Performance Benchmarking

(Industrial Projects)


www.fhinfinity.com

info@fhinfinity.com


FHinfinity

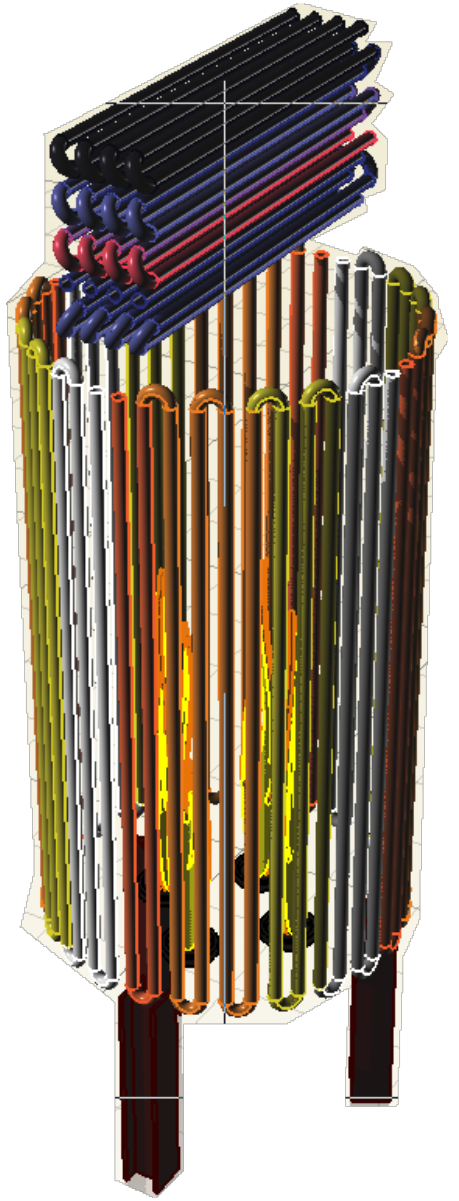
FHinfinity© CASE #RCS-1D

DEMO CASE #RCS-1D

HEATER GEOMETRY	*Radiant + Convection*
FIREBOX TYPE / NO. OF PATH	*Cylindrical / Four (4)*
FIREBOX TUBE LAYOUT	*Vertical, Refractory Backed*
CONV. LAYOUT / NO. OF T.B.	*Triangular / Two (2)*
CONV. TUBE TYPE	*Bare - Fin*
BURNER LAYOUT	*Up-Fired*
STACK	*None*
FAN / APH / TRANSFER LINE	*None*
FUEL	*Fuel Gas*
NO. OF PROCESS STREAM	*One (1)*
PROCESS THERMO. STATE	*All Vapor*
THERMO ENGINE	*User Input Data*

Model Specification & Setting:

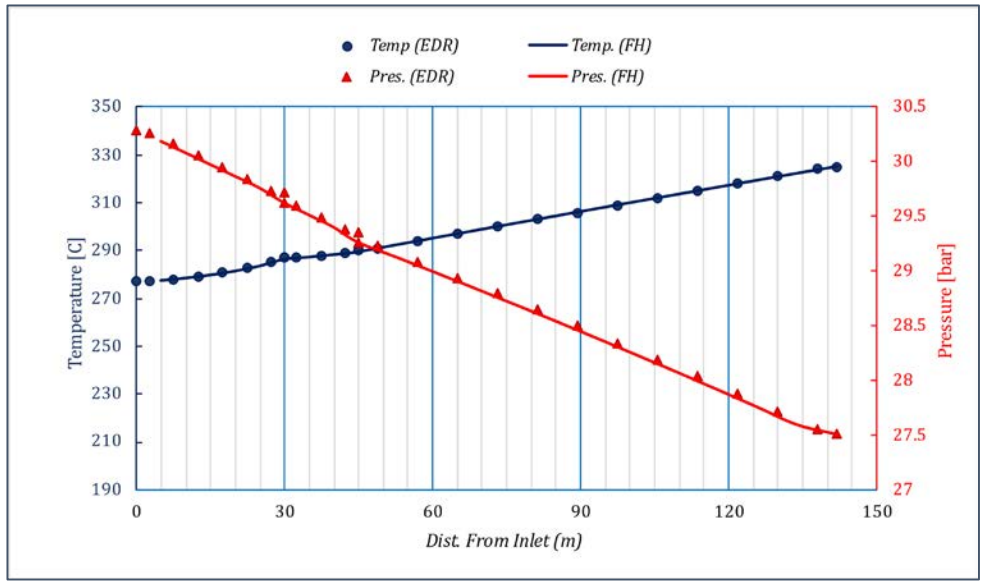
- ☑ *Radiation to Tube Bank*
- ☑ *Hottel Parameter*
- ☑ *Fouling Factor*



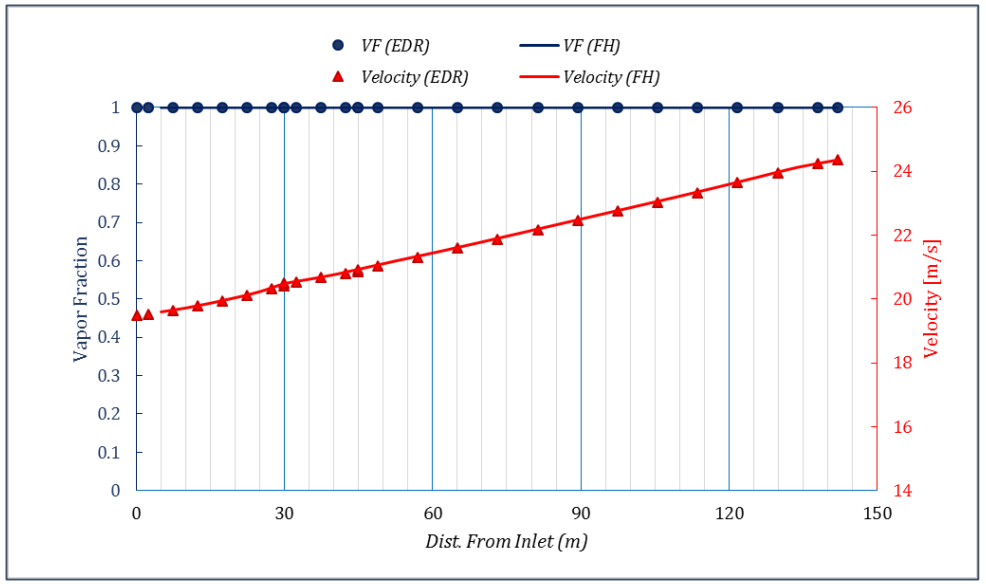
	FHinfinity	ASPEN EDR	% ERR.	NOTE
Total Heat Absorption [kW]	9094	9103	- 0.1	
Firebox Duty [kW]	6740	6756	0.2	
Avg. Rad. Sec. Heat Flux Density [W/m2]	31107	31179	- 0.2	
Process Outlet Temperature [C]	325	325	(~ 0)	1
Process Side Pressure Drop [bar]	2.78	2.78	(~ 0)	1
Heater Efficiency [%]	81.1	81.3	(- 0.2)	
Flue Gas Temp. Leaving Heater [C]	387	386	(1)	1
Bridgewall Temperature [C]	791	789	(2)	1
Draft at Arch [in WC]	N/A	N/A	N/A	
Max. Flue Gas Mass Velocity [kg/m2.s]	1.86	1.86	~ 0	
Ratio of Peak to Mean Heat Flux [-]	1.89	1.89	~ 0	
Adiabatic Flame Temperature [C]	1862	1862	~ 0	1

NOTES:
(1) Absolute Error

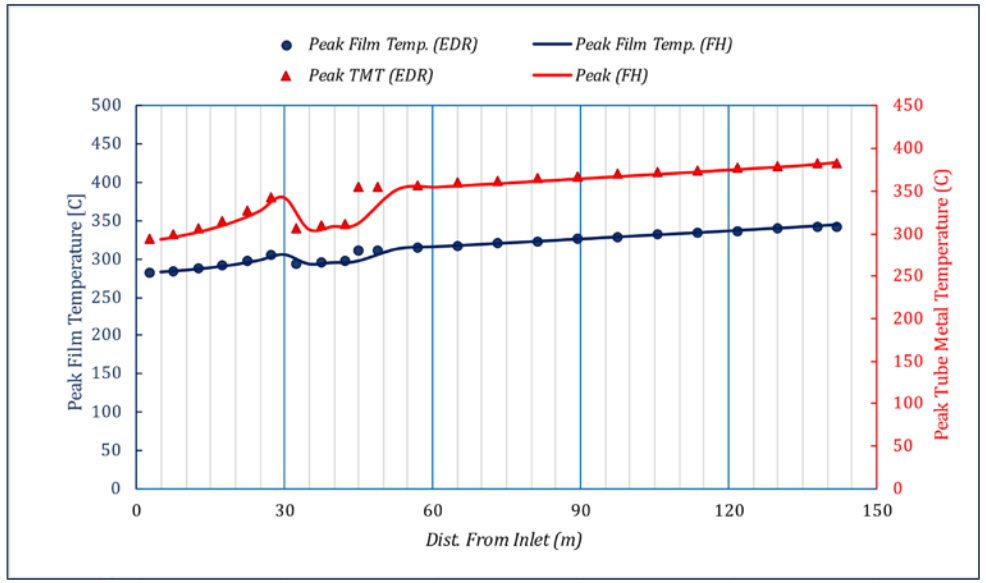
TEMPERATURE & PRESSURE



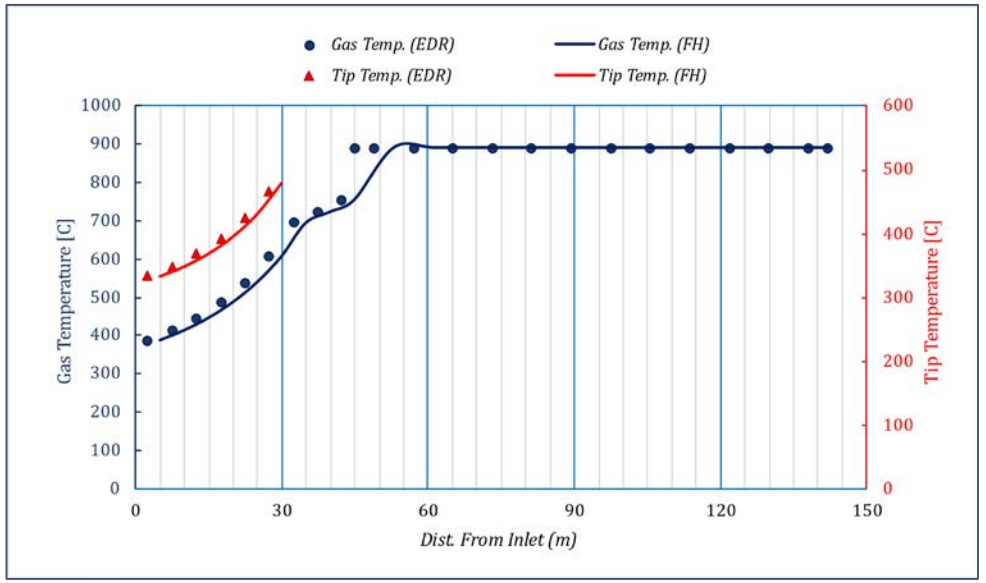
VELOCITY & VAPOR FRACTION



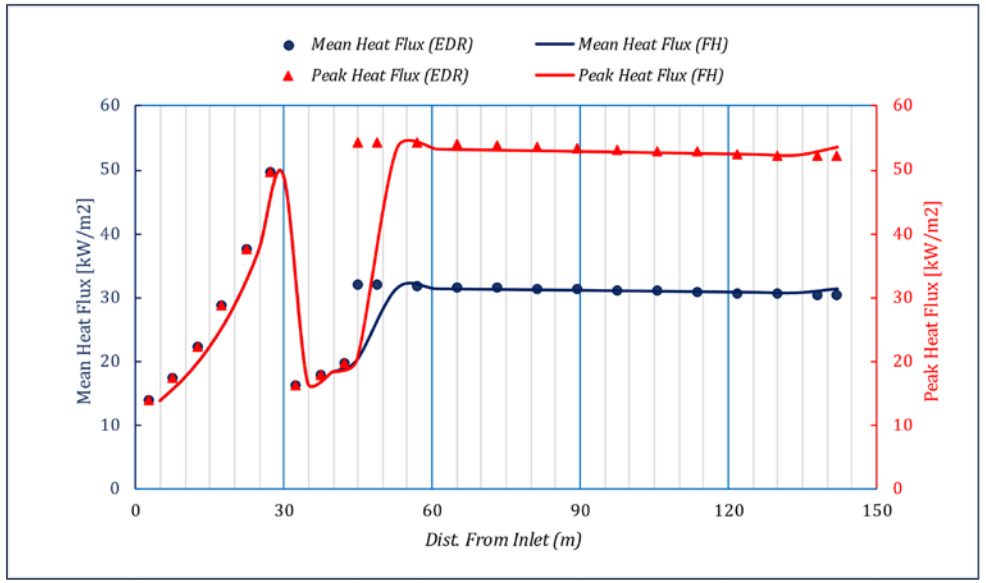
TUBE TEMPERATURES



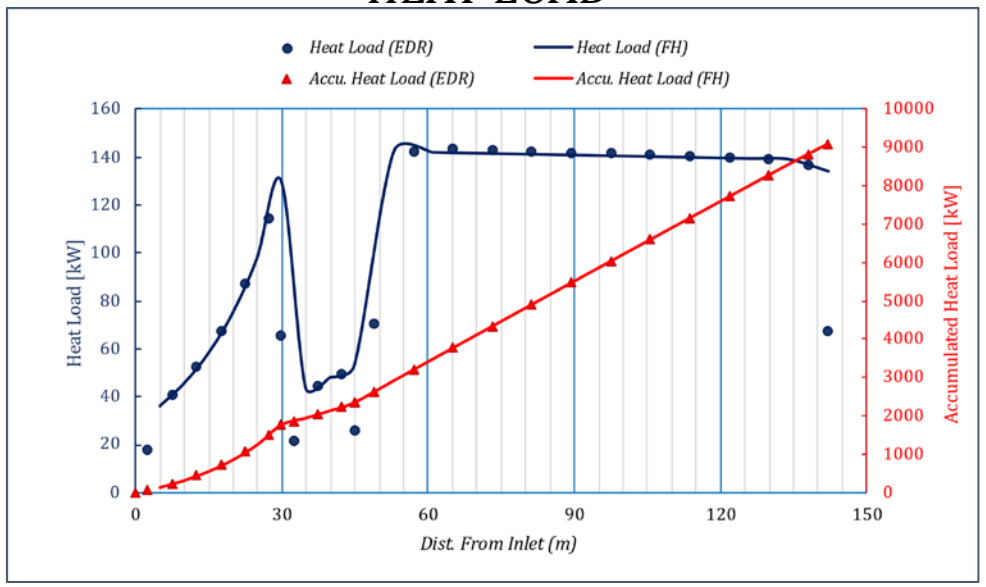
GAS TEMP. & TIP TEMP.



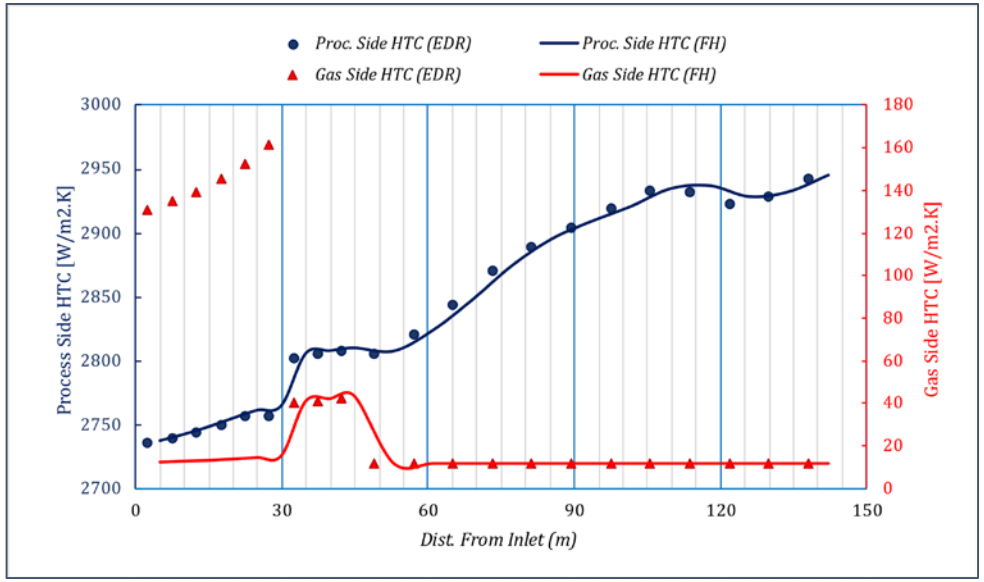
HEAT FLUXES



HEAT LOAD



HEAT TRANSFER COEF.



