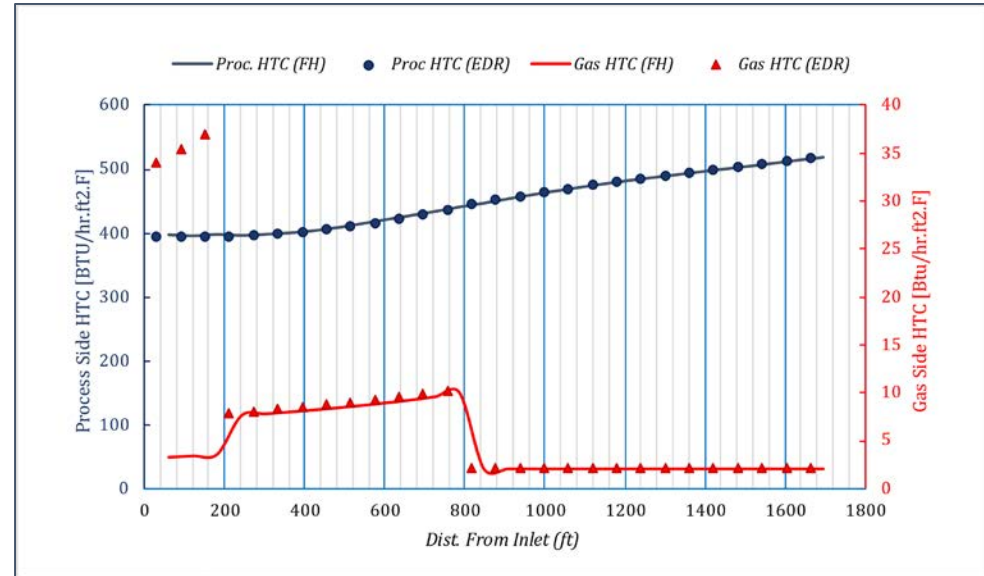
HEAT FLUXES



HEAT LOAD



HEAT TRANSFER COEF.



