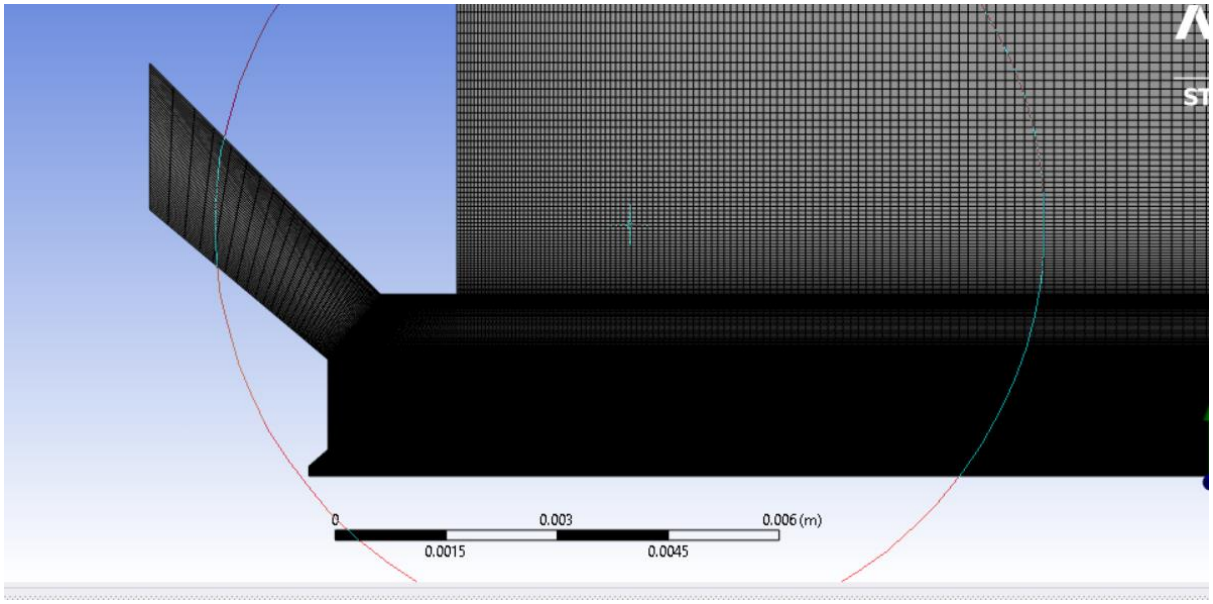
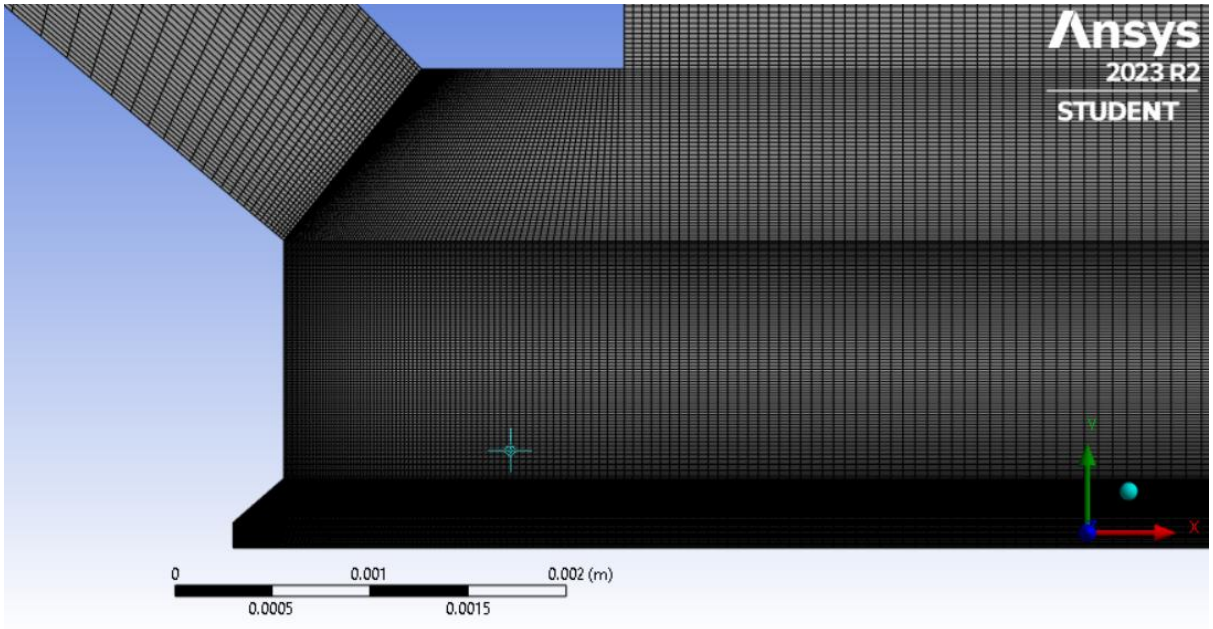