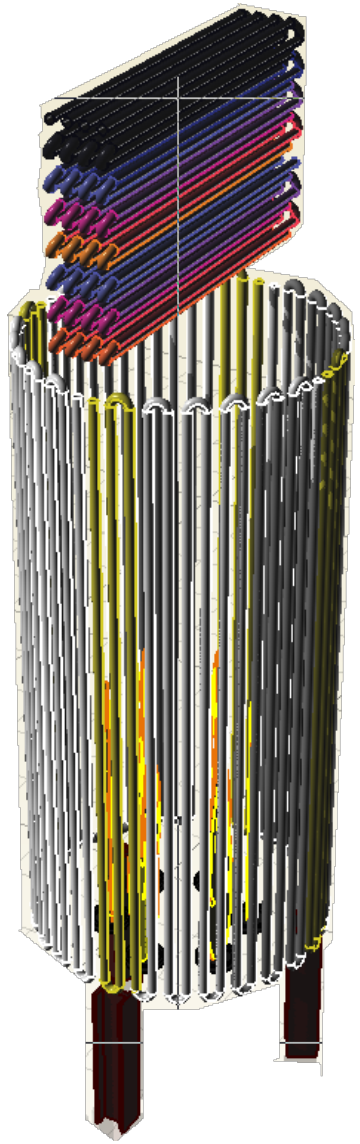
FHinfinity© CASE #RCS-2D

DEMO CASE #RCS-2D

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

Model Specification & Setting:

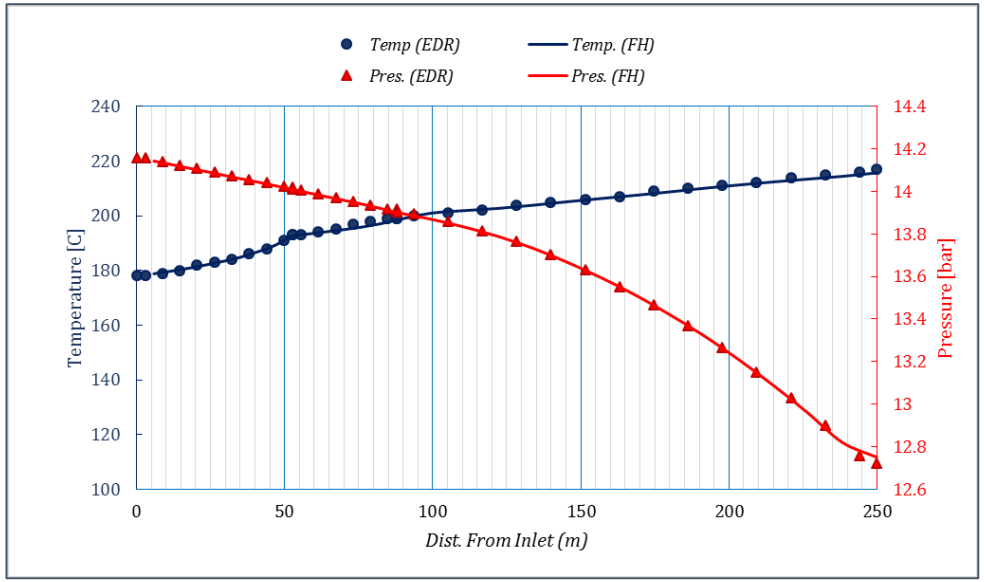
- ☑ *Radiation to Tube Bank*
- ☑ *Hottel Parameter*
- ☑ *Fouling Factor*



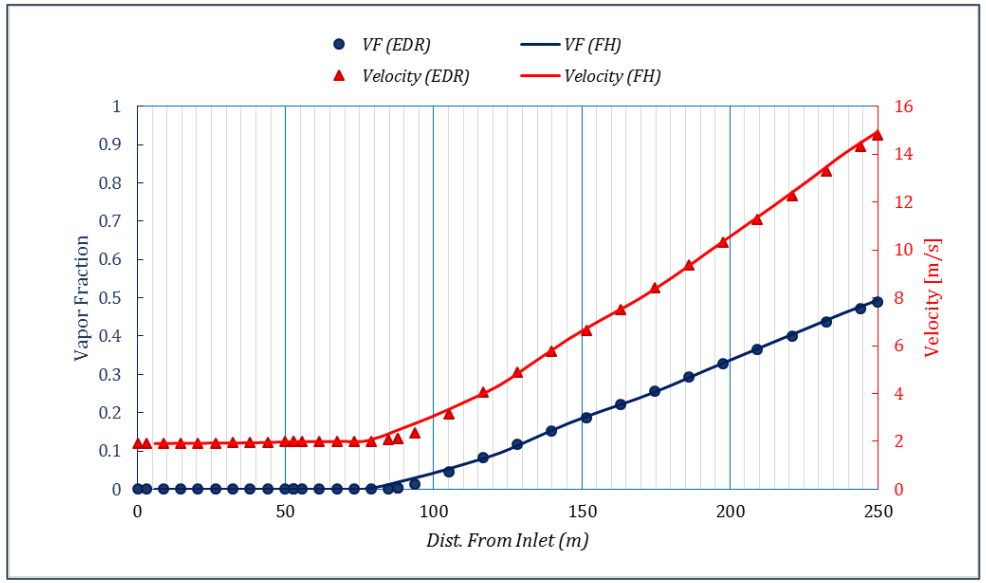
	FHinfinity	ASPEN EDR	% ERR.	NOTE
Total Heat Absorption [kW]	16349	16341	0.05	
Firebox Duty [kW]	11434	11389	- 0.5	
Avg. Rad. Sec. Heat Flux Density [W/m2]	32114	31987	0.4	
Process Outlet Temperature [C]	215.7	217	(- 1.3)	1
Process Side Pressure Drop [bar]	1.42	1.44	(- 0.02)	1
Heater Efficiency [%]	87.4	87.4	0	
Flue Gas Temp. Leaving Heater [C]	261	261	(0)	1
Bridgewall Temperature [C]	775	779	(-4)	1
Draft at Arch [in WC]	N/A	N/A	N/A	
Max. Flue Gas Mass Velocity [kg/m2.s]	2.65	2.65	0	
Ratio of Peak to Mean Heat Flux [-]	1.89	1.89	~ 0	
Adiabatic Flame Temperature [C]	1866	1867	(1)	1

NOTES:
(1) Absolute Error

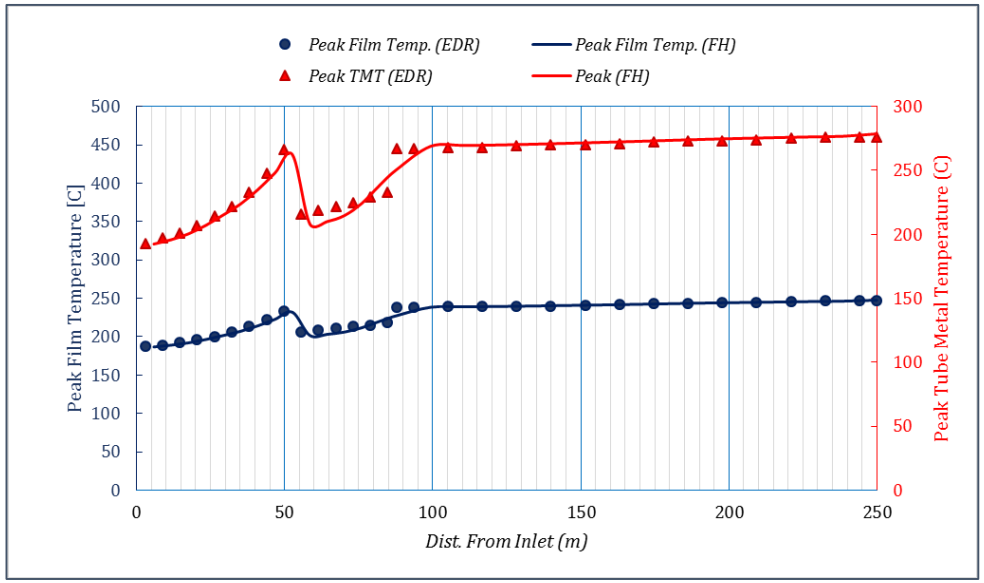
TEMPERATURE & PRESSURE



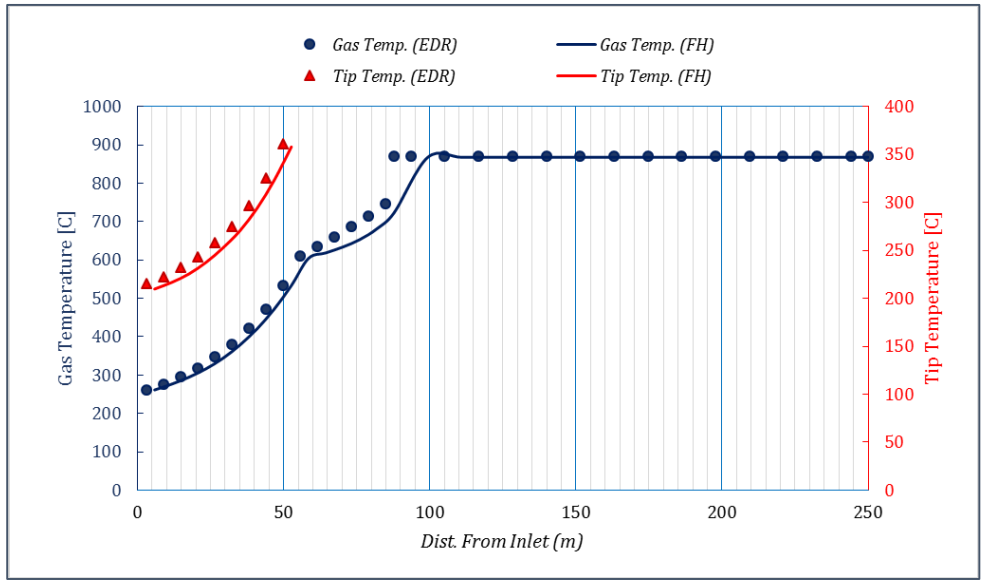
VELOCITY & VAPOR FRACTION



TUBE TEMPERATURES

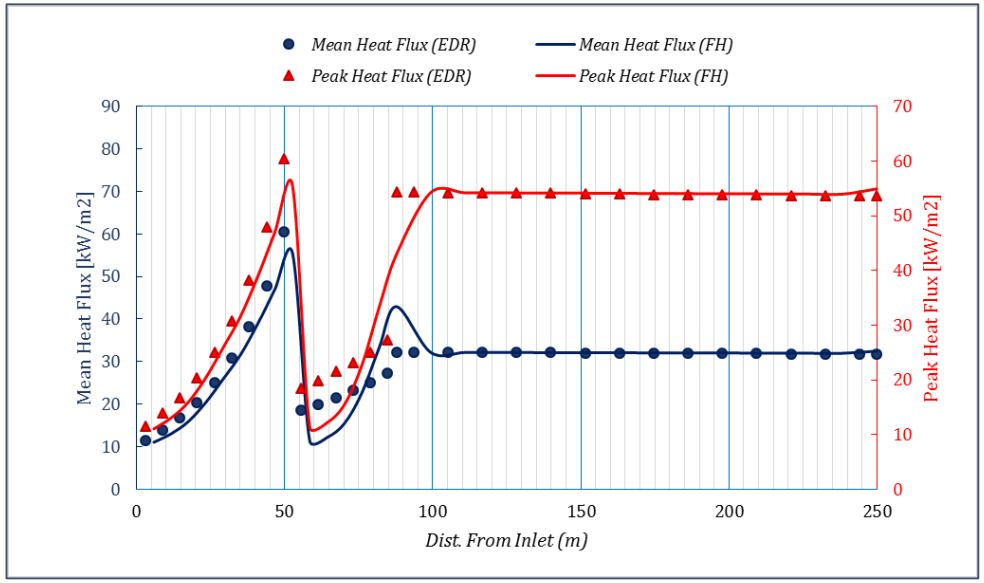


GAS TEMP. & TIP TEMP.

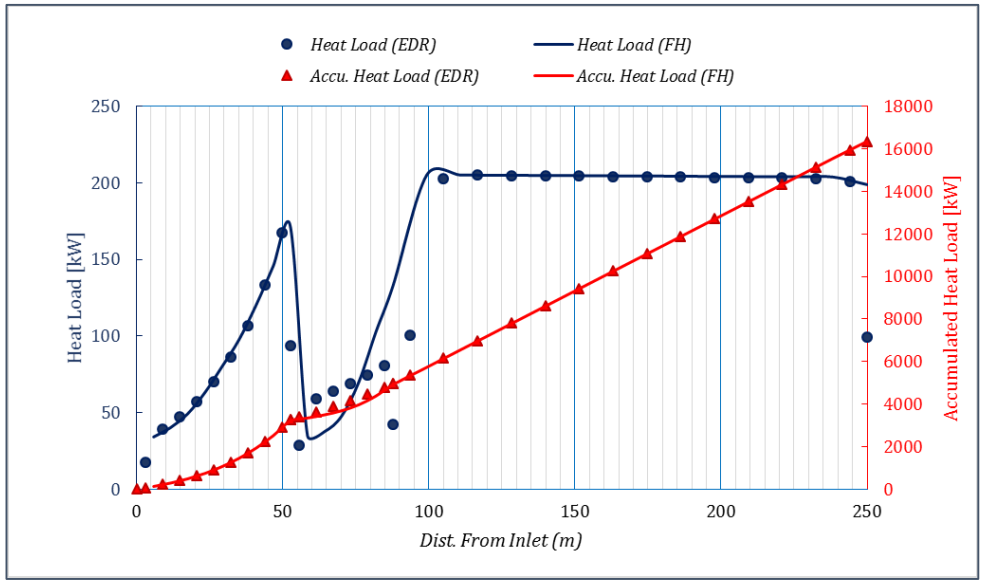


DEMO CASE #RCS-2D - DIAGRAMS

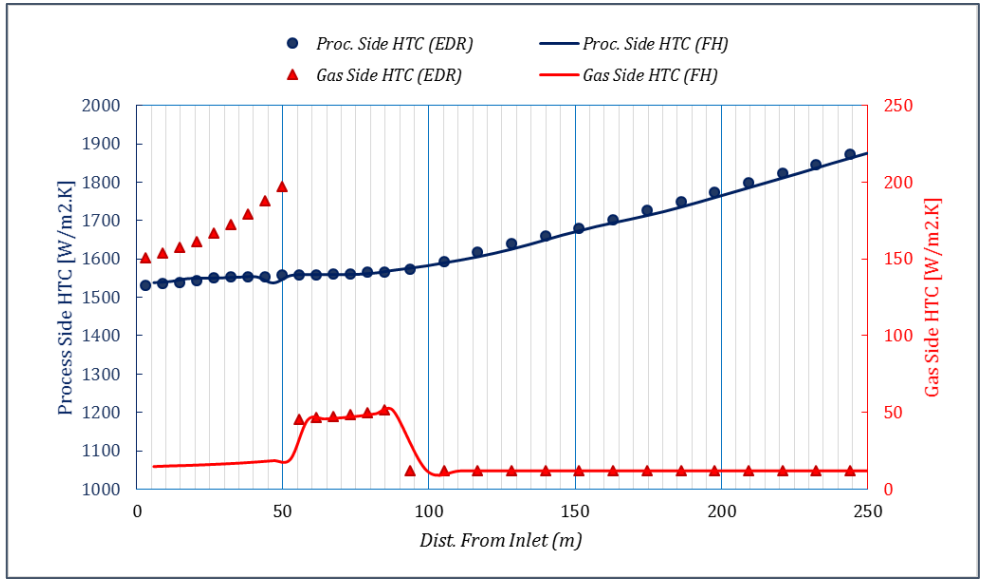
HEAT FLUXES



HEAT LOAD



HEAT TRANSFER COEF.