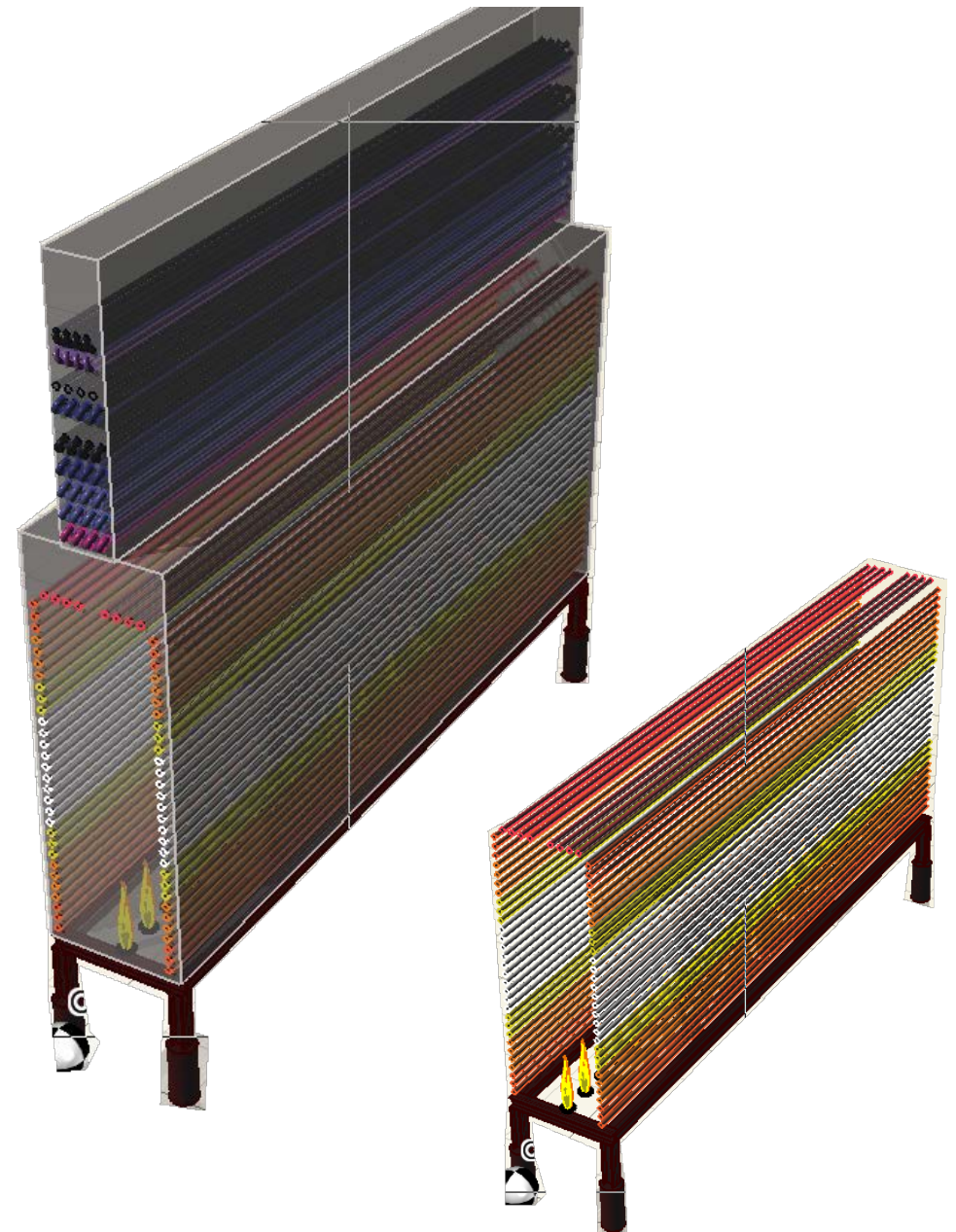
FHinfinity[©] CASE #RCS-15T

DEMO CASE #RCS-15T

| | |
|-------------------------------------|---|
| ⦿ HEATER GEOMETRY | <i>Radiant + Convection</i> |
| ⦿ FIREBOX TYPE / NO. OF PATH | <i>Cubical / Four (4)</i> |
| ⦿ FIREBOX TUBE LAYOUT | <i>Horiz., Ref. Back. (+ Roof Tube)</i> |
| ⦿ CONV. LAYOUT / NO. OF T.B. | <i>Triangular / Three (3)</i> |
| ⦿ CONV. TUBE TYPE | <i>Bare - Fin - Bare</i> |
| ⦿ BURNER LAYOUT | <i>Up-Fired</i> |
| ⦿ STACK | <i>None</i> |
| ⦿ FAN / APH / TRANSFER LINE | <i>None</i> |
| ⦿ FUEL | <i>Fuel Gas</i> |
| ⦿ NO. OF PROCESS STREAM | <i>One (1)</i> |
| ⦿ PROCESS THERMO. STATE | <i>All Vap. & Vaporizing (Liq/2ph.)</i> |
| ⦿ THERMO ENGINE | <i>Aspen Hysys / Aspen Hysys</i> |

Model Specification & Setting:

- Steam Injection to Firebox*
- Shield Duty*
- Hottel Parameter*
- Radiation to Tube Bank*

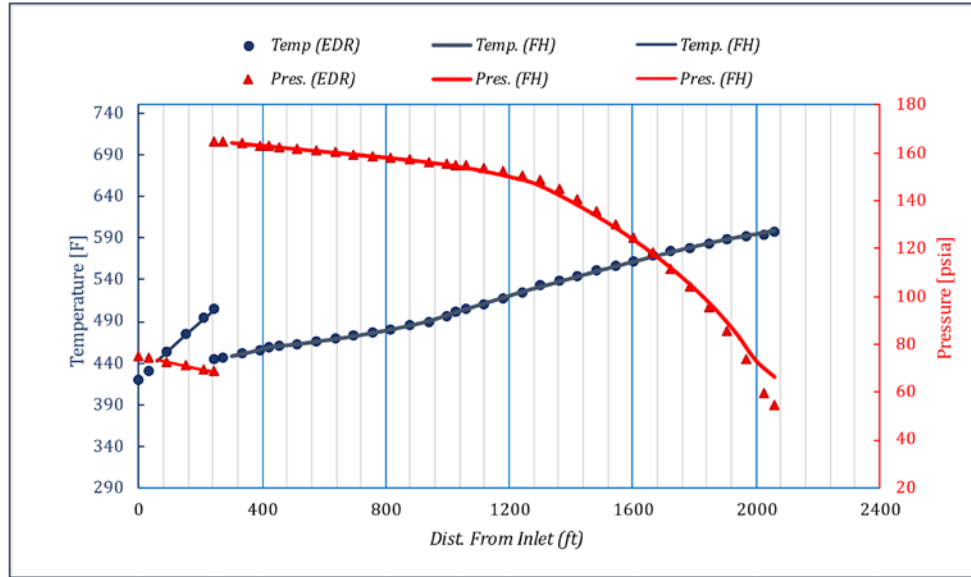


| | FHinfinity | ASPEN EDR | %ERR. | NOTE |
|--|-------------------|------------------|--------------|-------------|
| Total Heat Absorption [MM Btu/hr] | 73.8 | 73.7 | 0.1 | |
| Firebox Duty [MM Btu/hr] | 51.2 | 51 | 0.4 | |
| Avg. Rad. Sec. Heat Flux Density [Btu/hr.ft ²] | 8612 | 8583 | 0.3 | |
| Process Outlet Temperature [F] | 503 / 599 | 505 / 597 | (-2 / 2) | 1 |
| Process Side Pressure Drop [Psi] | 6.3 / 98.8 | 6.3 / 110.3 | (0 / - 11.5) | 1 |
| Heater Efficiency [%] | 80.9 | 80.9 | ~ 0 | |
| Flue Gas Temp. Leaving Heater [F] | 645 | 656 | (- 11) | 1 |
| Bridgewall Temperature [F] | 1405 | 1394 | (- 11) | 1 |
| Draft at Arch [in WC] | N/A | N/A | N/A | |
| Max. Flue Gas Mass Velocity [lb/ft ² .s] | 0.31 | 0.31 | 0 | |
| Ratio of Peak to Mean Heat Flux [-] | 1.9 | 1.91 | - 0.5 | |
| Adiabatic Flame Temperature [F] | 3117 | 3127 | (-10) | 1 |