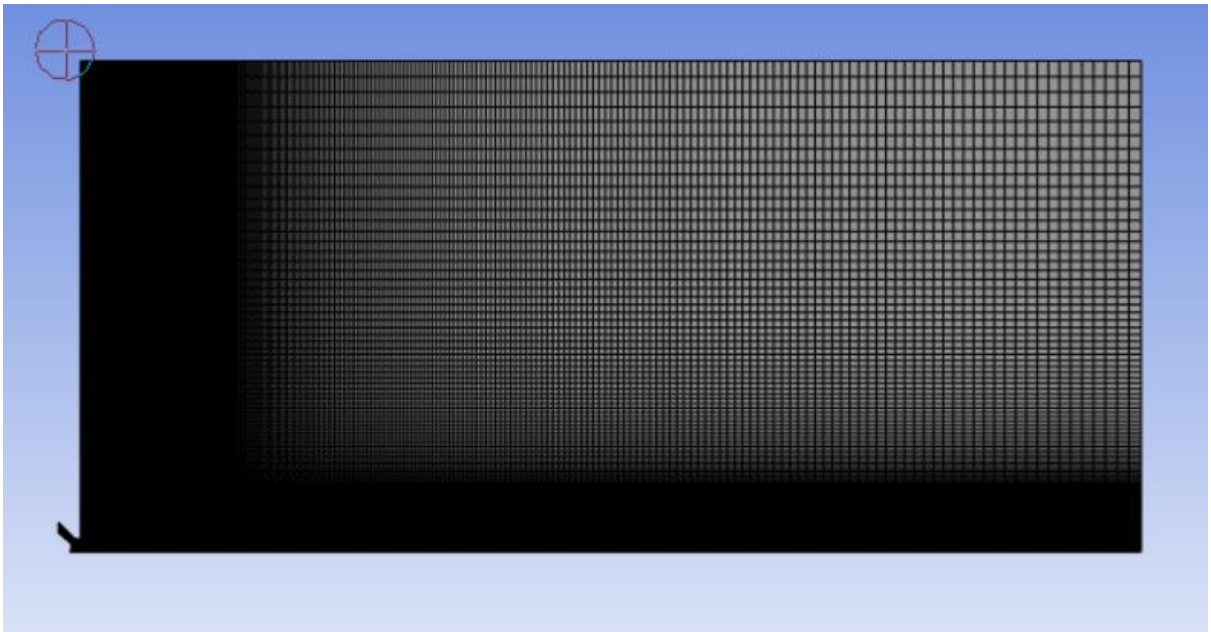
Mesh Model:

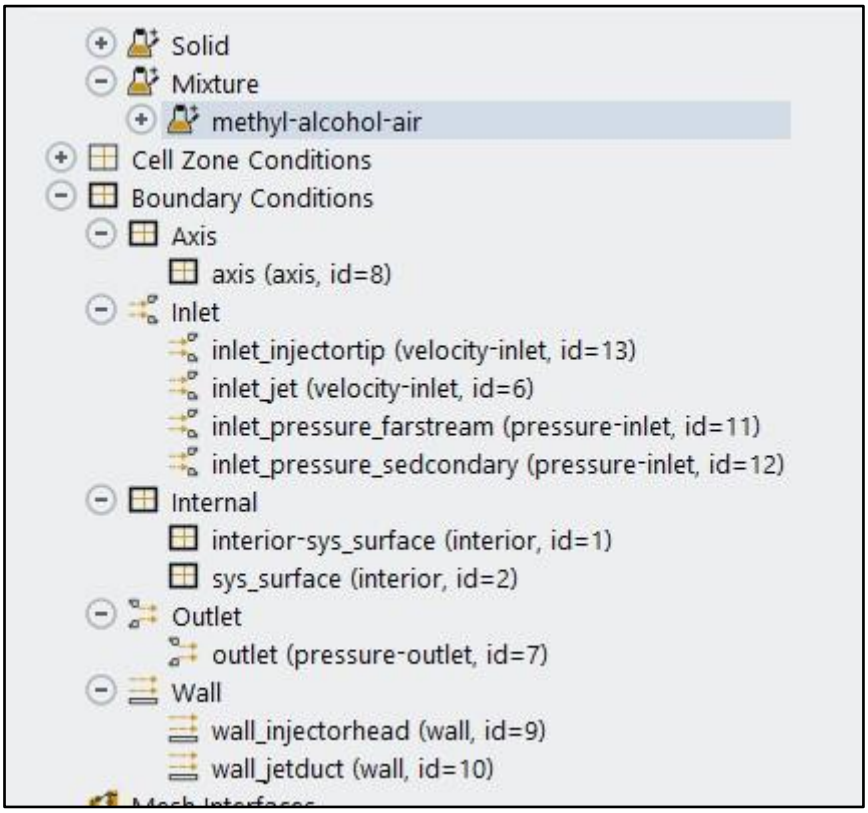

0
0.003
0.006 (m)
0.0015
0.0045


Ansys
2023 R2
STUDENT
0
0.001
0.002 (m)
0.0005
0.0015



Air flow model without injection

Boundary Conditions:



Species Mass Fractions

ch3oh	0
o2	0.21

Reference Values

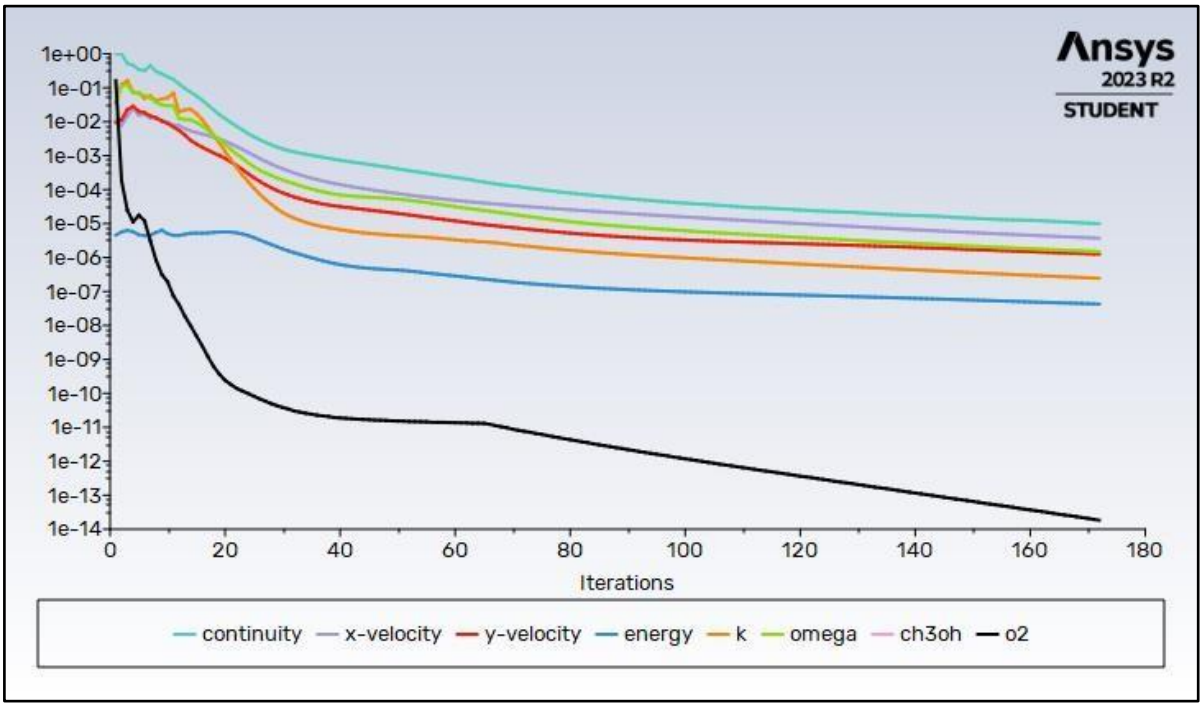
Compute from: inlet_jet

Reference Values

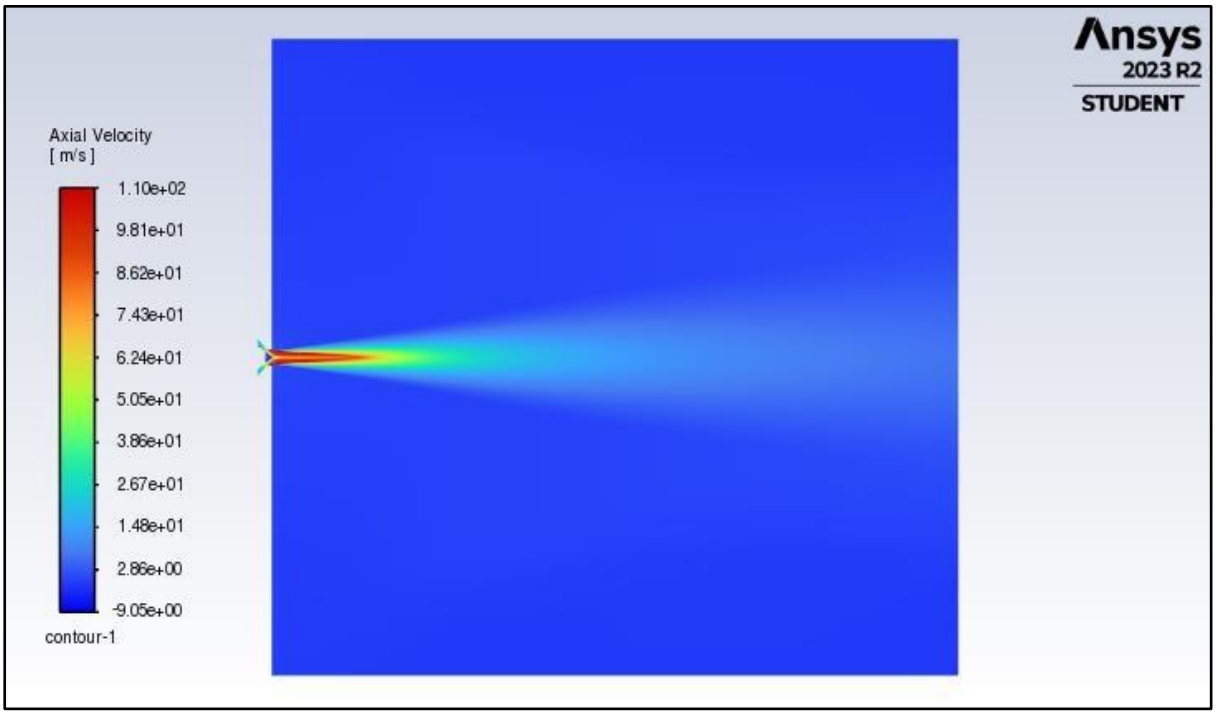
Area [m²]	1
Density [kg/m³]	0.4381956
Enthalpy [J/kg]	0
Length [mm]	1000
Pressure [Pa]	0
Temperature [K]	800
Velocity [m/s]	20
Viscosity [kg/(m s)]	1.72e-05
Ratio of Specific Heats	1.4
Yplus for Heat Tran. Coef.	300