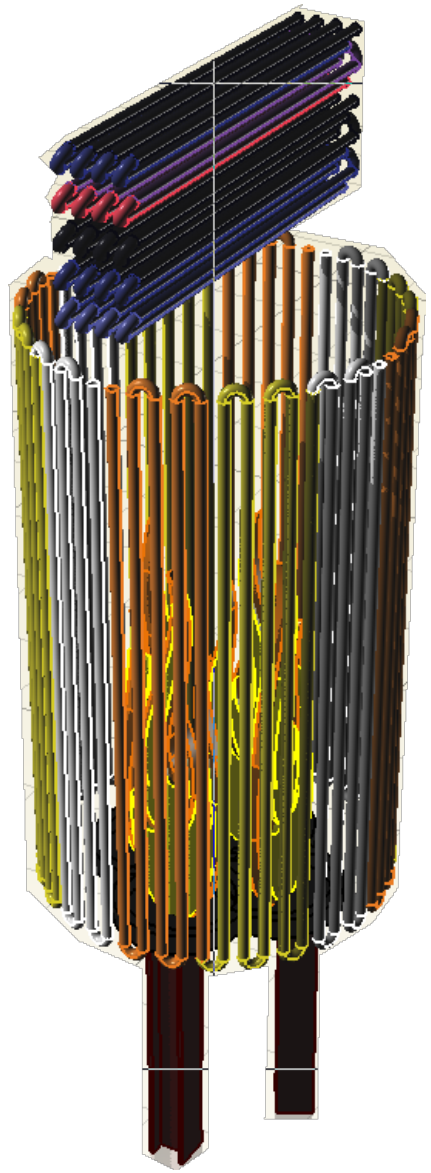
FHinfinity© CASE #RCS-3D

DEMO CASE #RCS-3D

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

Model Specification & Setting:

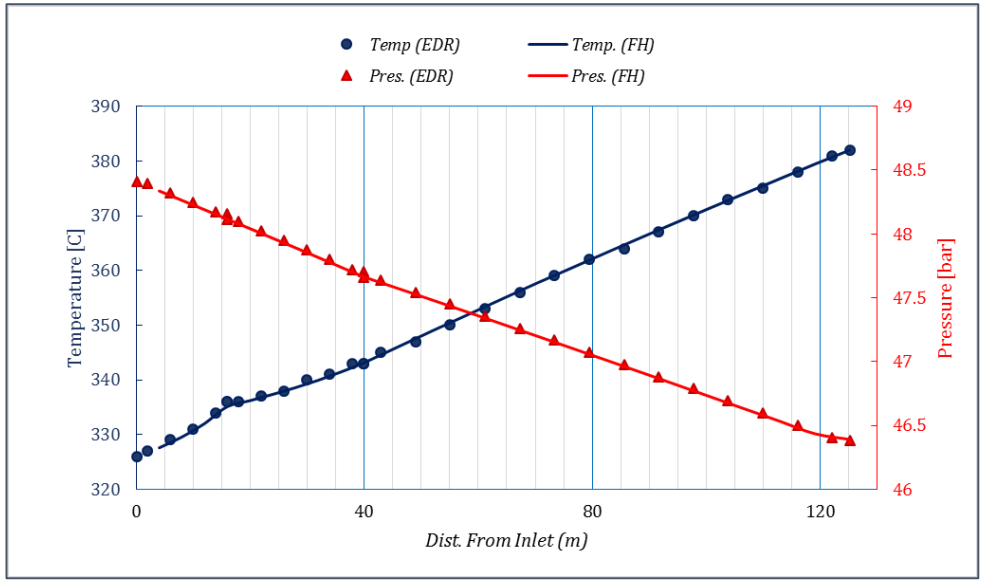
- ☑ *Radiation to Tube Bank*
- ☑ *Hottel Parameter*
- ☑ *Fouling Factor*



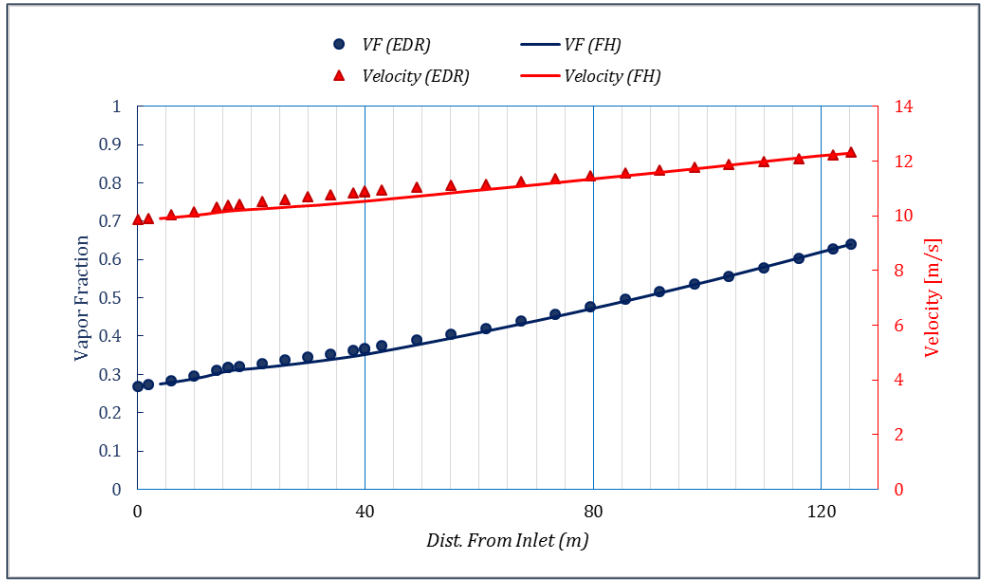
	FHinfinity	ASPEN EDR	% ERR.	NOTE
Total Heat Absorption [kW]	6683	6669	0.2	
Firebox Duty [kW]	4761	4781	- 0.4	
Avg. Rad. Sec. Heat Flux Density [W/m2]	37042	37197	- 0.4	
Process Outlet Temperature [C]	382	382	(~ 0)	1
Process Side Pressure Drop [bar]	2.02	2.03	(~ 0)	1
Heater Efficiency [%]	75.4	75.3	0.1	
Flue Gas Temp. Leaving Heater [C]	502	506	(- 4)	1
Bridgewall Temperature [C]	908	905	(3)	1
Draft at Arch [in WC]	N/A	N/A	N/A	
Max. Flue Gas Mass Velocity [kg/m2.s]	2.96	2.96	~ 0	
Ratio of Peak to Mean Heat Flux [-]	1.92	1.92	~ 0	
Adiabatic Flame Temperature [C]	1866	1867	(1)	1

NOTES:
(1) Absolute Error

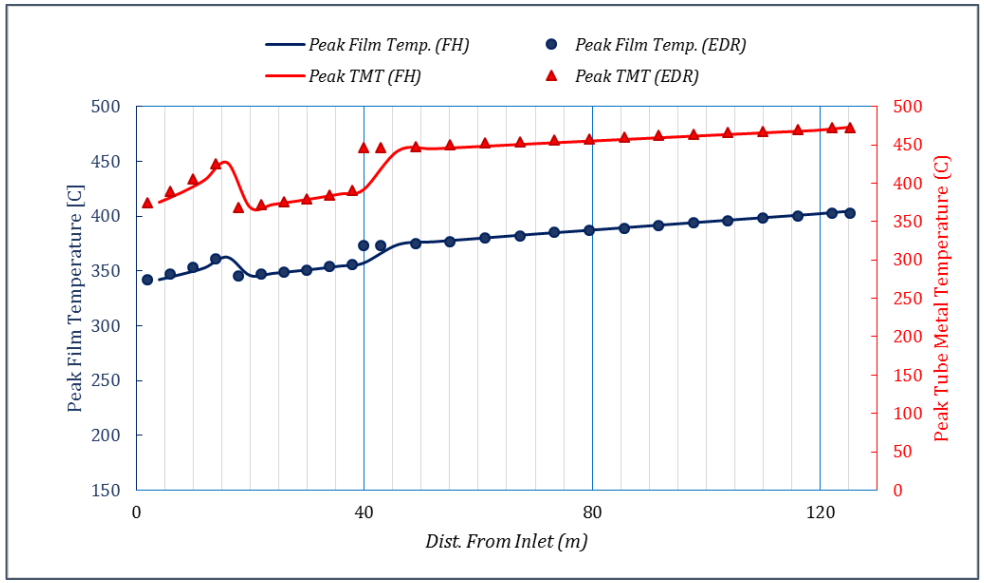
TEMPERATURE & PRESSURE



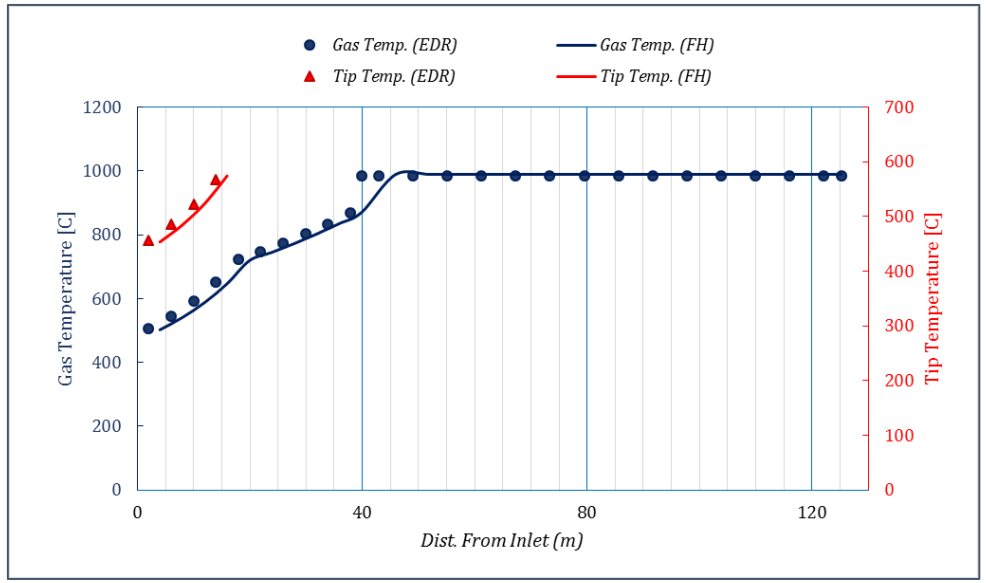
VELOCITY & VAPOR FRACTION



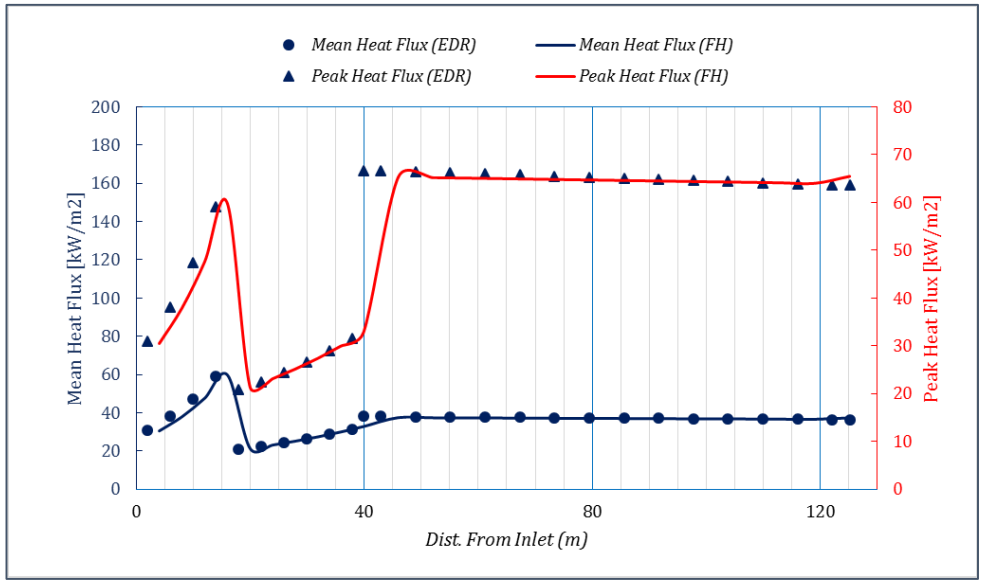
TUBE TEMPERATURES



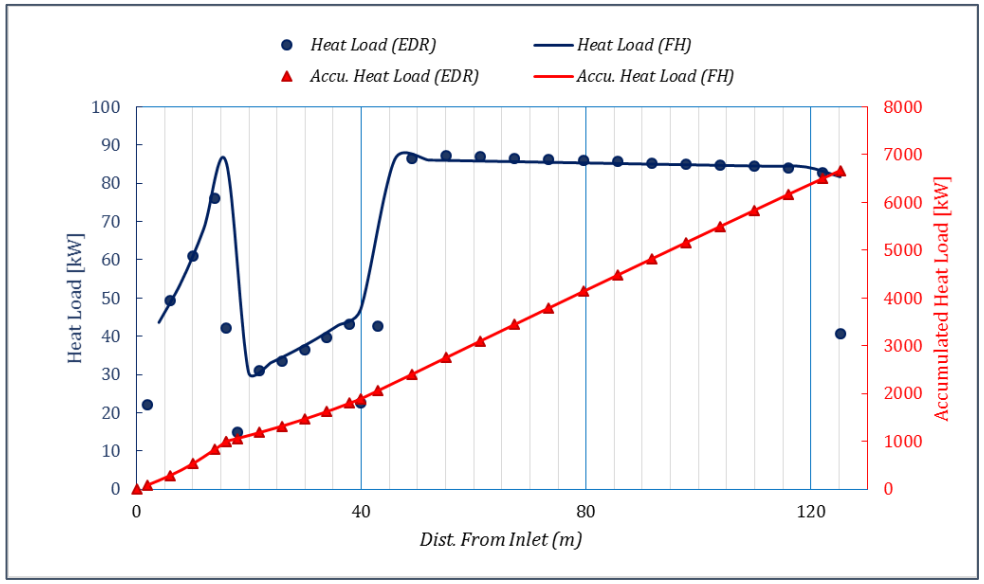
GAS TEMP. & TIP TEMP.



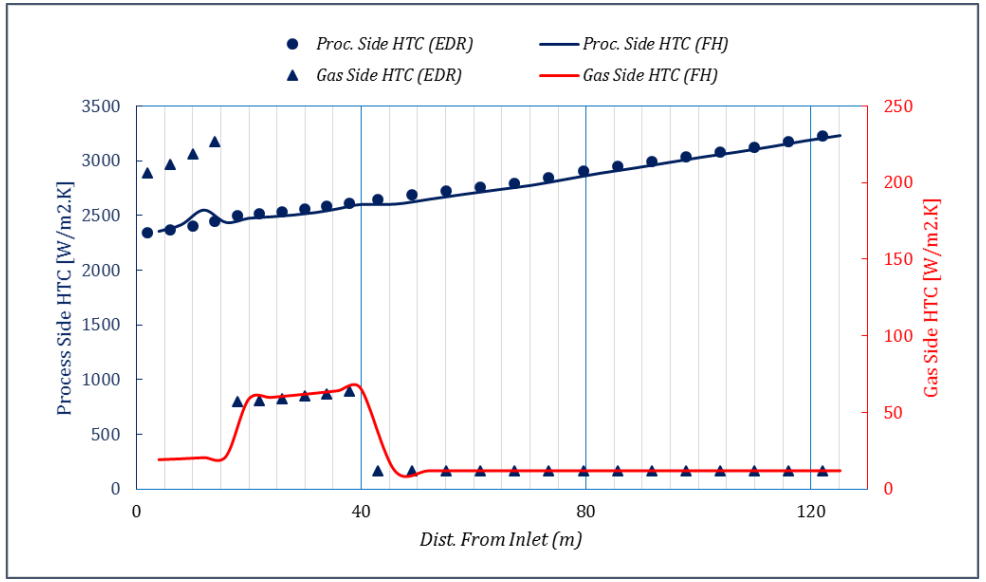
HEAT FLUXES



HEAT LOAD



HEAT TRANSFER COEF.