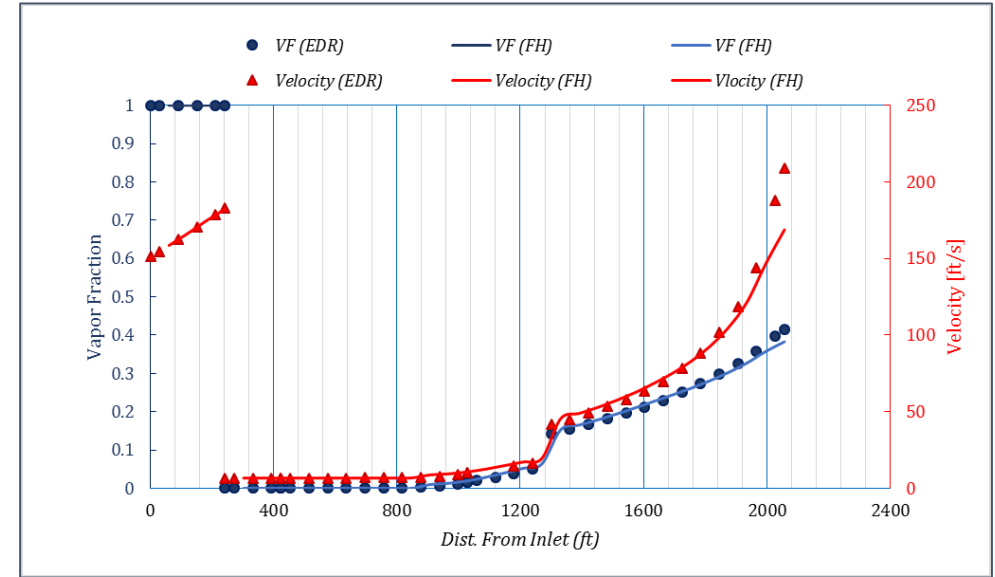
NOTES:

(1) Absolute Error

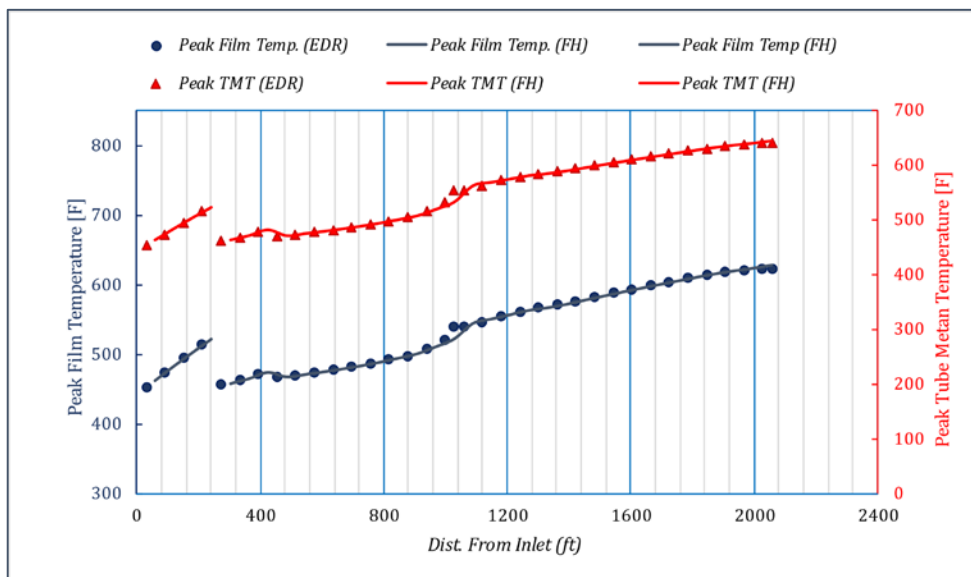
TEMPERATURE & PRESSURE



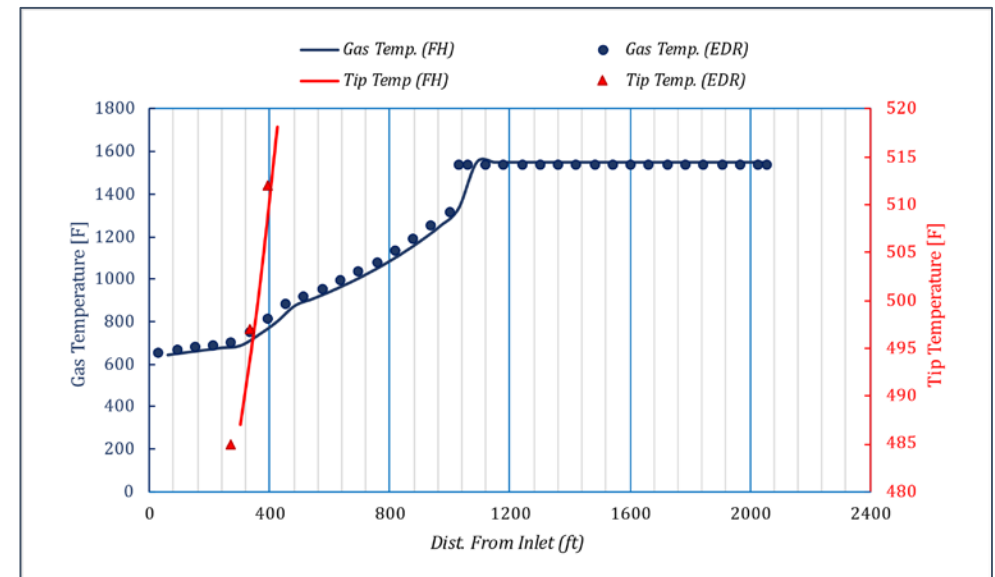
VELOCITY & VAPOR FRACTION



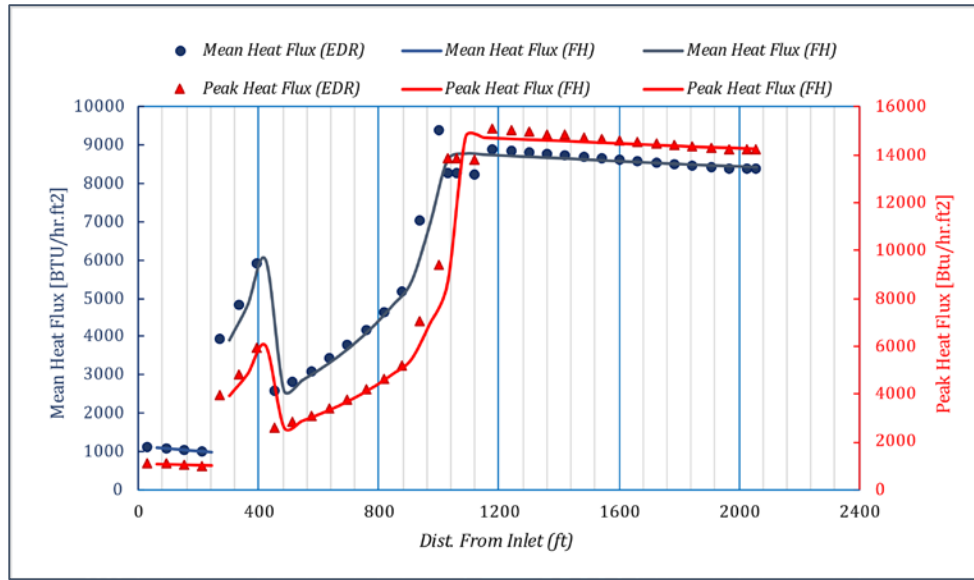
TUBE TEMPERATURES



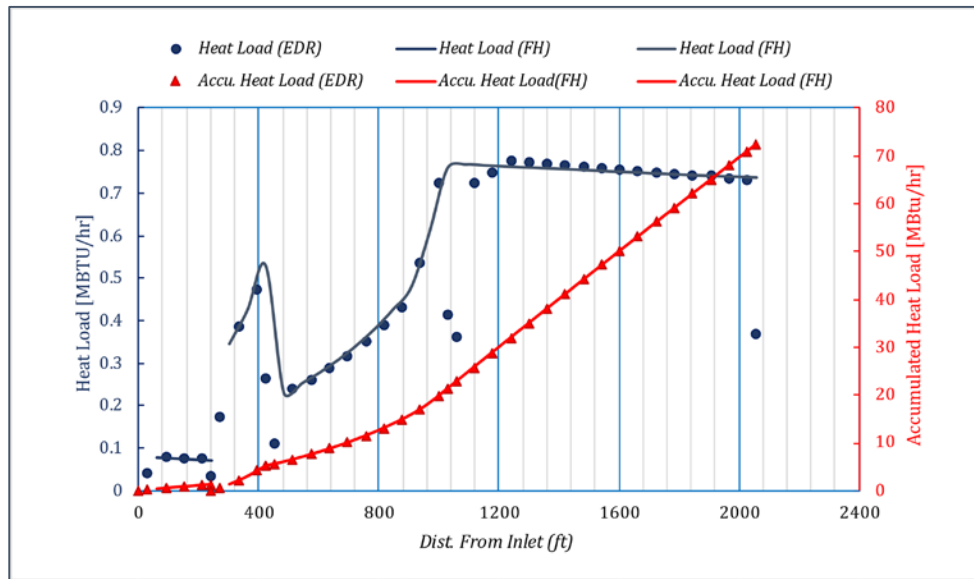
GAS TEMP. & TIP TEMP.