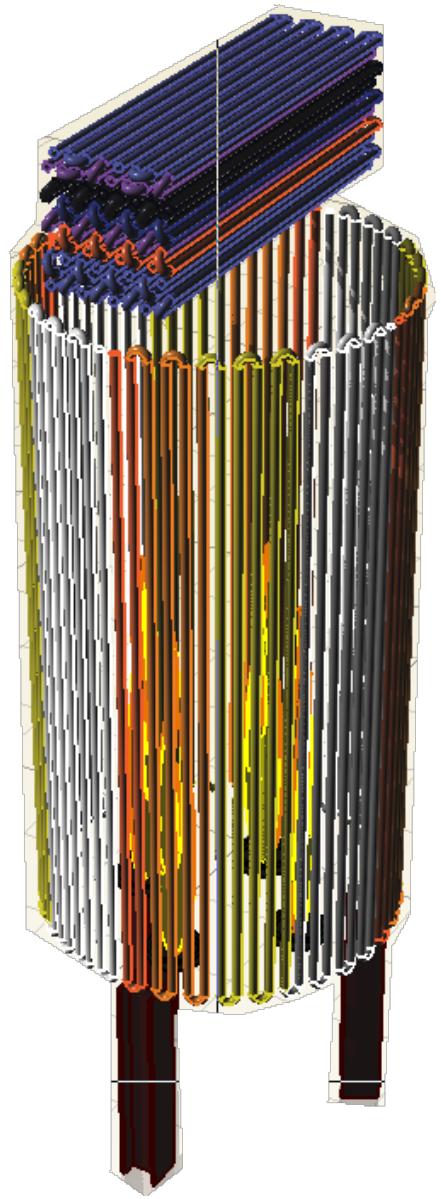
FHinfinity© CASE #RCS-4D

DEMO CASE #RCS-4D

HEATER GEOMETRY	*Radiant + Convection*
FIREBOX TYPE / NO. OF PATH	*Cylindrical / Four (4)*
FIREBOX TUBE LAYOUT	*Vertical, Refractory Backed*
CONV. LAYOUT / NO. OF T.B.	*Triangular / Three (3)*
CONV. TUBE TYPE	*Bare - Fin1 – Fin2*
BURNER LAYOUT	*Up-Fired*
STACK	*None*
FAN / APH / TRANSFER LINE	*None*
FUEL	*Fuel Gas*
NO. OF PROCESS STREAM	*Two (2)*
PROCESS THERMO. STATE	*All Vap. & Vaporiz. (2ph./2ph.)*
THERMO ENGINE	*User Input Data / NAFTPack*

Model Specification & Setting:

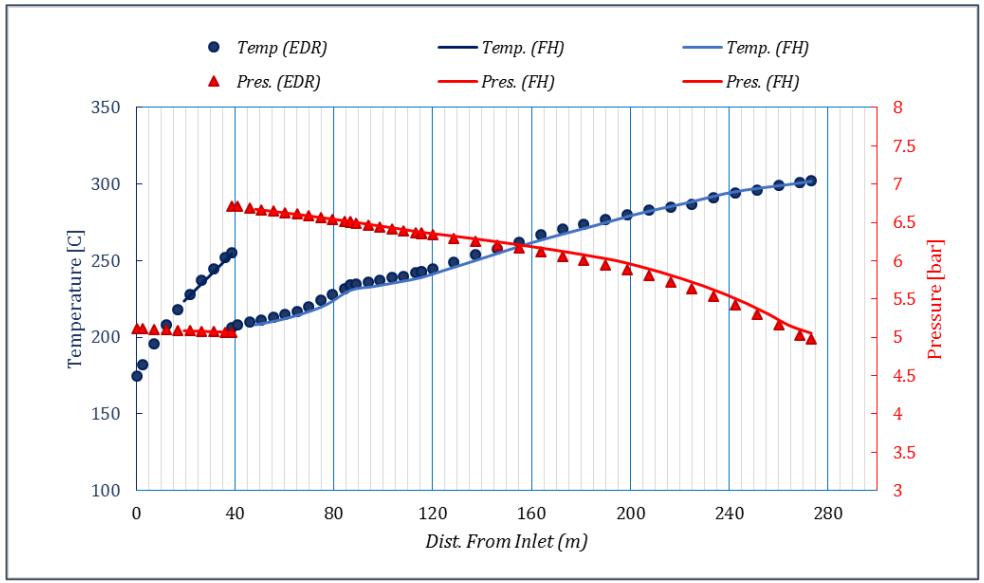
- ☑ *Radiation to Tube Bank*
- ☑ *Hottel Parameter*
- ☑ *Fouling Factor*



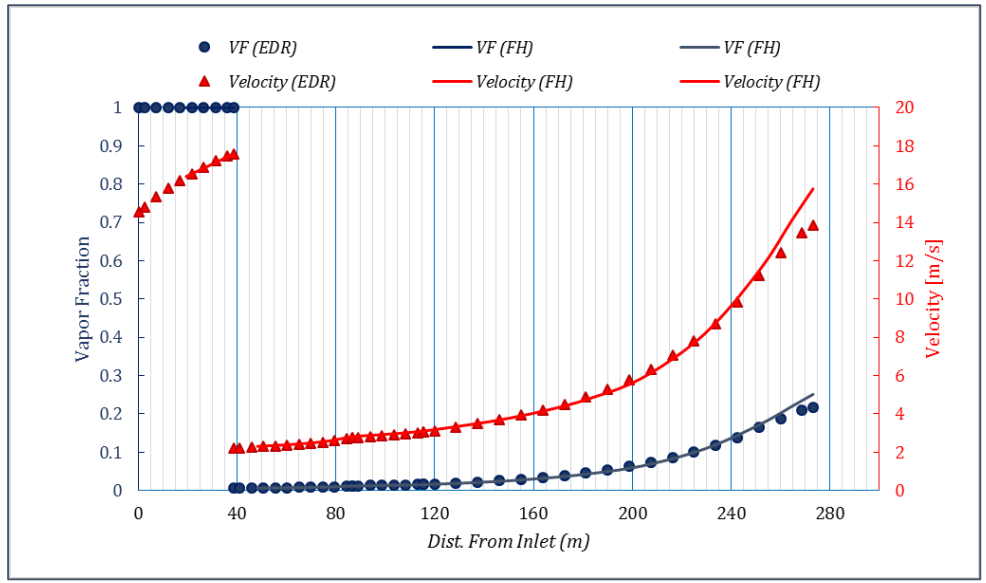
	FHinfinity	ASPEN EDR	% ERR.	NOTE
Total Heat Absorption [kW]	9997	9965	0.3	
Firebox Duty [kW]	7003	7013	0.1	
Avg. Rad. Sec. Heat Flux Density [W/m2]	29885	29927	- 0.1	
Process Outlet Temperature [C]	254 / 302	255 / 302	(- 1 / 0)	1
Process Side Pressure Drop [bar]	0.04 / 1.65	0.04 / 1.73	(0 / -0.08)	1
Heater Efficiency [%]	86.8	86.5	0.3	
Flue Gas Temp. Leaving Heater [C]	270	278	(- 8)	1
Bridgewall Temperature [C]	779	777	(2)	1
Draft at Arch [in WC]	N/A	N/A	N/A	
Max. Flue Gas Mass Velocity [kg/m2.s]	1.65	1.65	0	
Ratio of Peak to Mean Heat Flux [-]	1.92	1.92	~ 0	
Adiabatic Flame Temperature [C]	1866	1867	(-1)	1

NOTES:
(1) Absolute Error

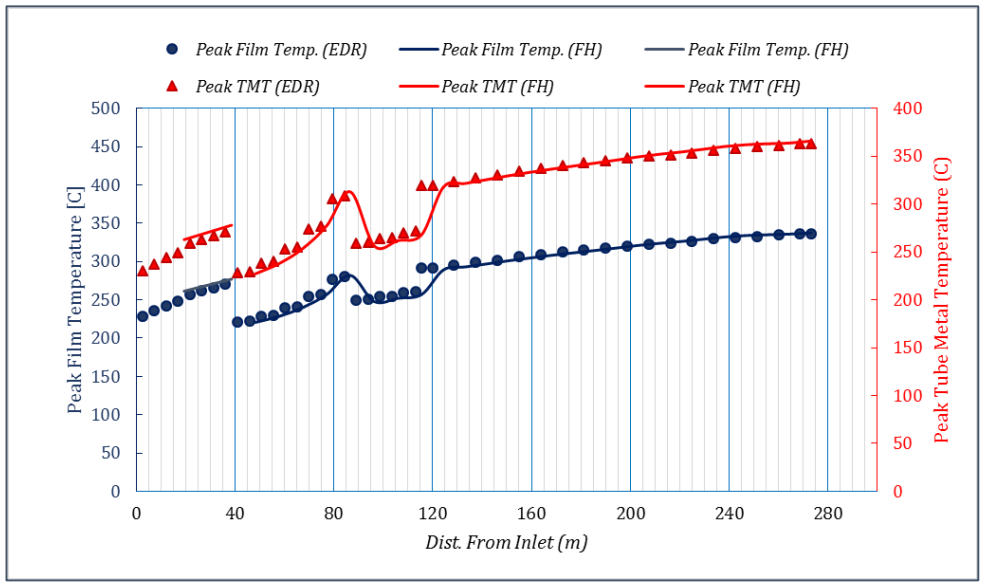
TEMPERATURE & PRESSURE



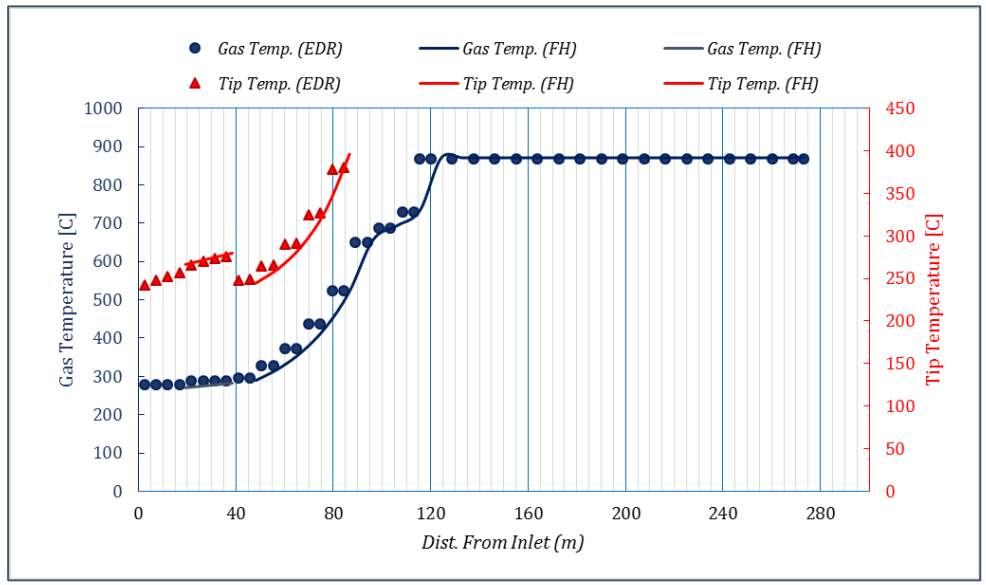
VELOCITY & VAPOR FRACTION



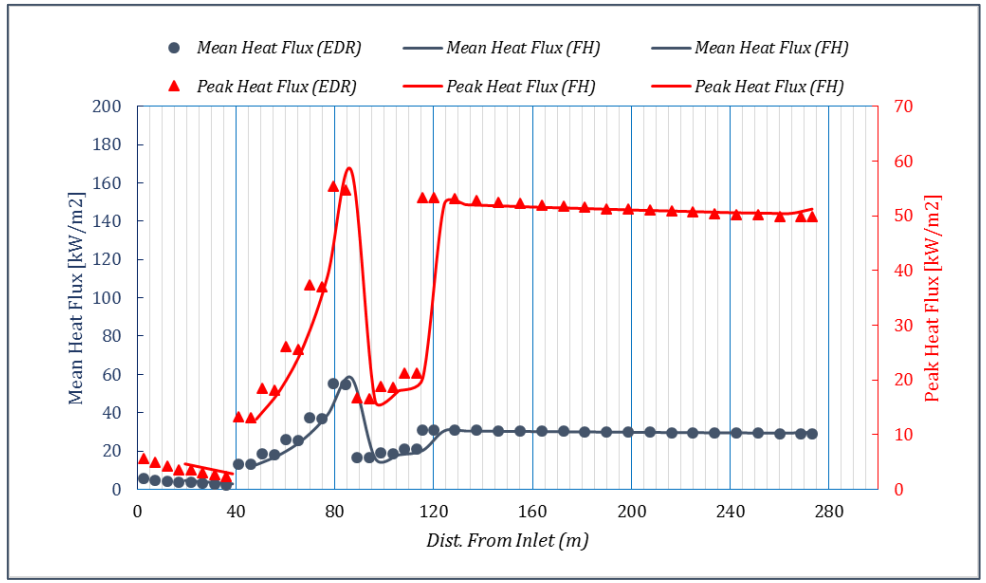
TUBE TEMPERATURES



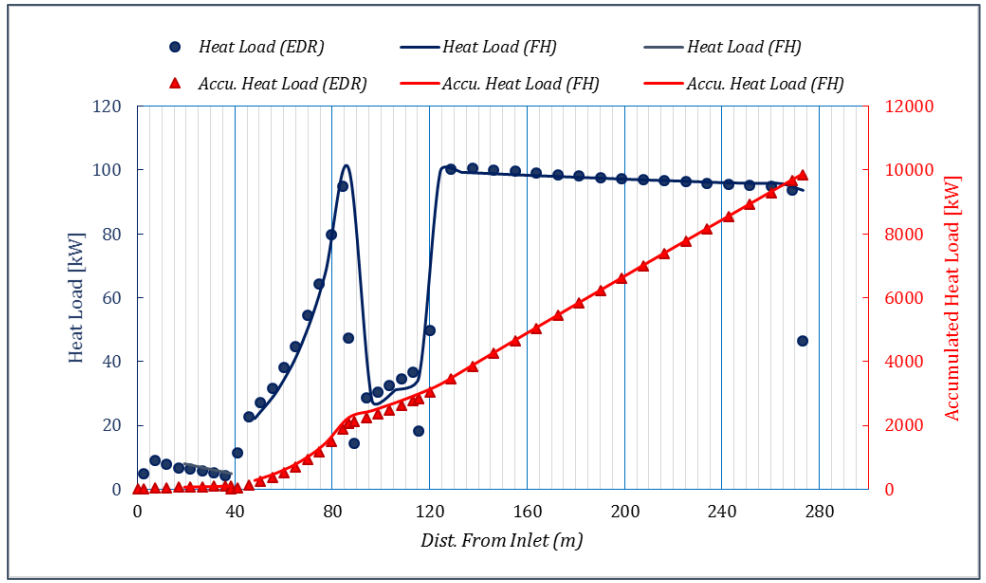
GAS TEMP. & TIP TEMP.



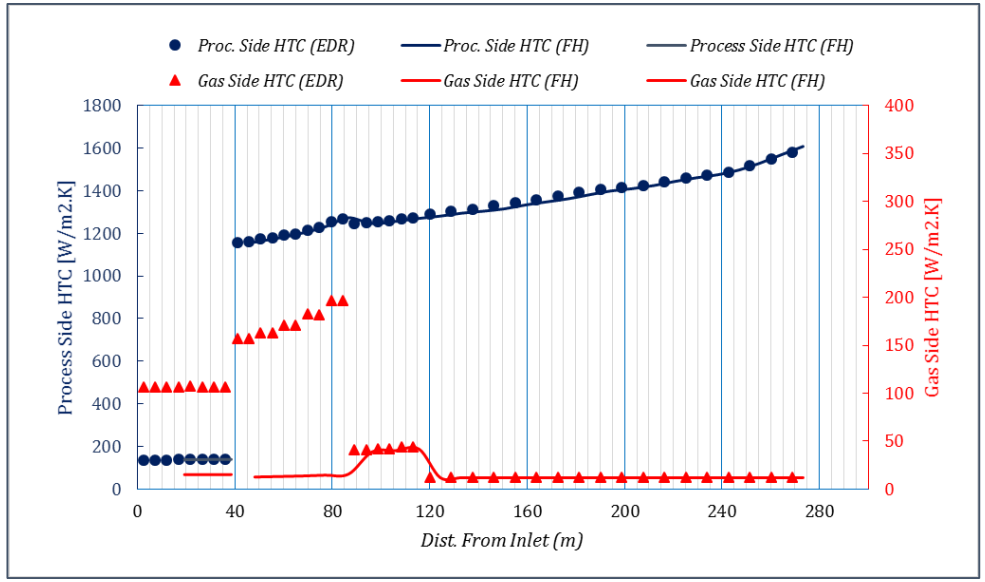
HEAT FLUXES



HEAT LOAD



HEAT TRANSFER COEF.



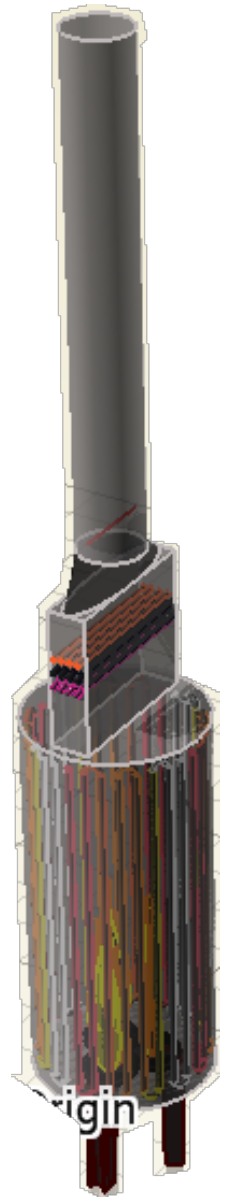
FHinfinity© CASE #RCS-5S

DEMO CASE #RCS-5S

HEATER GEOMETRY	*Radiant + Convection*
FIREBOX TYPE / NO. OF PATH	*Cylindrical / Four (4)*
FIREBOX TUBE LAYOUT	*Vertical, Refractory Backed*
CONV. LAYOUT / NO. OF T.B.	*Triangular / Two (2)*
CONV. TUBE TYPE	*Bare - Fin*
BURNER LAYOUT	*Up-Fired*
STACK	*One*
FAN / APH / TRANSFER LINE	*None*
FUEL	*Fuel Gas*
NO. OF PROCESS STREAM	*One (1)*
PROCESS THERMO. STATE	*All Vapor*
THERMO ENGINE	*User Input Data*

Model Specification & Setting:

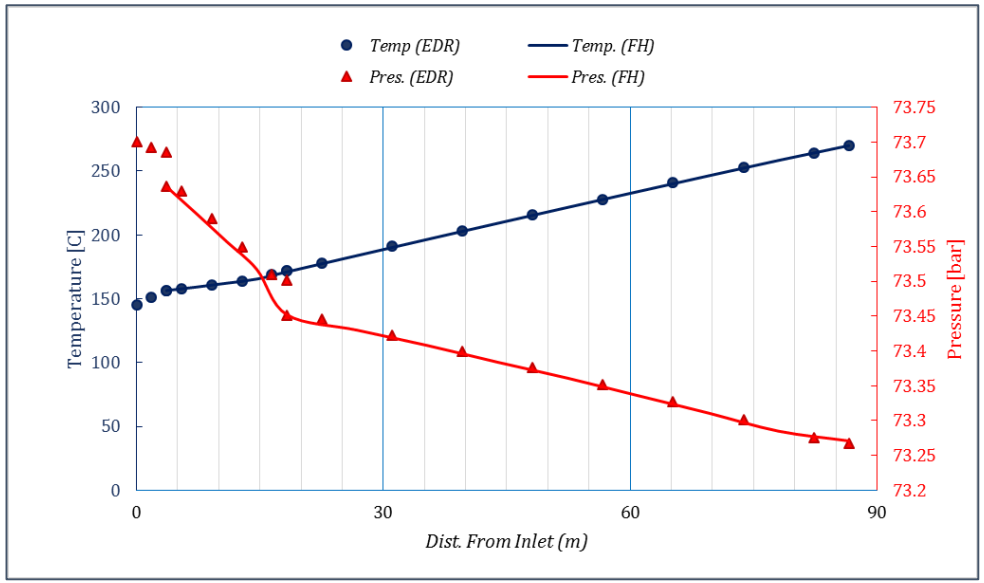
- ☑ *Shield Duty*
- ☑ *Radiation to Tube Bank*
- ☑ *Hottel Parameter*
- ☑ *Fouling Factor*



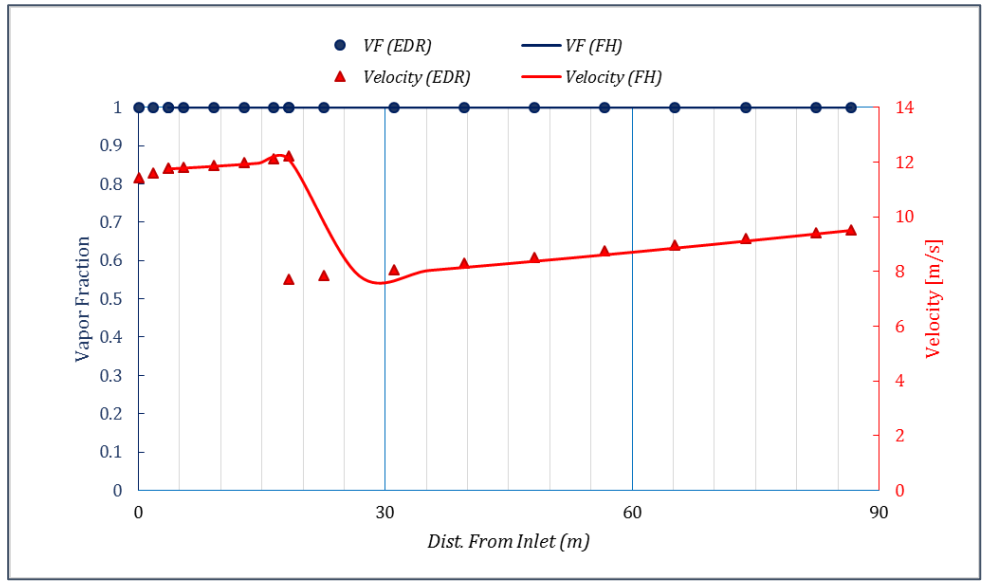
	FHinfinity	Datasheet	% ERR.	NOTE
Total Heat Absorption [kW]	5587	5586	~ 0	
Firebox Duty [kW]	4418	4433	- 0.3	
Avg. Rad. Sec. Heat Flux Density [W/m2]	34341	34104	0.7	
Process Outlet Temperature [C]	270	270	(0)	1
Process Side Pressure Drop [bar]	0.44	0.7	(0.3)	1
Heater Efficiency [%]	72.5	72.6	0.1	
Flue Gas Temp. Leaving Heater [C]	529	524	(5)	1
Bridgewall Temperature [C]	786	788	(-2)	1
Draft at Arch [in WC]	- 0.29	- 0.1	(- 0.19)	1, 2
Max. Flue Gas Mass Velocity [kg/m2.s]	3	2.92	2.7	
Ratio of Peak to Mean Heat Flux [-]	1.53	N/A	N/A	
Adiabatic Flame Temperature [C]	1805	N/A	N/A	1

NOTES:
(1) Absolute Error
(2) Over Design

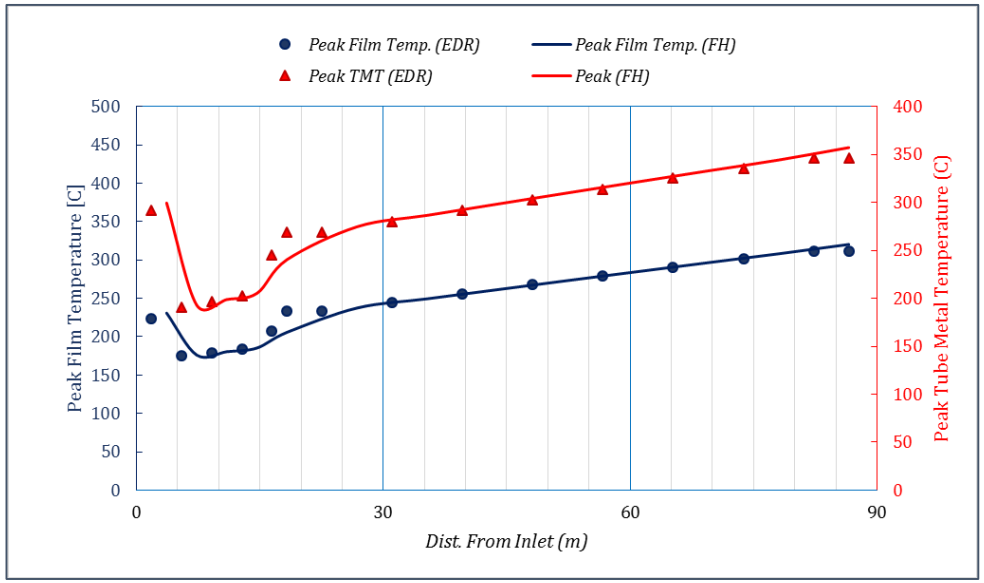
TEMPERATURE & PRESSURE



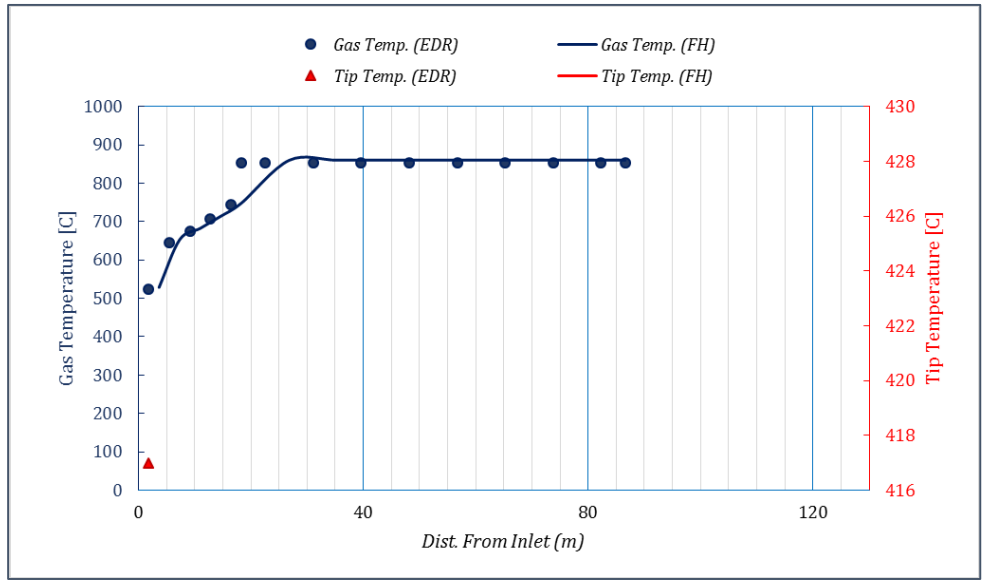
VELOCITY & VAPOR FRACTION



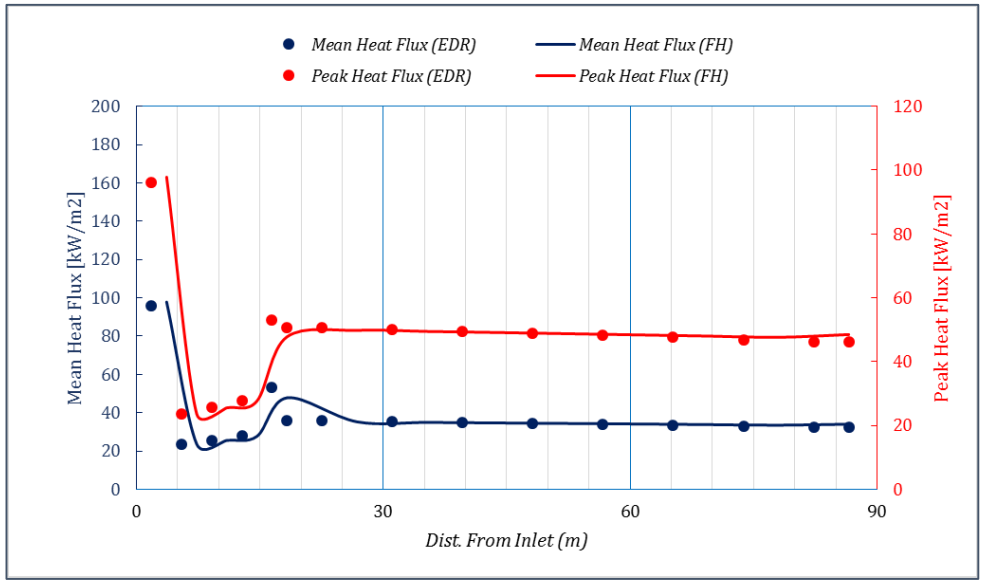
TUBE TEMPERATURES



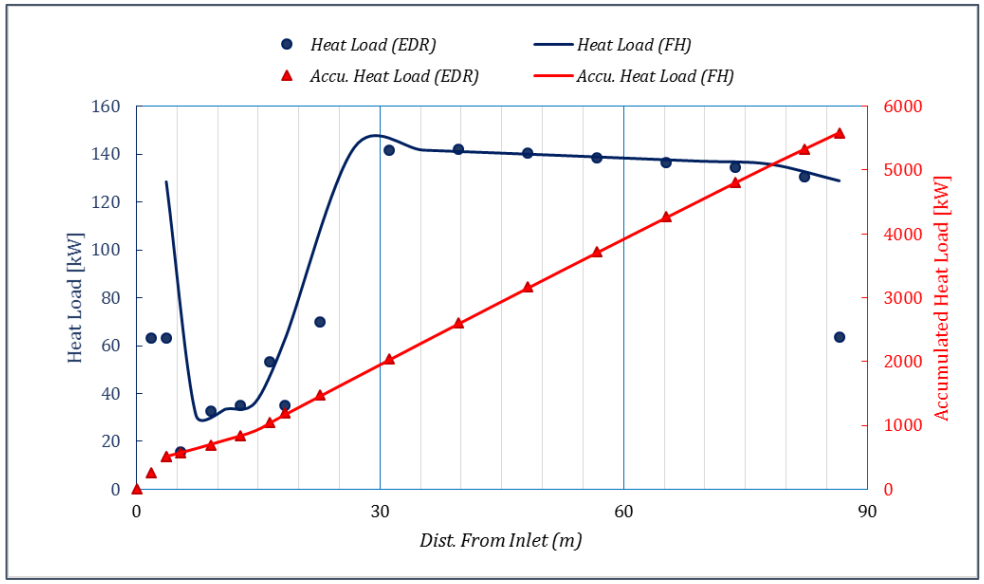
GAS TEMP.



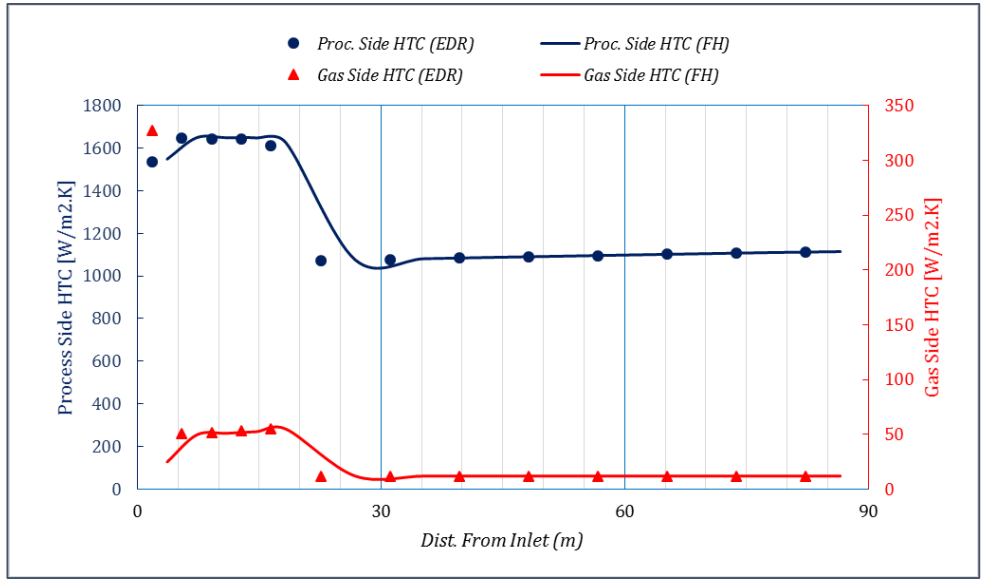
HEAT FLUXES



HEAT LOAD



HEAT TRANSFER COEF.