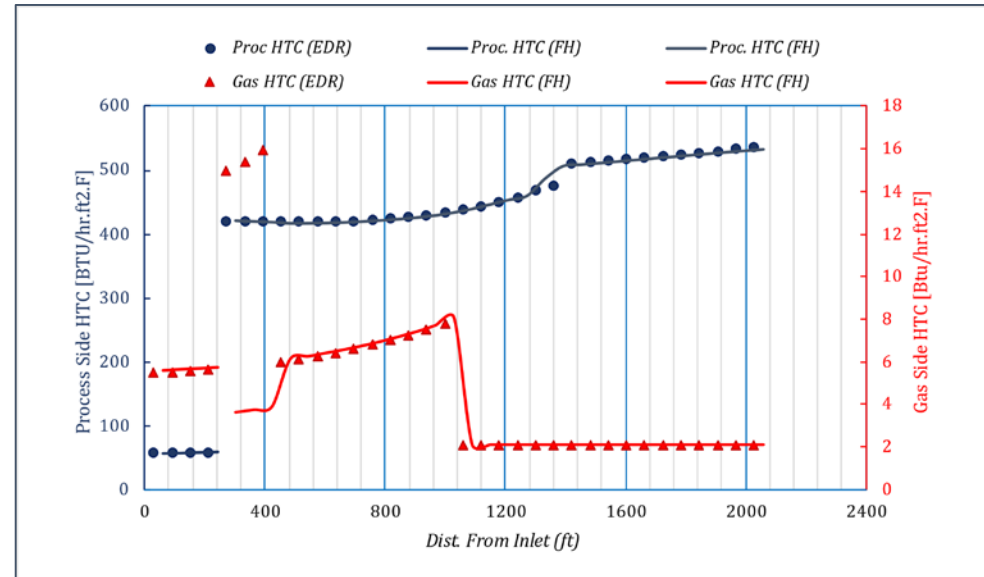
HEAT FLUXES



HEAT LOAD



HEAT TRANSFER COEF.