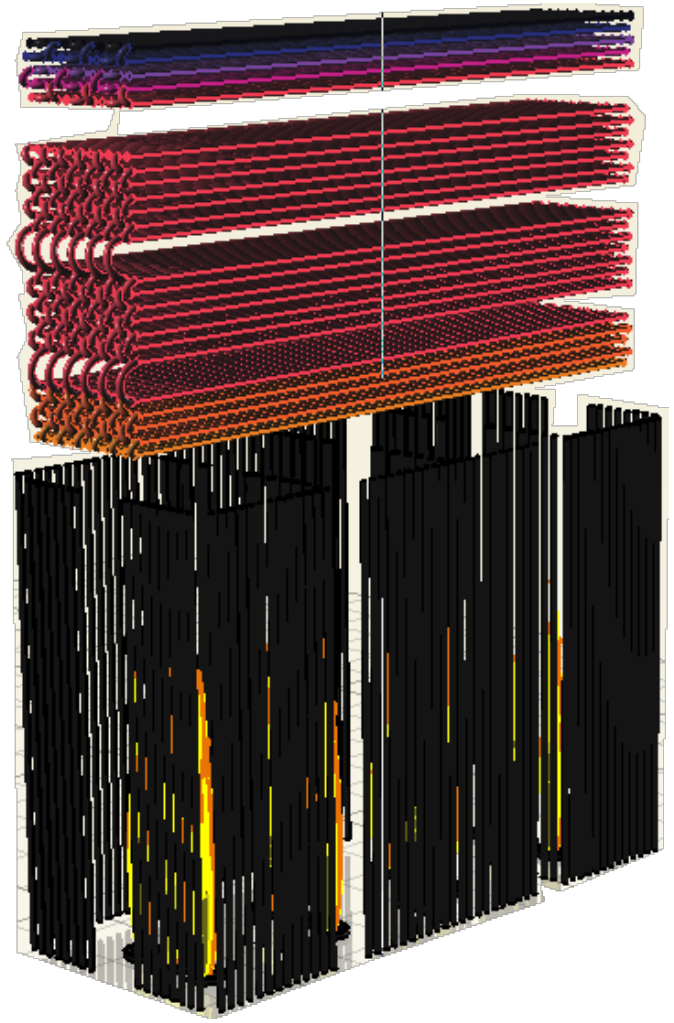
FHinfinity© CASE #RCS-6S

DEMO CASE #RCS-6S

HEATER GEOMETRY	*Radiant + Convection*
FIREBOX TYPE / NO. OF PATH	*Box / Six (6)*
FIREBOX TUBE LAYOUT	*Vertical, Ref. Backed & Central*
CONV. LAYOUT / NO. OF T.B.	*Triangular / Three (3)*
CONV. TUBE TYPE	*Bare*
BURNER LAYOUT	*Up-Fired*
STACK	*None*
FAN / APH / TRANSFER LINE	*Transfer Line*
FUEL	*Fuel Oil (+ Atm. Steam)*
NO. OF PROCESS STREAM	*Three (3)*
PROCESS THERMO. STATE	*All Vap. & Vaporizing (Liq/2ph.)*
THERMO ENGINE	*Aspen Hysys / Hysys / Hysys*

Model Specification & Setting:

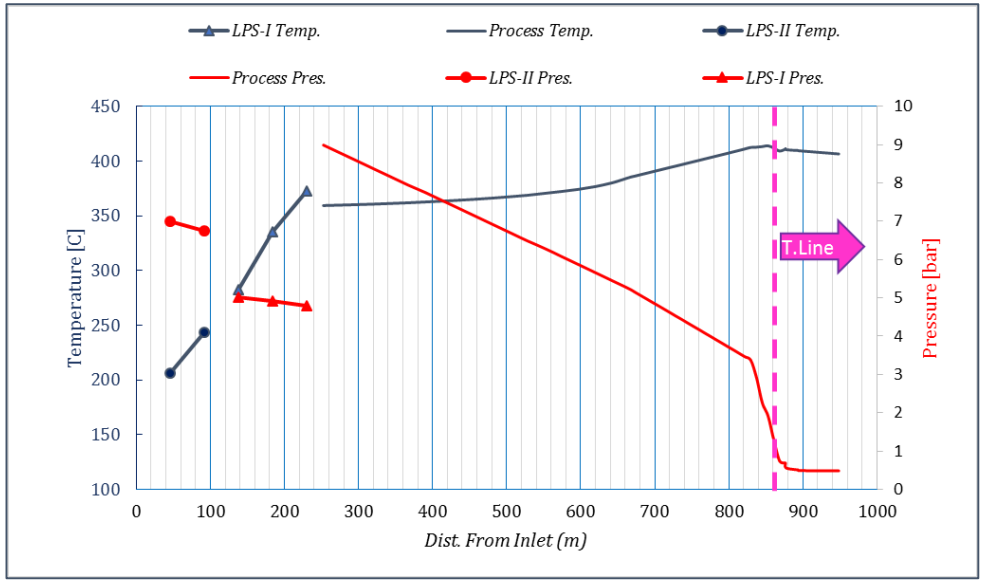
- ☑ *Steam Injection to Firebox*
- ☑ *Shield Duty*
- ☑ *Radiation to Tube Bank*
- ☑ *Hottel Parameter*
- ☑ *Fouling Factor*



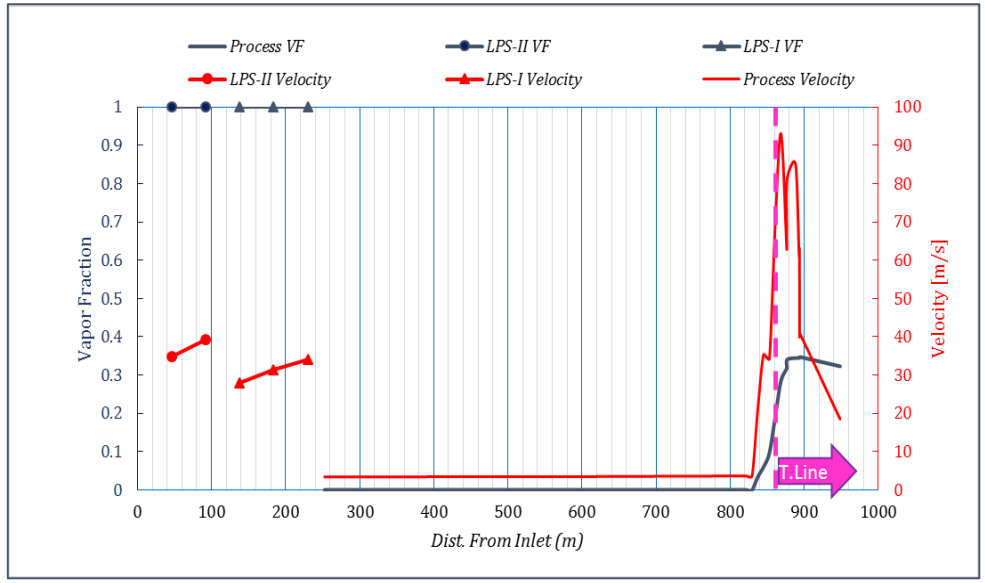
	FHinfinity	Datasheet	% ERR.	NOTE
Total Heat Absorption [kW]	25420	25222	0.8	
Firebox Duty [kW]	15220	15362	- 0.9	
Avg. Rad. Sec. Heat Flux Density [W/m2]	29444	29224	0.8	
Process Outlet Temperature [C]	411	412	(-1)	1, 2
Process Side Pressure Drop [bar]	8.5	8.7	(- 0.2)	1, 2
Heater Efficiency [%]	80.6	80	0.8	
Flue Gas Temp. Leaving Heater [C]	388	376	(12)	1, 3
Bridgewall Temperature [C]	917	886	(31)	1, 3
Draft at Arch [in WC]	N/A	N/A	N/A	
Max. Flue Gas Mass Velocity [kg/m2.s]	1.12	1.25		
Ratio of Peak to Mean Heat Flux [-]	1.76	N/A	N/A	
Adiabatic Flame Temperature [C]	1797	N/A	N/A	1

NOTES:
(1) Absolute Error
(2) Firebox Outlet
(3) Datasheet value does not match the Combustion Analysis results.

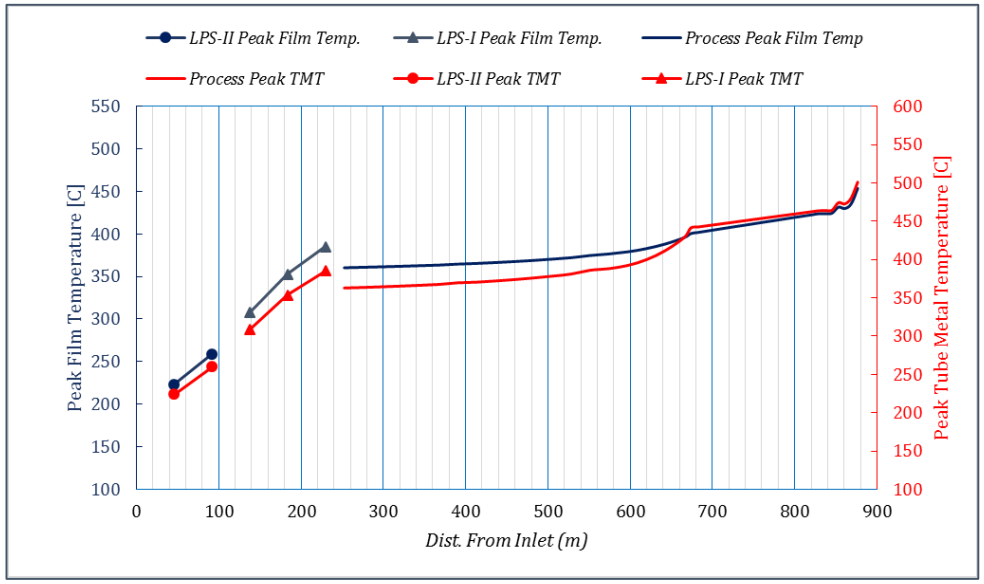
TEMPERATURE & PRESSURE



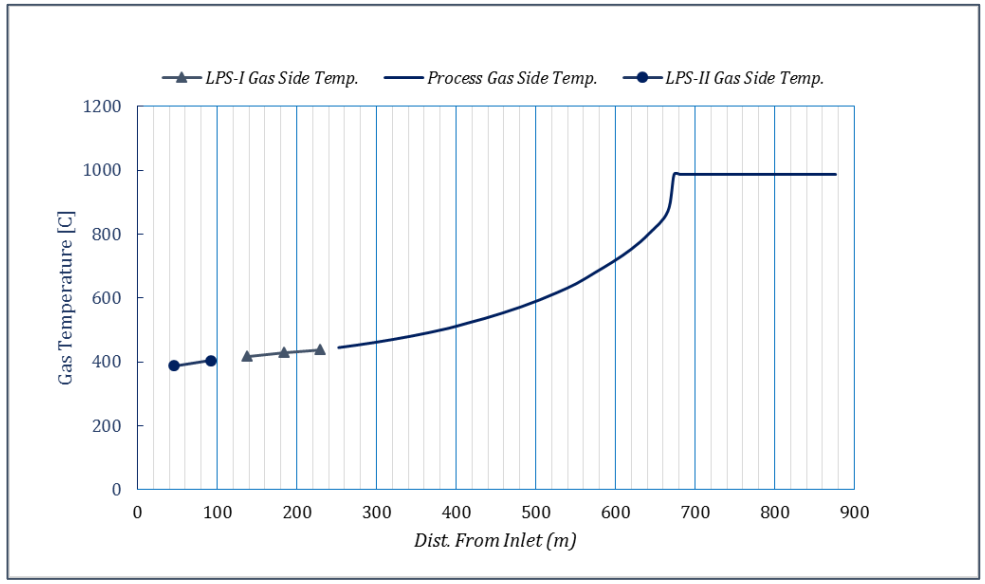
VELOCITY & VAPOR FRACTION



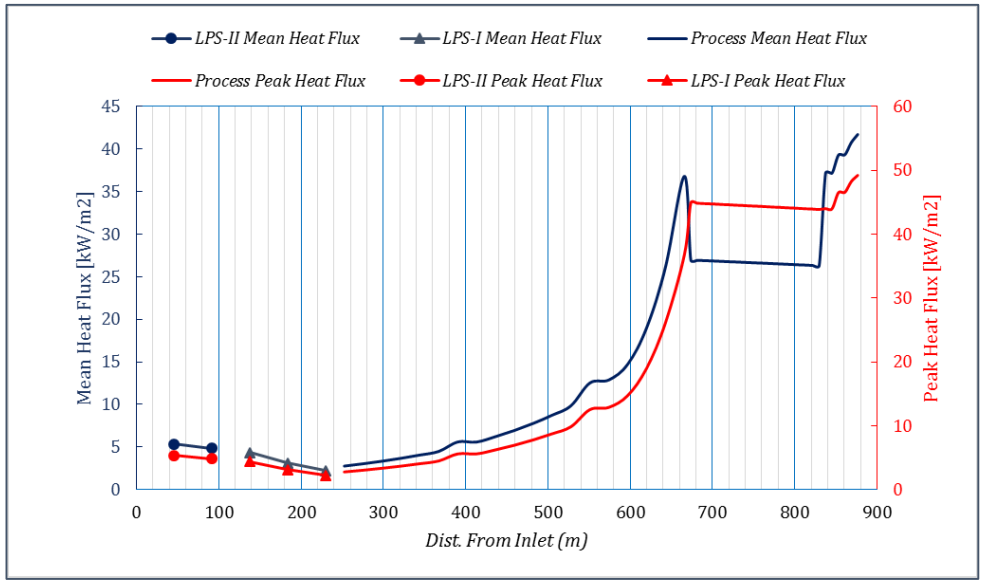
TUBE TEMPERATURES



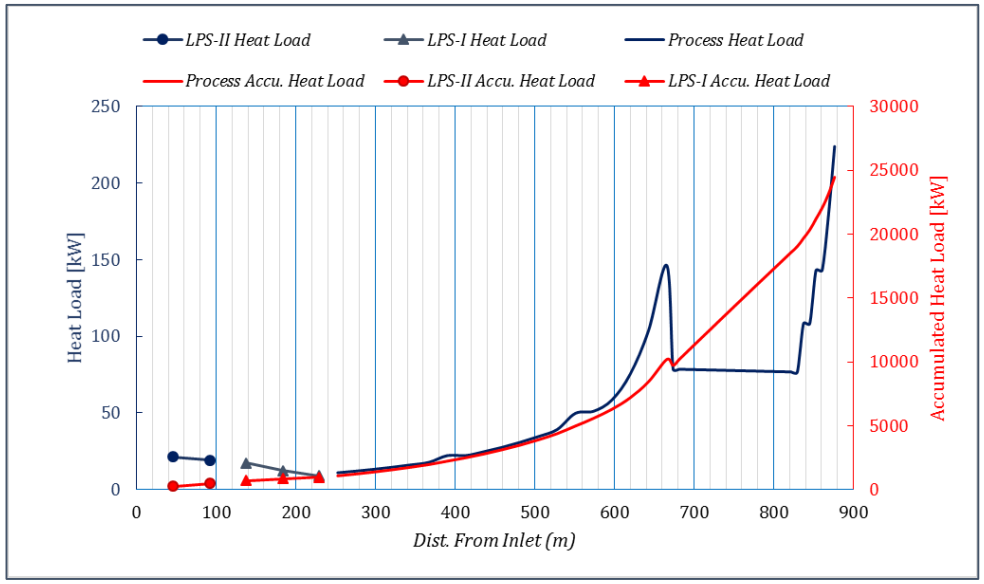
GAS TEMP.



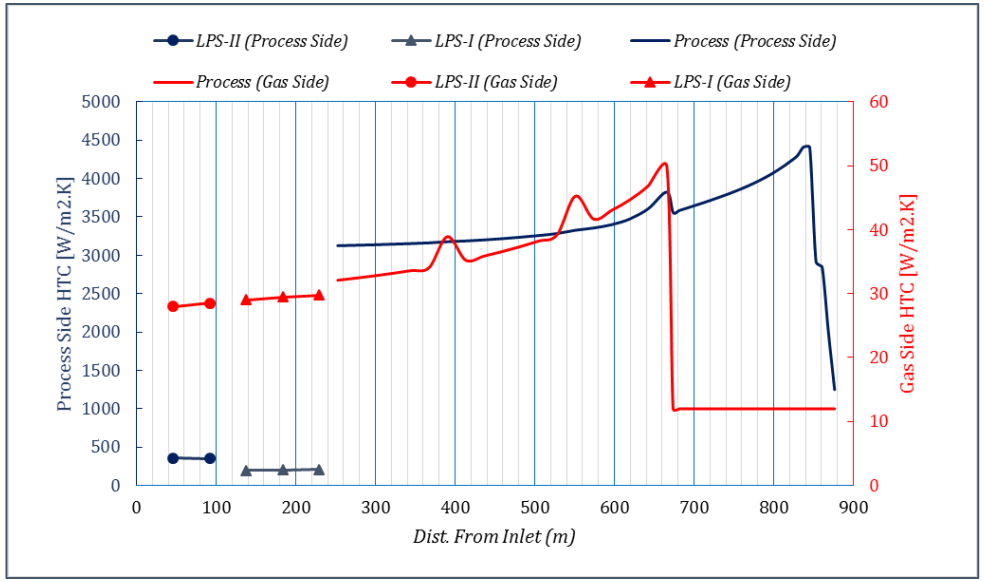
HEAT FLUXES



HEAT LOAD



HEAT TRANSFER COEF.