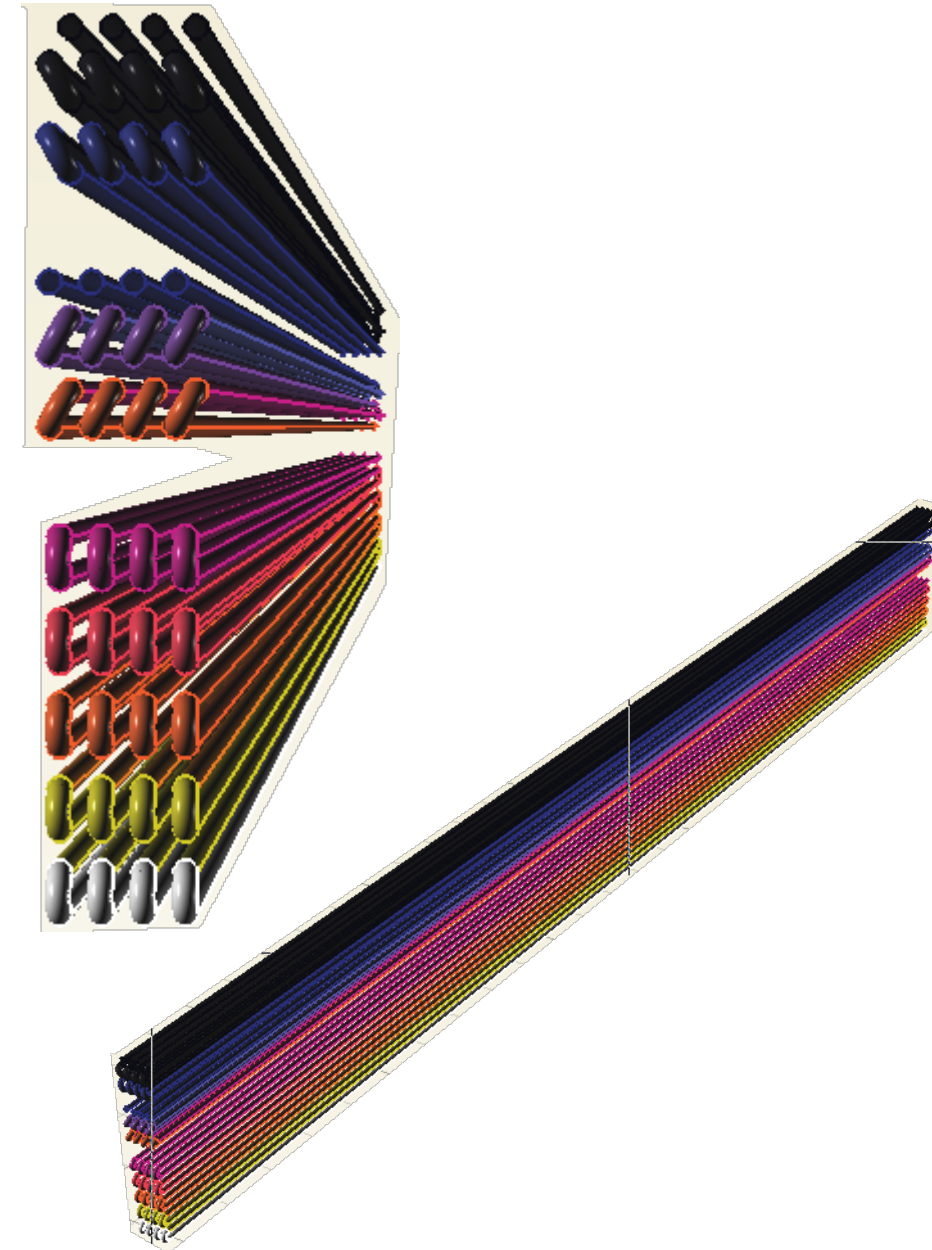


FHinfinity[©] CASE #CS-16T

- ⦿ **HEATER GEOMETRY** *Convection Only*
- ⦿ **FIREBOX TYPE / NO. OF PATH** *None*
- ⦿ **FIREBOX TUBE LAYOUT** *None*
- ⦿ **CONV. LAYOUT / NO. OF T.B.** *Rectang. & Triang. / Three (3)*
- ⦿ **CONV. TUBE TYPE** *Bare - Fin - Stud*
- ⦿ **BURNER LAYOUT** *None*
- ⦿ **STACK** *None*
- ⦿ **FAN / APH / TRANSFER LINE** *None*
- ⦿ **FUEL** *None*
- ⦿ **NO. OF PROCESS STREAM** *One (1)*
- ⦿ **PROCESS THERMO. STATE** *All Liquid*
- ⦿ **THERMO ENGINE** *User Input Data*

Model Specification & Setting:

- Firebox Leakage Duty*
- Radiation to Tube Bank*
- Fouling Factor*

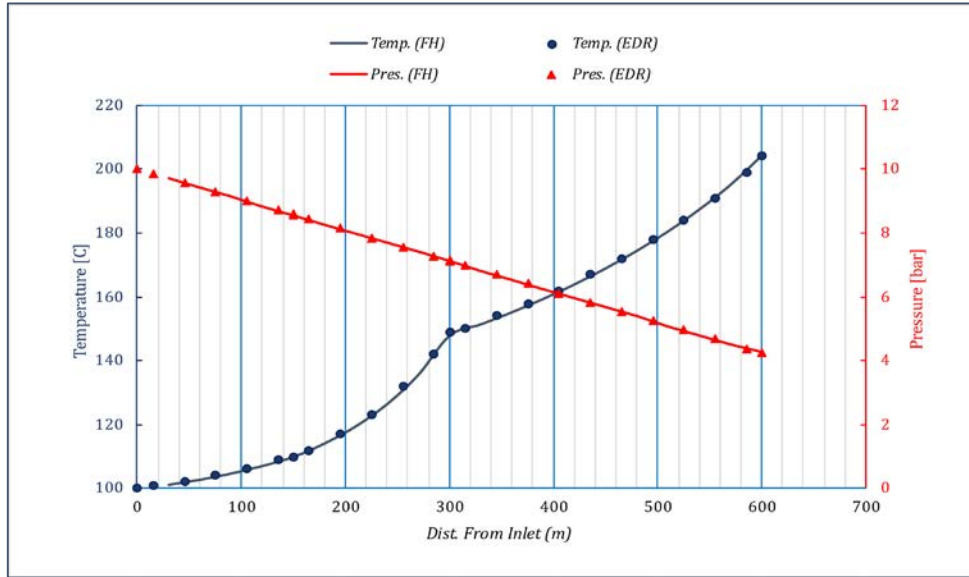


| | FHinfinity | ASPEN EDR | % ERR. | NOTE |
|--|-------------------|------------------|---------------|-------------|
| Total Heat Absorption [kW] | 10435 | 10377 | 0.6 | |
| Firebox Duty [kW] | N/A | N/A | N/A | |
| Avg. Rad. Sec. Heat Flux Density [W/m ²] | N/A | N/A | N/A | |
| Process Outlet Temperature [C] | 204 | 204 | (~ 0) | 1 |
| Process Side Pressure Drop [bar] | 5.7 | 5.7 | (~ 0) | 1 |
| Heater Efficiency [%] | 85.2 | 86.7 | - 1.7 | |
| Flue Gas Temp. Leaving Heater [C] | 134 | 135 | (- 1) | 1 |
| Bridgewall Temperature [C] | N/A | N/A | N/A | |
| Draft at Arch [in WC] | N/A | N/A | N/A | |
| Max. Flue Gas Mass Velocity [kg/m ² .s] | 2.07 | 2.07 | 0 | |
| Ratio of Peak to Mean Heat Flux [-] | N/A | N/A | N/A | |
| Adiabatic Flame Temperature [C] | N/A | N/A | N/A | |

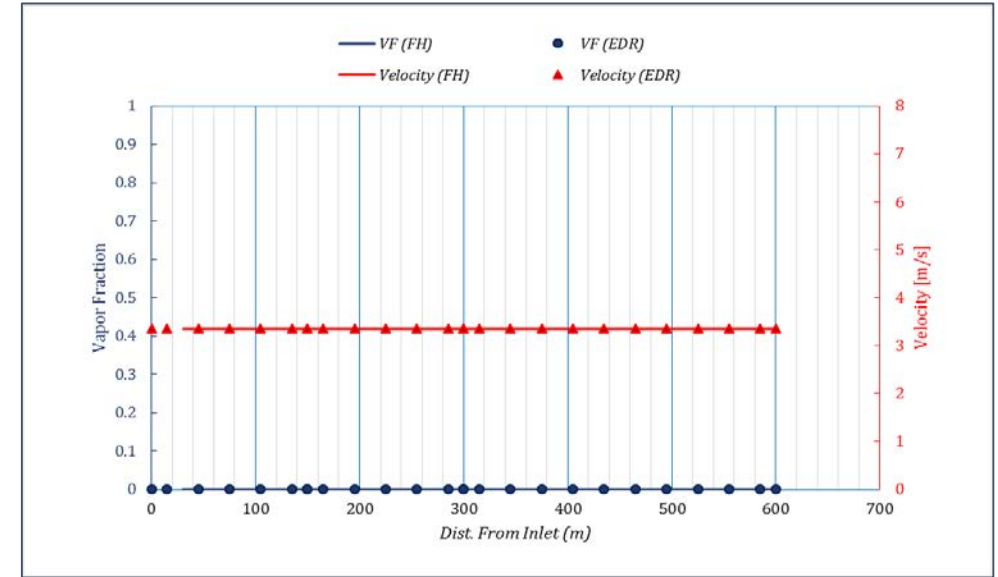
NOTES:

(1) Absolute Error

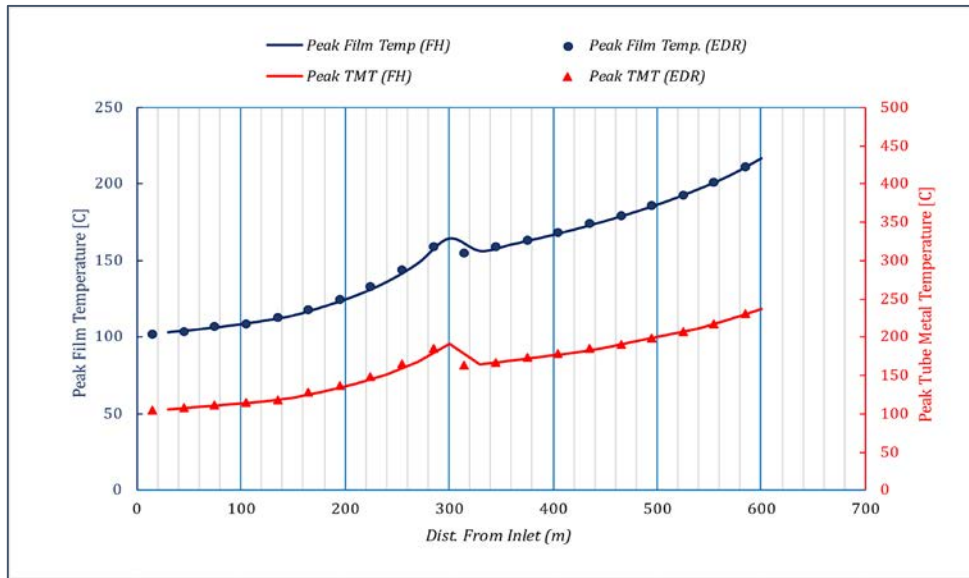
TEMPERATURE & PRESSURE



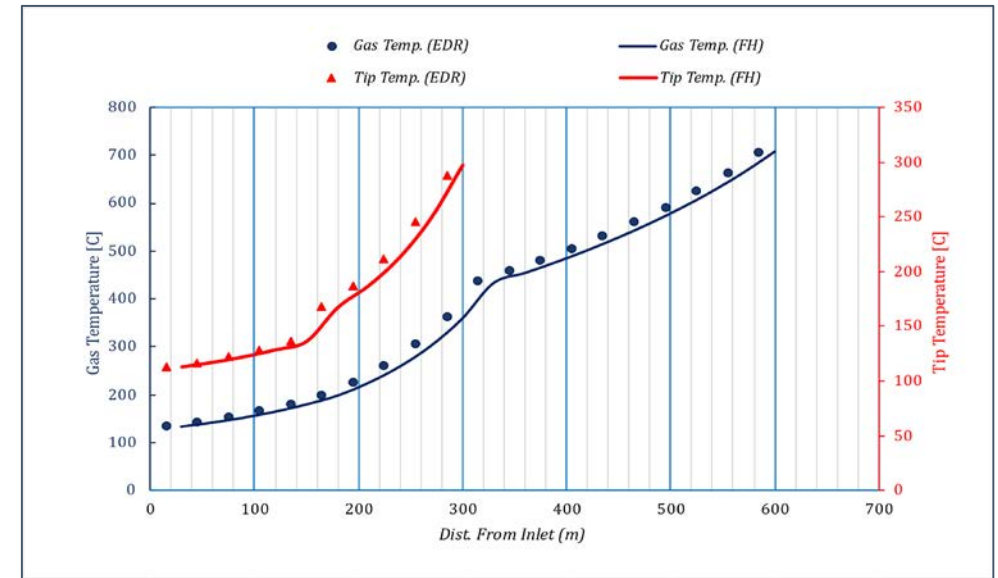
VELOCITY & VAPOR FRACTION



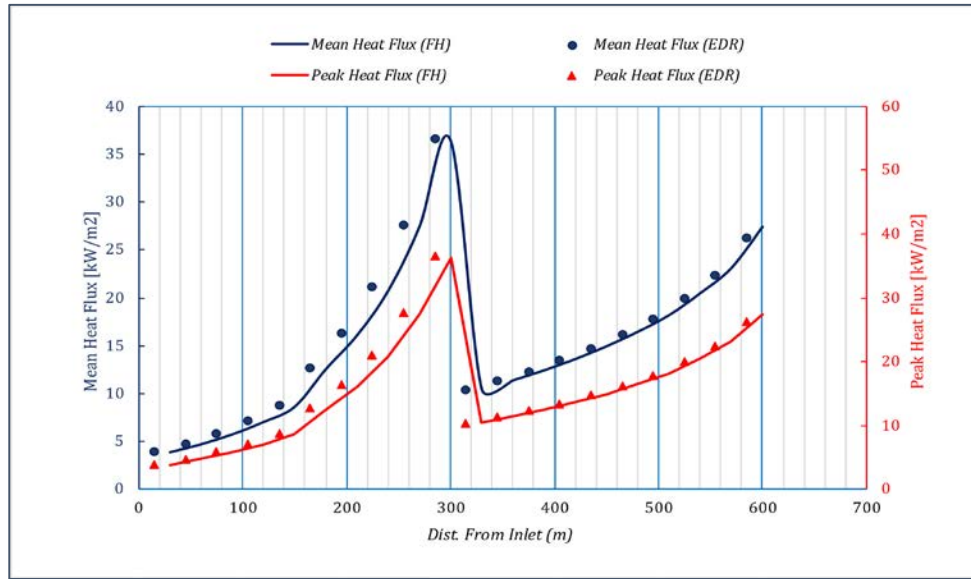
TUBE TEMPERATURES



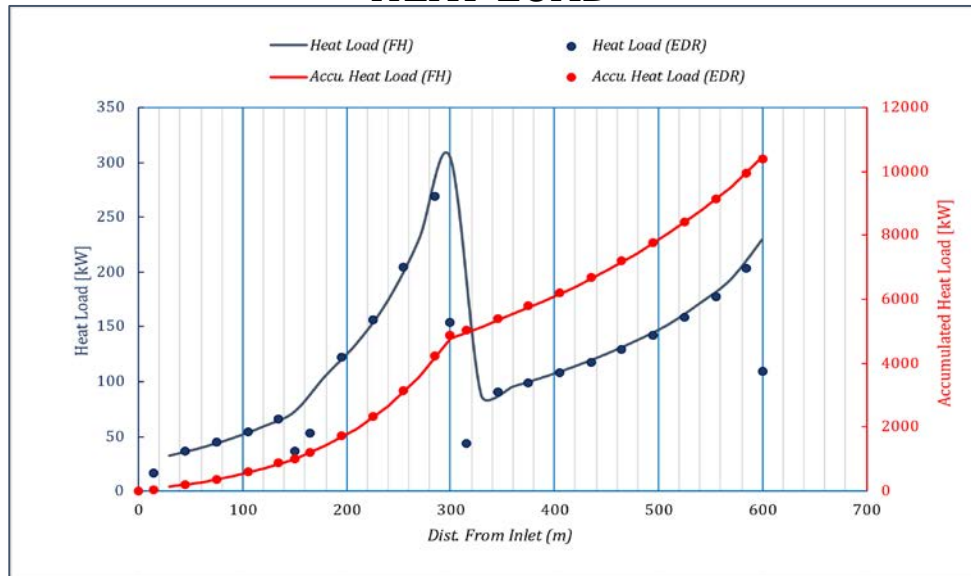
GAS TEMP. & TIP TEMP.



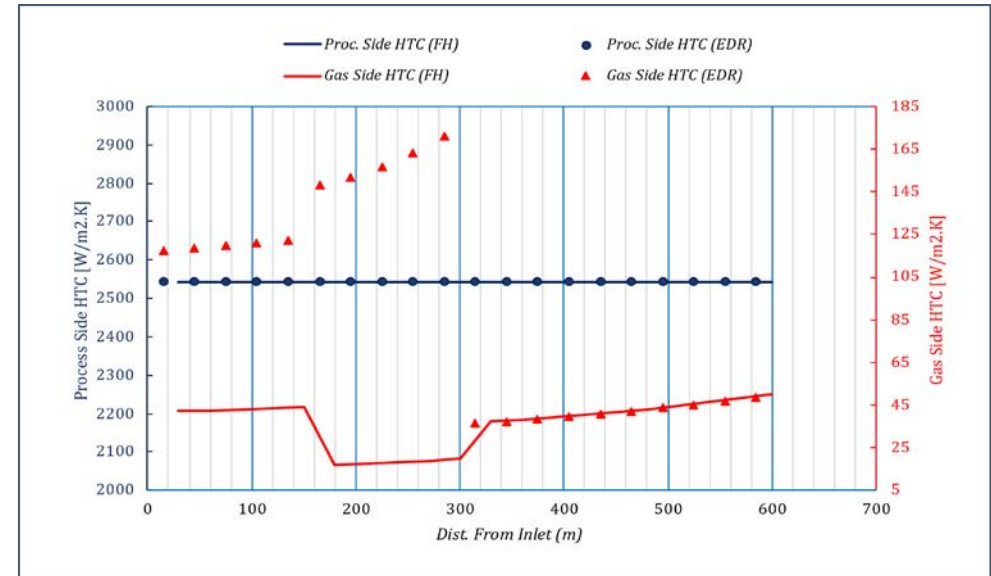
HEAT FLUXES



HEAT LOAD



HEAT TRANSFER COEF.



The End

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