FHinfinity© CASE #RCS-7D

DEMO CASE #RCS-7D

HEATER GEOMETRY	*Radiant + Convection*
FIREBOX TYPE / NO. OF PATH	*Cylindrical / Two (2)*
FIREBOX TUBE LAYOUT	*Vertical, Ref. Backed (3 OD)*
CONV. LAYOUT / NO. OF T.B.	*Triangular / One (1)*
CONV. TUBE TYPE	*Bare*
BURNER LAYOUT	*Up-Fired*
STACK	*None*
FAN / APH / TRANSFER LINE	*None*
FUEL	*Fuel Gas*
NO. OF PROCESS STREAM	*One (1)*
PROCESS THERMO. STATE	*Vaporizing (Liq. / 2ph.)*
THERMO ENGINE	*Aspen Hysys*

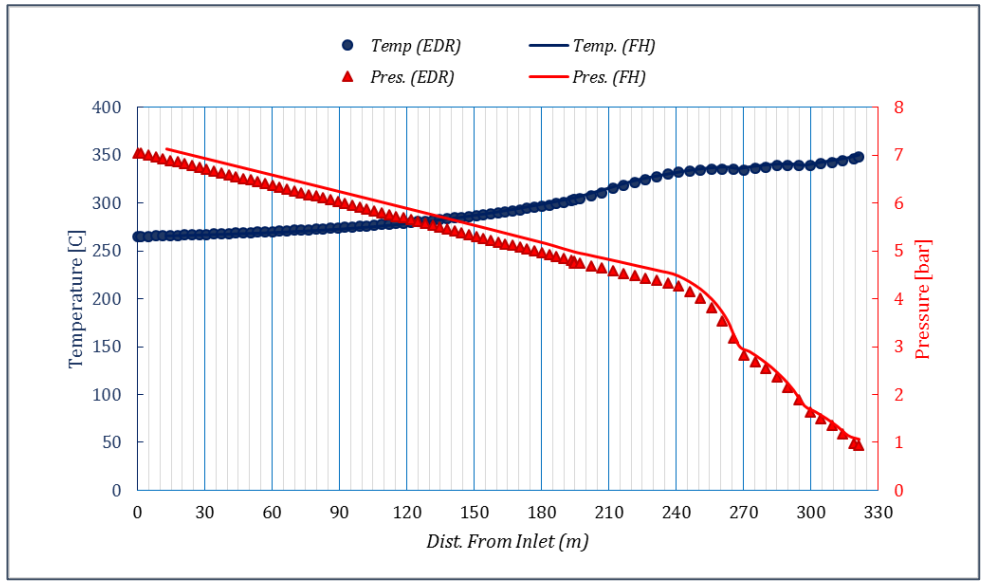
Model Specification & Setting:

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

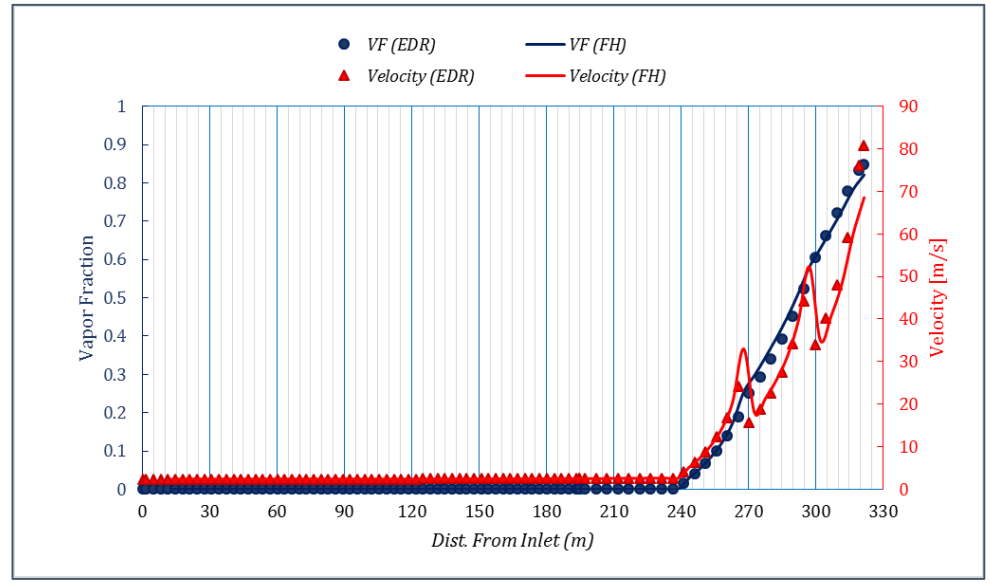
	FHinfinity	ASPEN EDR	% ERR.	NOTE
Total Heat Absorption [kW]	2870	2849	0.7	
Firebox Duty [kW]	2072	2085	- 0.6	
Avg. Rad. Sec. Heat Flux Density [W/m2]	32118	32022	0.3	
Process Outlet Temperature [C]	350	348	(2)	1
Process Side Pressure Drop [bar]	6.2	6.1	(0.1)	1
Heater Efficiency [%]	81.6	81	0.7	
Flue Gas Temp. Leaving Heater [C]	351	363	(- 12)	1
Bridgewall Temperature [C]	790	783	(7)	1
Draft at Arch [in WC]	N/A	N/A	N/A	
Max. Flue Gas Mass Velocity [kg/m2.s]	1.18	1.18	0	
Ratio of Peak to Mean Heat Flux [-]	1.64	1.64	~ 0	
Adiabatic Flame Temperature [C]	1868	1869	(-1)	1

NOTES:
(1) Absolute Error

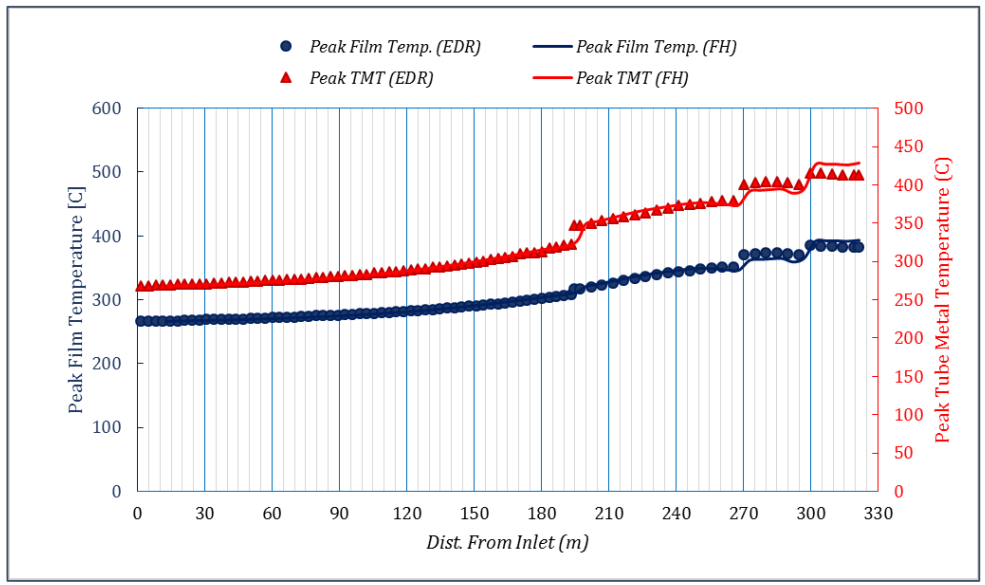
TEMPERATURE & PRESSURE



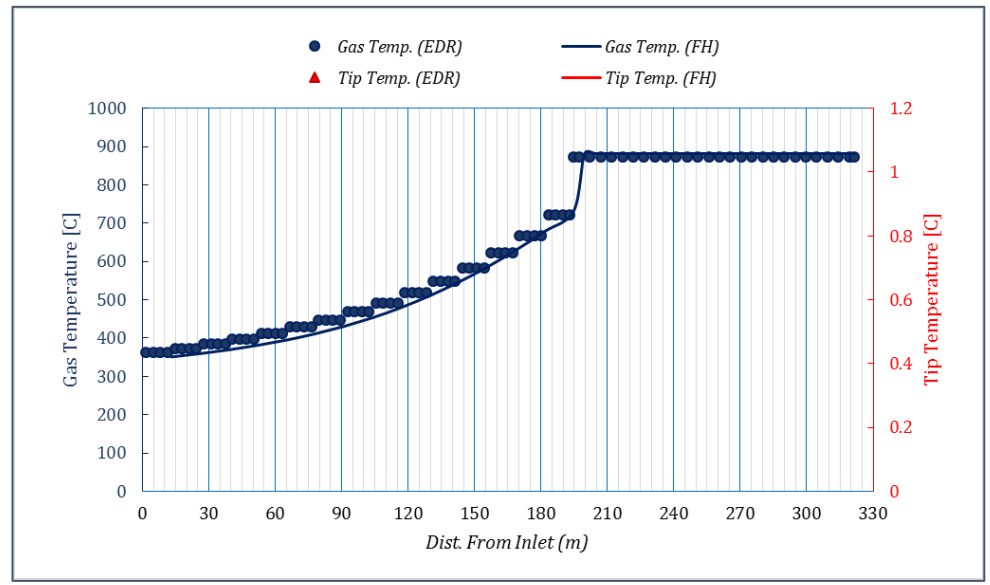
VELOCITY & VAPOR FRACTION



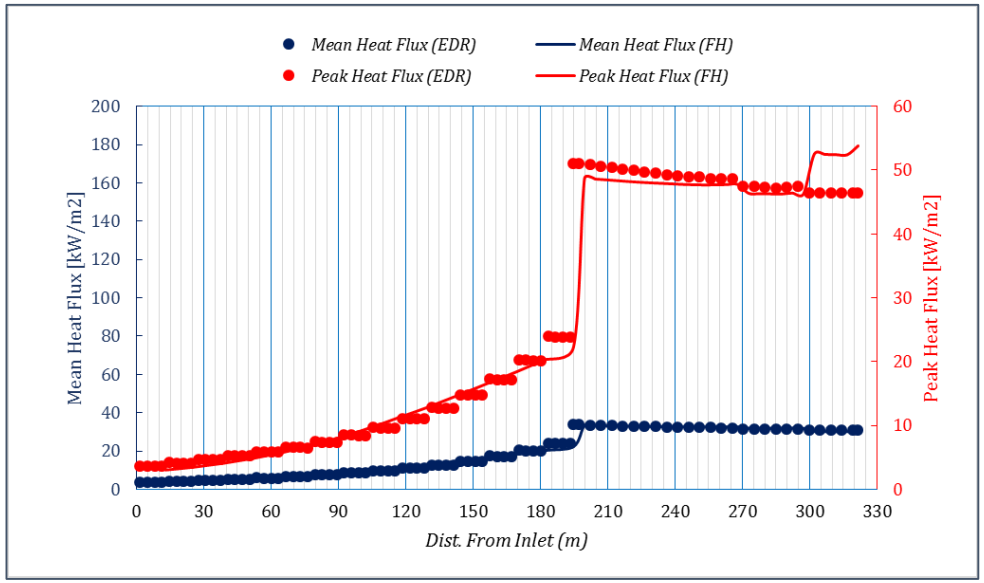
TUBE TEMPERATURES



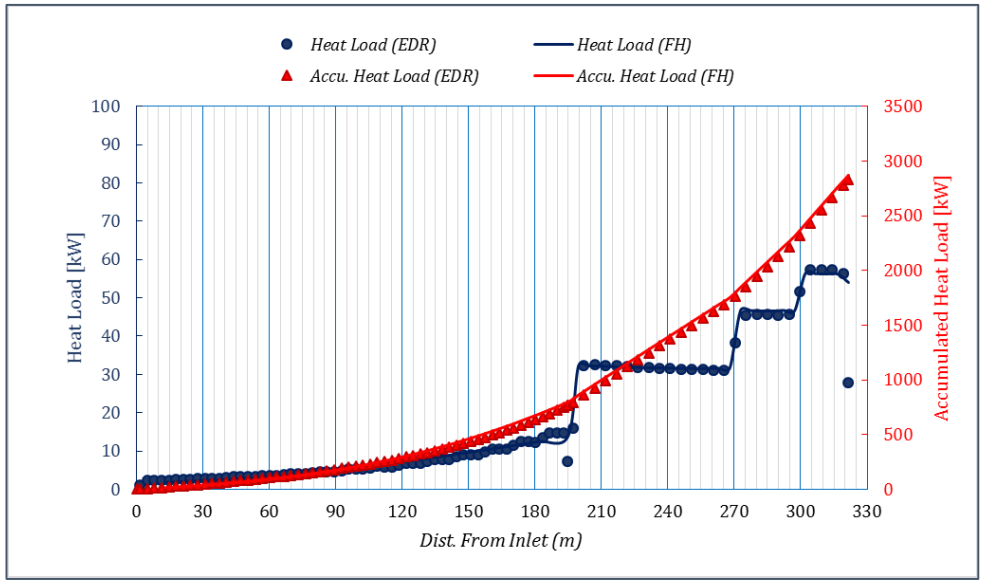
GAS TEMP.



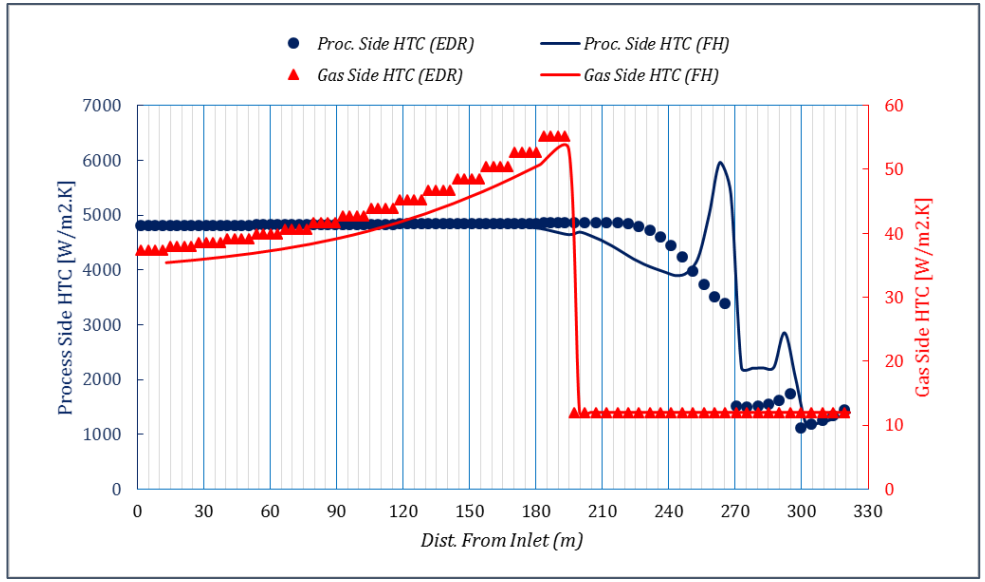
HEAT FLUXES



HEAT LOAD



HEAT TRANSFER COEF.



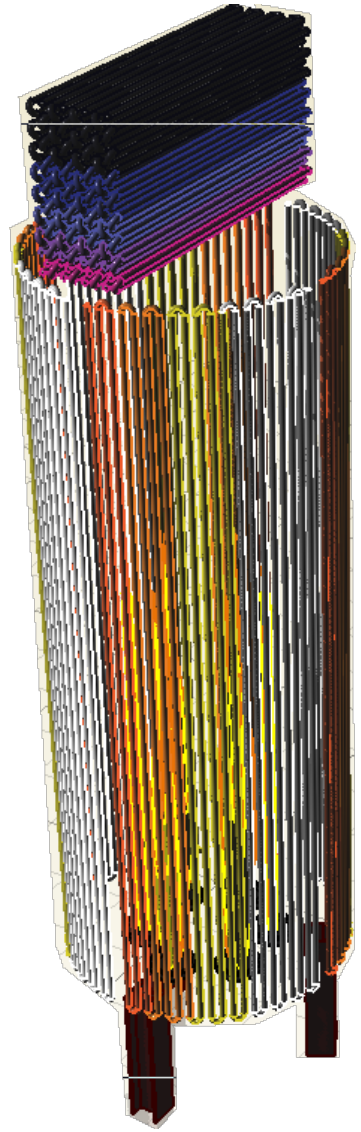
FHinfinity© CASE #RCS-8D

DEMO CASE #RCS-8D

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

Model Specification & Setting:

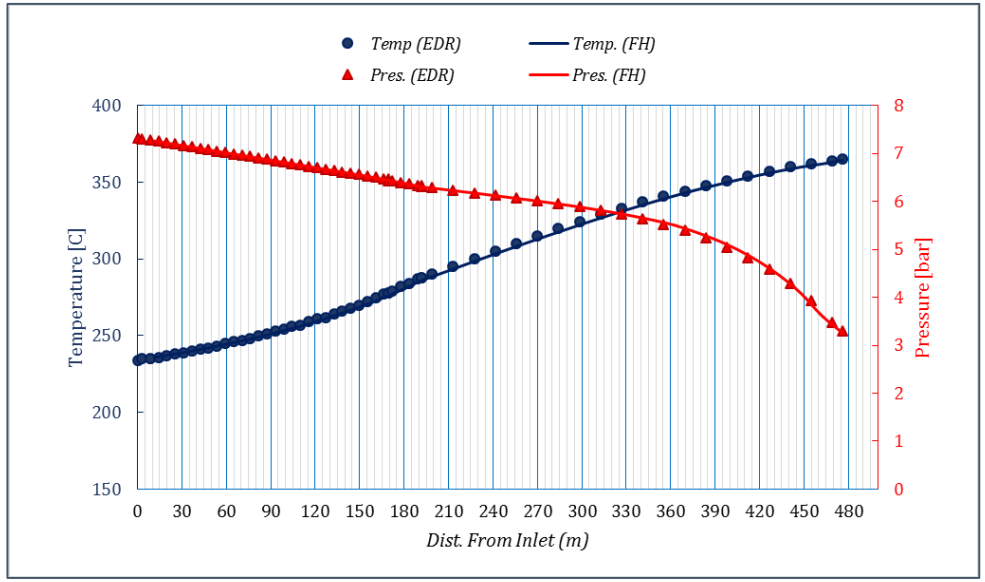
- ☑ *Radiation to Tube Bank*
- ☑ *Hottel Parameter*



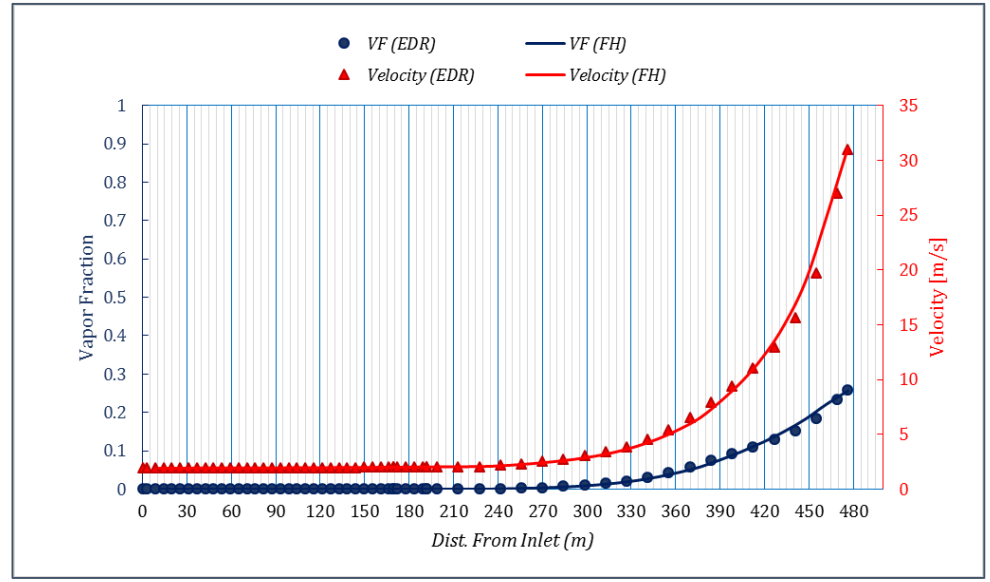
	FHinfinity	ASPEN EDR	% ERR.	NOTE
Total Heat Absorption [kW]	19024	19140	- 0.6	
Firebox Duty [kW]	12665	12496	1.3	
Avg. Rad. Sec. Heat Flux Density [W/m2]	30998	30583	1.3	
Process Outlet Temperature [C]	364	365	(-1)	1
Process Side Pressure Drop [bar]	4.1	4	(0.1)	1
Heater Efficiency [%]	73.7	74.2	0.6	
Flue Gas Temp. Leaving Heater [C]	494	488	(6)	1
Bridgewall Temperature [C]	930	943	(-13)	1
Draft at Arch [in WC]	- 0.29	- 0.32	(0.03)	1
Max. Flue Gas Mass Velocity [kg/m2.s]	2.5	2.5	~ 0	
Ratio of Peak to Mean Heat Flux [-]	1.92	1.92	~ 0	
Adiabatic Flame Temperature [C]	1772	1767	(5)	1

NOTES:
(1) Absolute Error

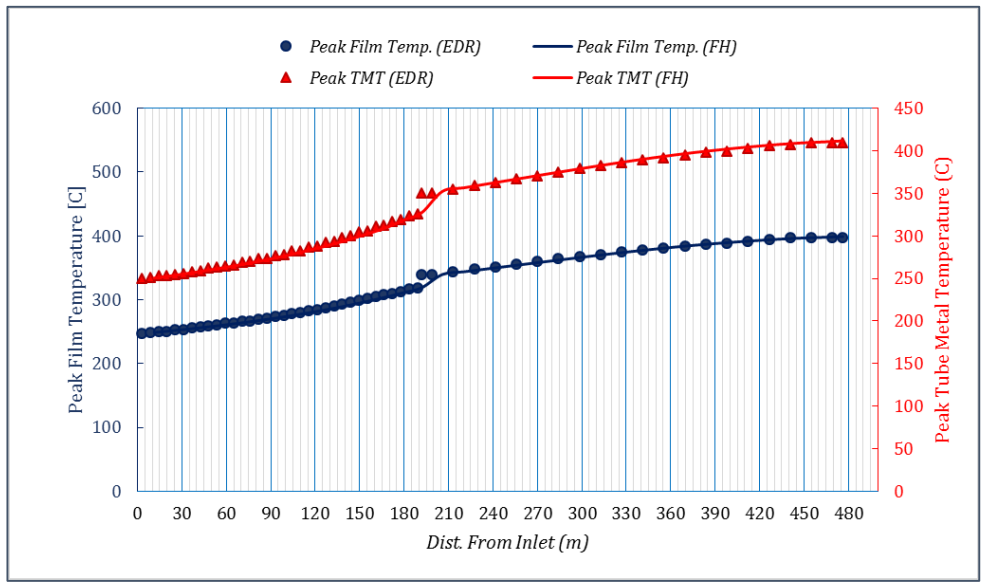
TEMPERATURE & PRESSURE



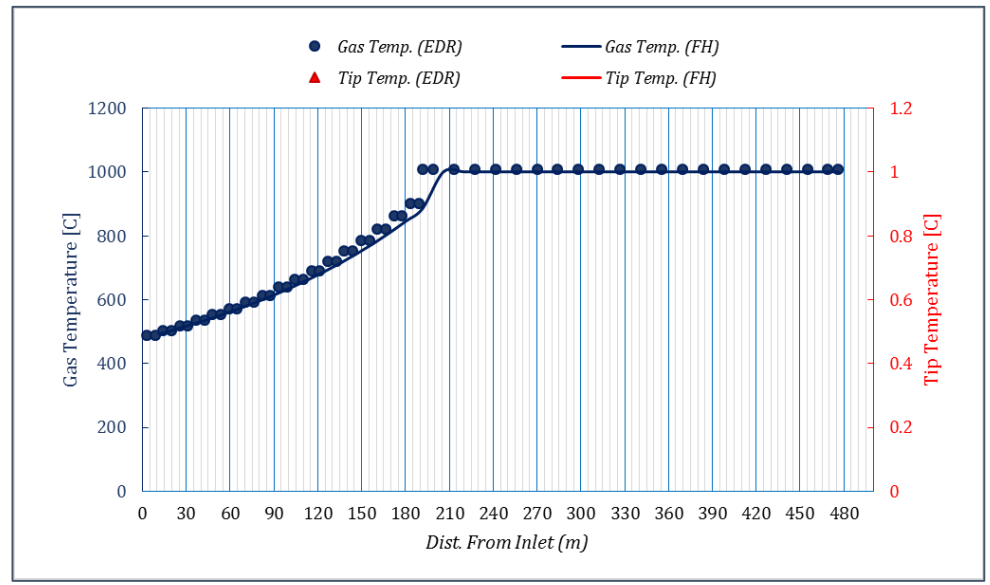
VELOCITY & VAPOR FRACTION



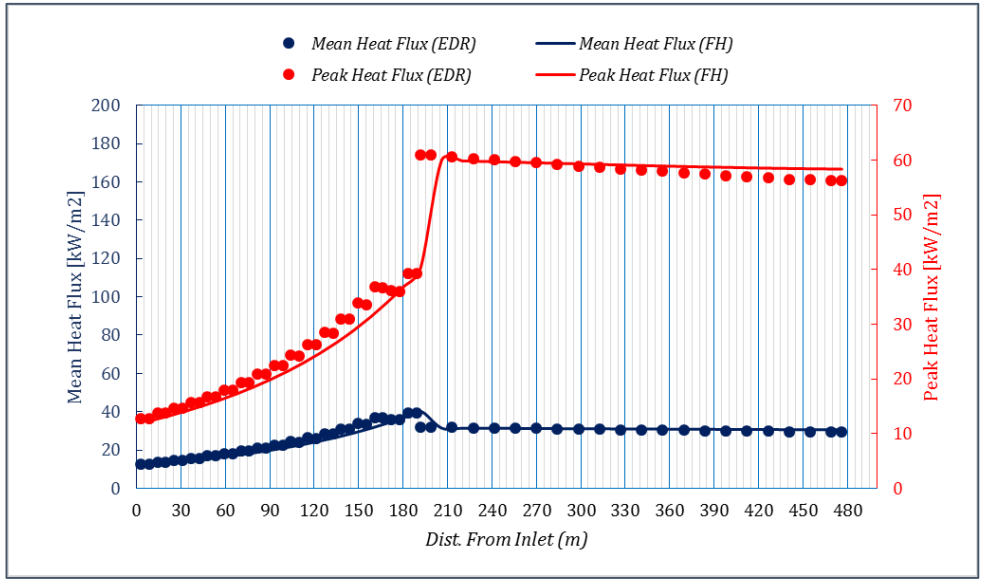
TUBE TEMPERATURES



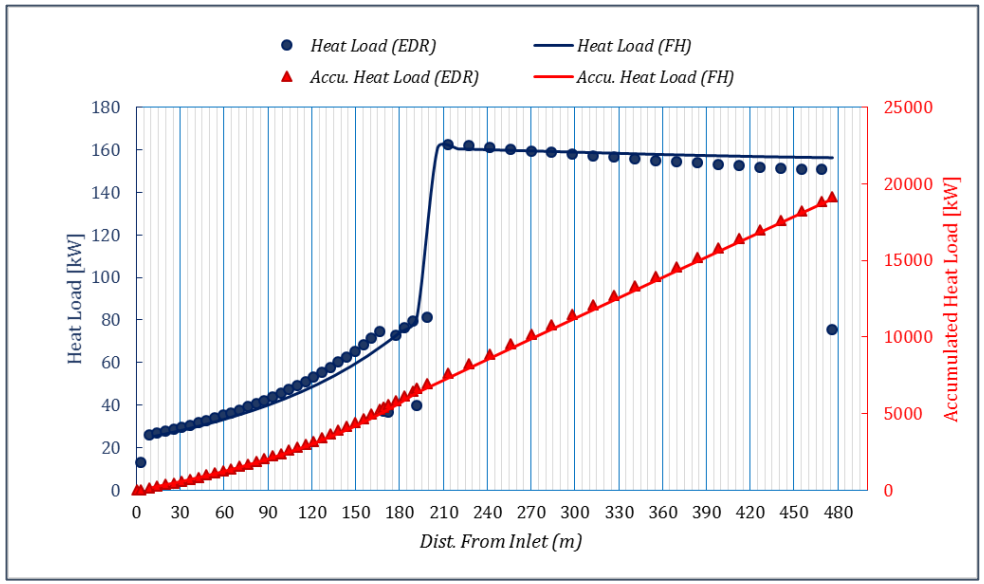
GAS TEMP.



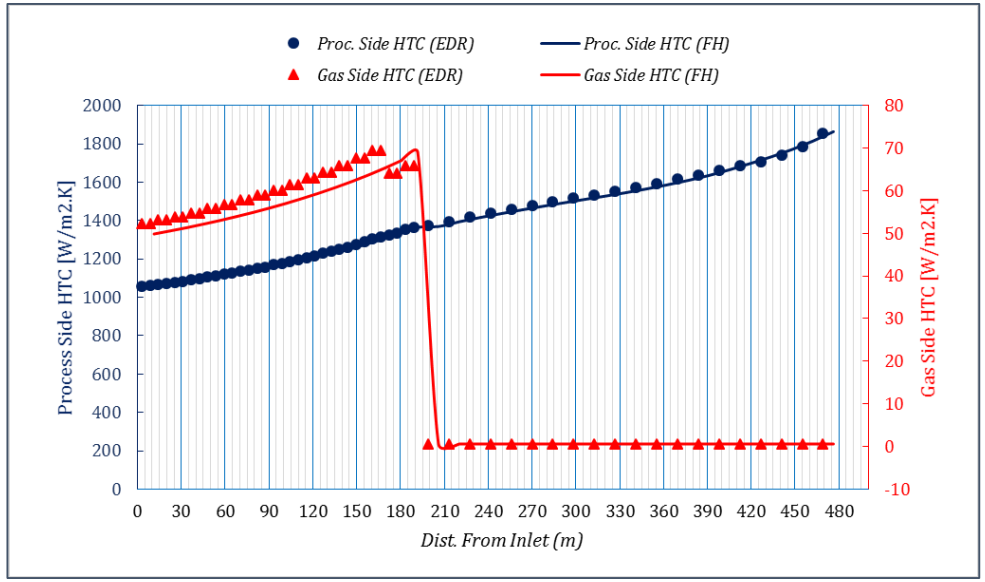
HEAT FLUXES



HEAT LOAD



HEAT TRANSFER COEF.



FHinfinity© CASE #RCS-9S

DEMO CASE #RS-9S

HEATER GEOMETRY	*Radiant Only (Four Cells)*
FIREBOX TYPE / NO. OF PATH	*Cubical / 30 & 34*
FIREBOX TUBE LAYOUT	*Arbor Tube, Central*
CONV. LAYOUT / NO. OF T.B.	*None*
CONV. TUBE TYPE	*None*
BURNER LAYOUT	*Up-Fired*
STACK	*None*
FAN / APH / TRANSFER LINE	*None*
FUEL	*Fuel Gas*
NO. OF PROCESS STREAM	*One (1)*
PROCESS THERMO. STATE	*All Vapor*
THERMO ENGINE	*User Input Data*

Model Specification & Setting:

- ☑ *Fouling Factor*

	FHinfinity	Datasheet	% ERR.	NOTE
Total Heat Absorption [kW]	9337	9357	- 0.2	
Firebox Duty [kW]	9337	9357	- 0.2	
Avg. Rad. Sec. Heat Flux Density [W/m2]	37856	37882	- 0.07	
Process Outlet Temperature [C]	512.7	510	(2.7)	1
Process Side Pressure Drop [bar]	0.12	~ 0.15	(~ 0)	1
Heater Efficiency [%]	54.9	55	0.2	
Flue Gas Temp. Leaving Heater [C]	N/A	N/A	N/A	
Bridgewall Temperature [C]	897	860	(37)	1
Draft at Arch [in WC]	N/A	N/A	N/A	
Max. Flue Gas Mass Velocity [kg/m2.s]	N/A	N/A	N/A	
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

	FHinfinity	Datasheet	% ERR.	NOTE
Total Heat Absorption [kW]	12300	12322	- 0.2	
Firebox Duty [kW]	12300	12322	- 0.2	
Avg. Rad. Sec. Heat Flux Density [W/m2]	49867	49887	- 0.04	
Process Outlet Temperature [C]	511	510	(1)	1
Process Side Pressure Drop [bar]	0.16	~ 0.15	(~ 0)	1
Heater Efficiency [%]	54.9	55	0.2	
Flue Gas Temp. Leaving Heater [C]	N/A	N/A	N/A	
Bridgewall Temperature [C]	897	892	(5)	1
Draft at Arch [in WC]	N/A	N/A	N/A	
Max. Flue Gas Mass Velocity [kg/m2.s]	N/A	N/A	N/A	
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

	FHinfinity	Datasheet	% ERR.	NOTE
Total Heat Absorption [kW]	7505	7490	0.2	
Firebox Duty [kW]	7505	7490	0.2	
Avg. Rad. Sec. Heat Flux Density [W/m2]	26848	26750	0.4	
Process Outlet Temperature [C]	509	510	(-1)	1
Process Side Pressure Drop [bar]	0.16	~ 0.15	(~ 0)	1
Heater Efficiency [%]	55.1	55	0.2	
Flue Gas Temp. Leaving Heater [C]	N/A	N/A	N/A	
Bridgewall Temperature [C]	893	838	(55)	1, 2
Draft at Arch [in WC]	N/A	N/A	N/A	
Max. Flue Gas Mass Velocity [kg/m2.s]	N/A	N/A	N/A	
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
(2) Different Fuel Gas

	FHinfinity	Datasheet	% ERR.	NOTE
Total Heat Absorption [kW]	5725	5722	0.05	
Firebox Duty [kW]	5725	5722	0.05	
Avg. Rad. Sec. Heat Flux Density [W/m2]	20482	20435	0.2	
Process Outlet Temperature [C]	510	510	(0)	1, 2
Process Side Pressure Drop [bar]	0.18	~ 0.15	(~ 0)	1
Heater Efficiency [%]	57.7	55	4.9	
Flue Gas Temp. Leaving Heater [C]	N/A	N/A	N/A	
Bridgewall Temperature [C]	849	795	(54)	1, 2
Draft at Arch [in WC]	N/A	N/A	N/A	
Max. Flue Gas Mass Velocity [kg/m2.s]	N/A	N/A	N/A	
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.
(2) Solved in TIC Mode.

The End

www.FHinfinity.com