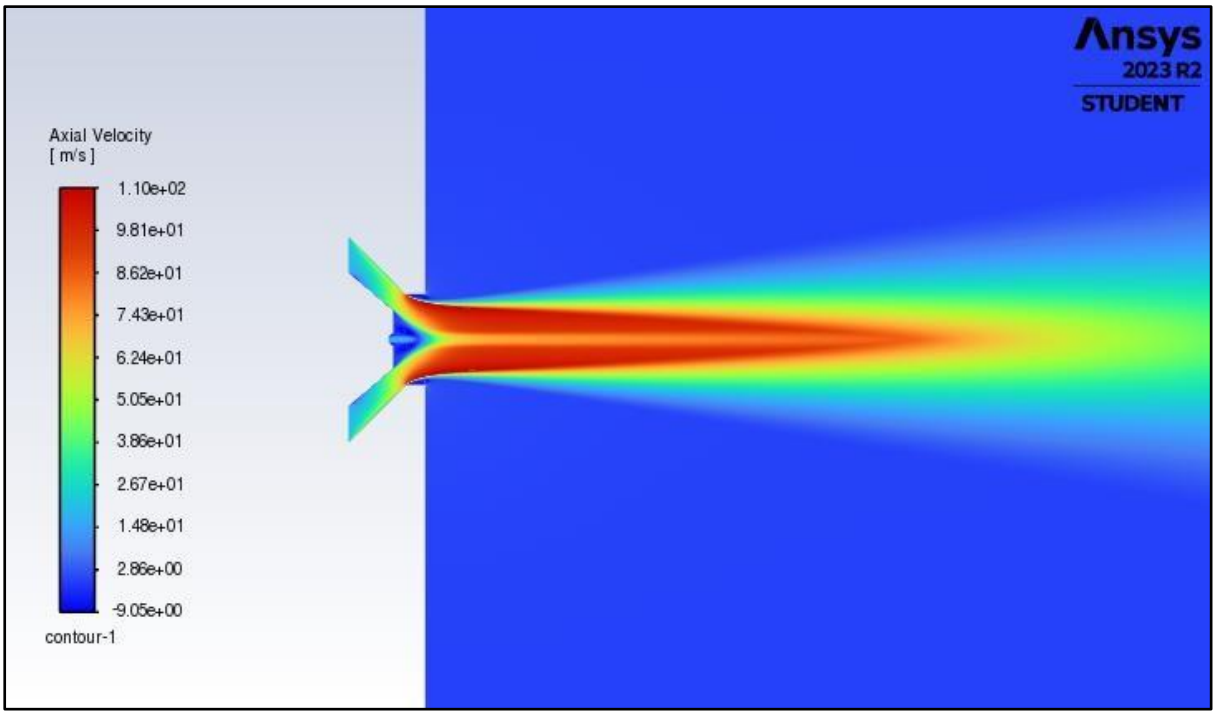
Reference Zone: solid-sys_surface

Convergence:

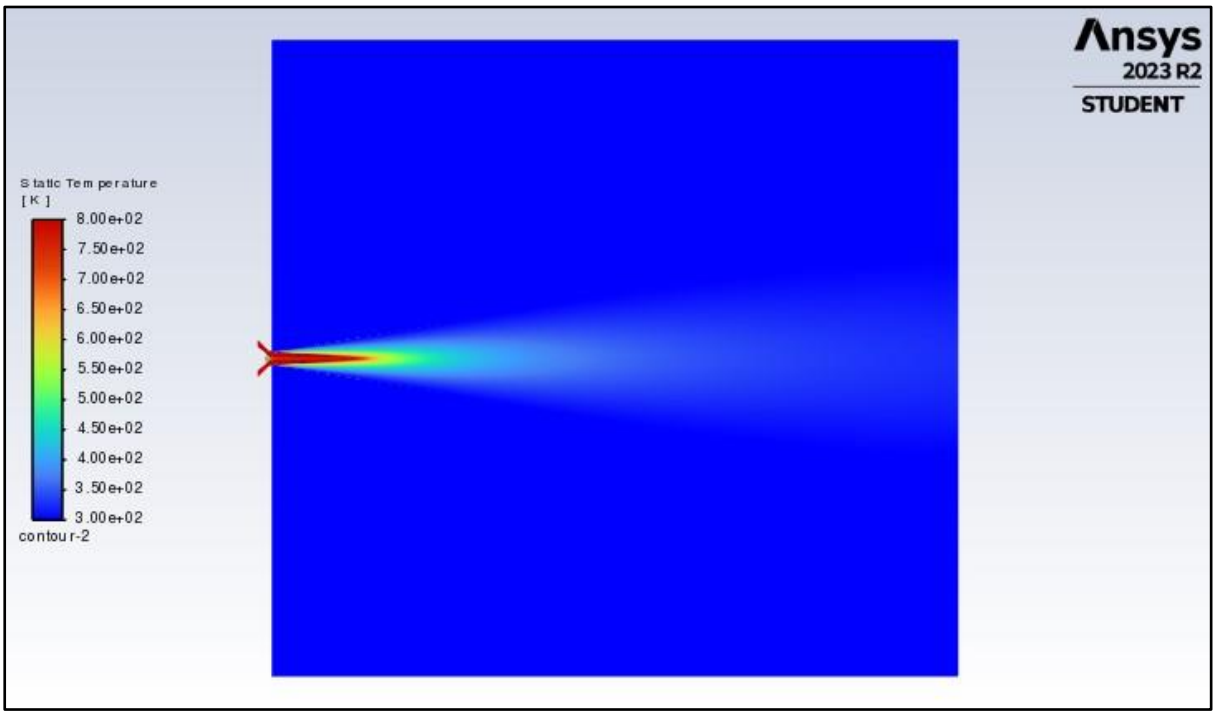


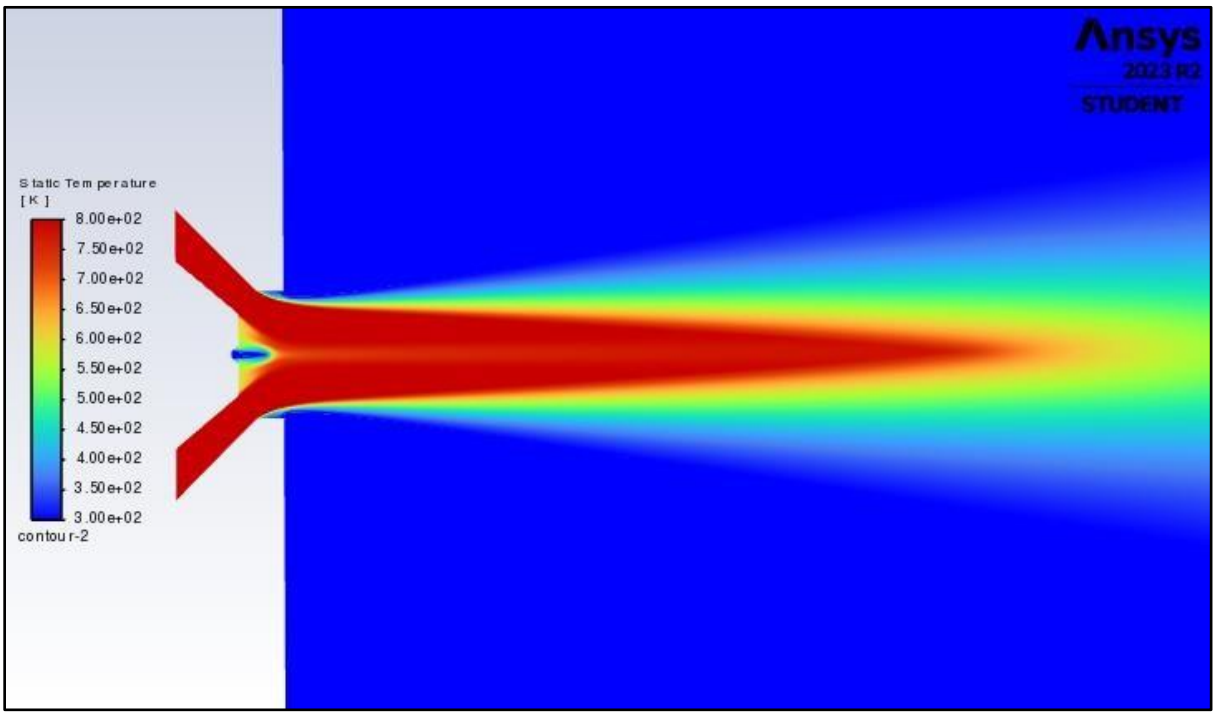
Contour of axial velocity:



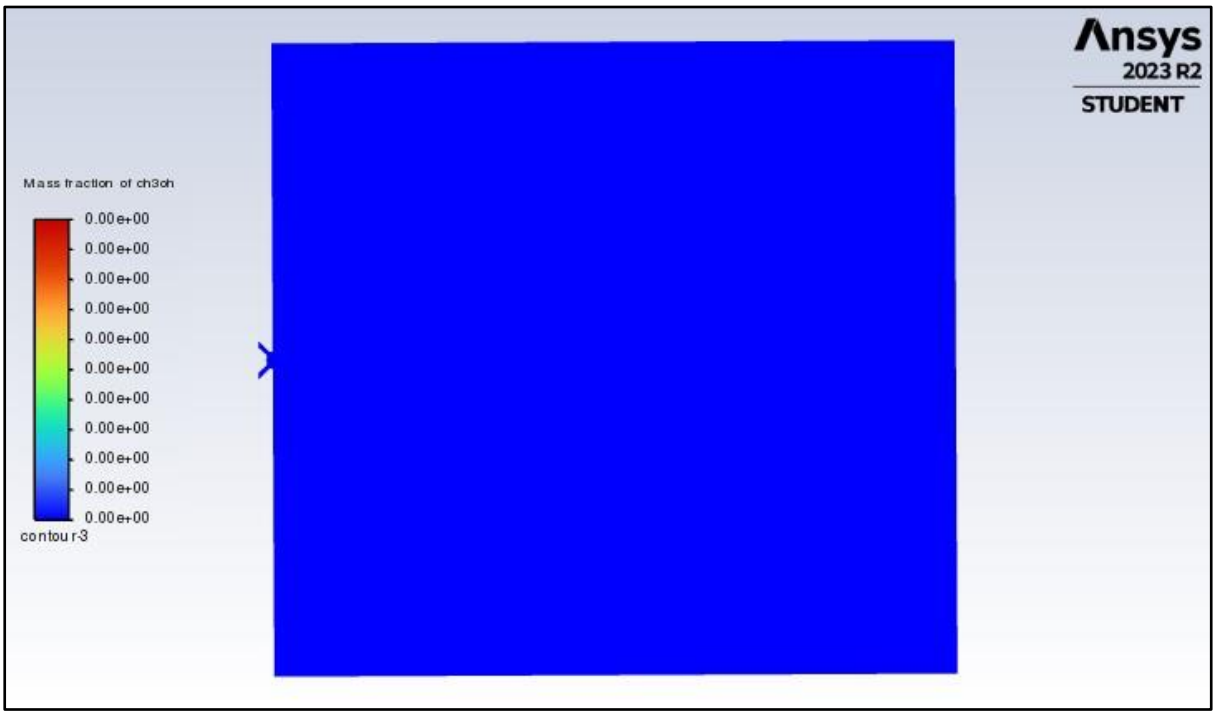


Contour of Temperature:

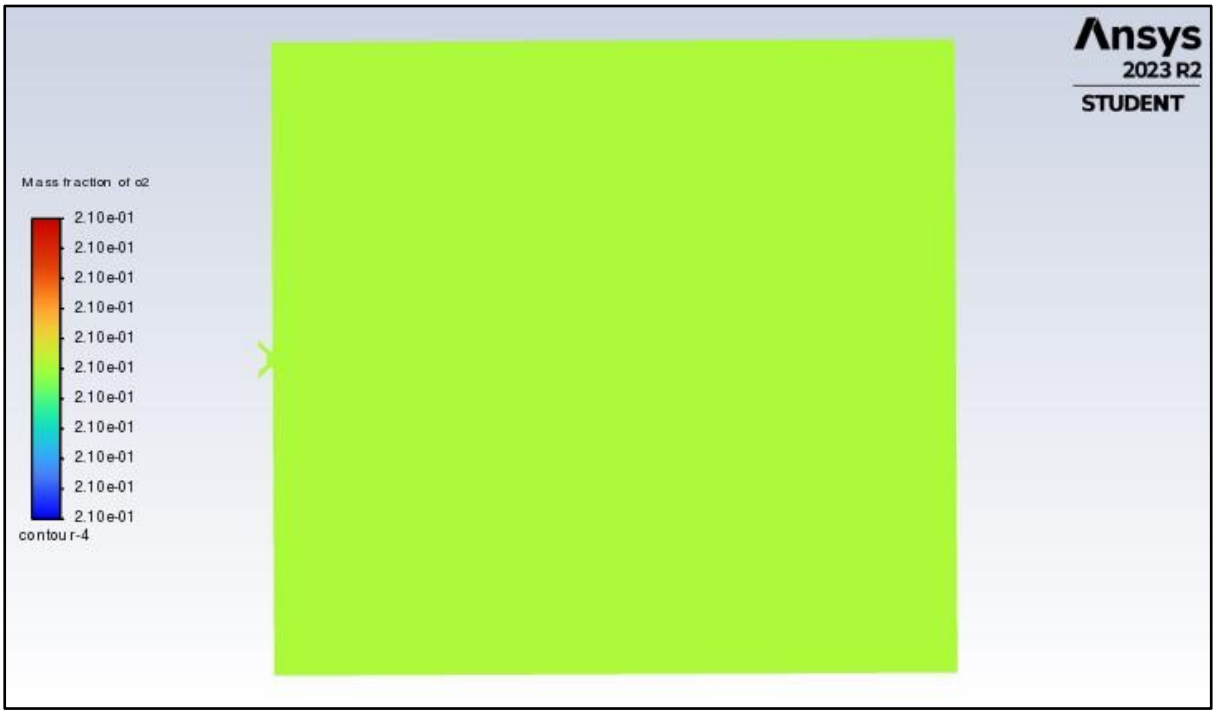




Contour of Species:

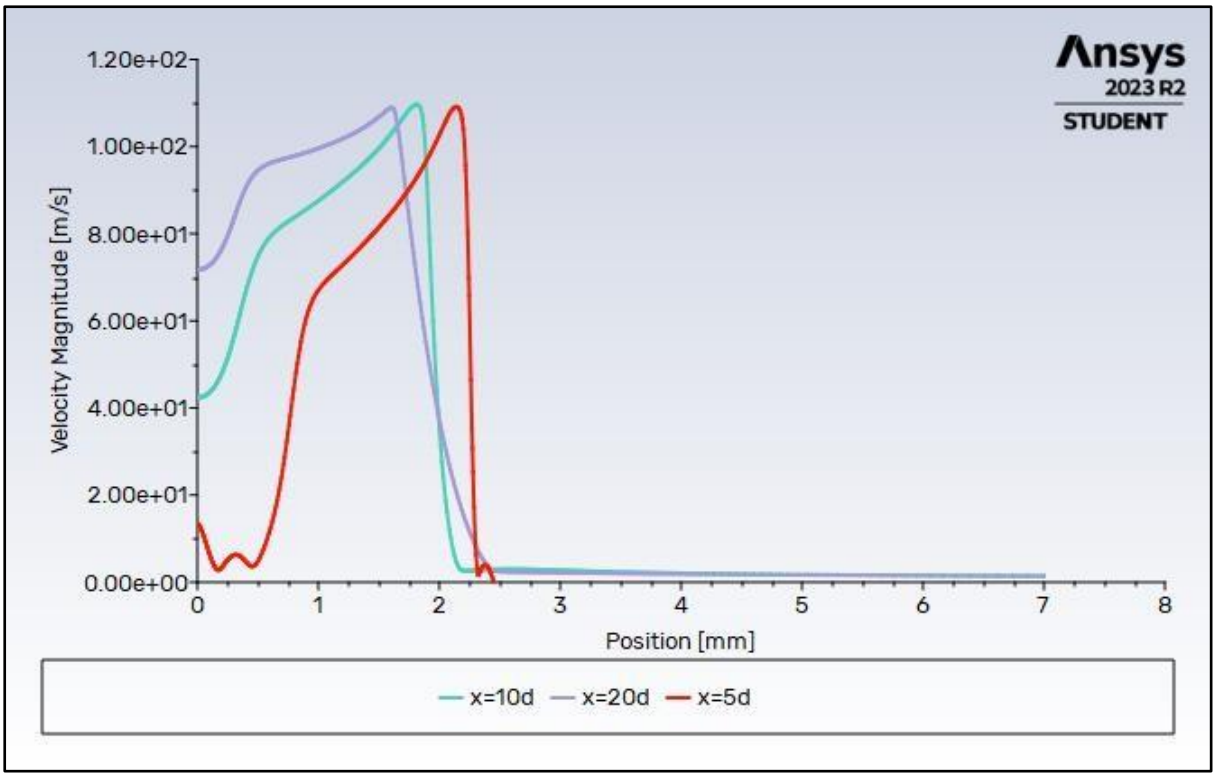


Contour of CH_3OH



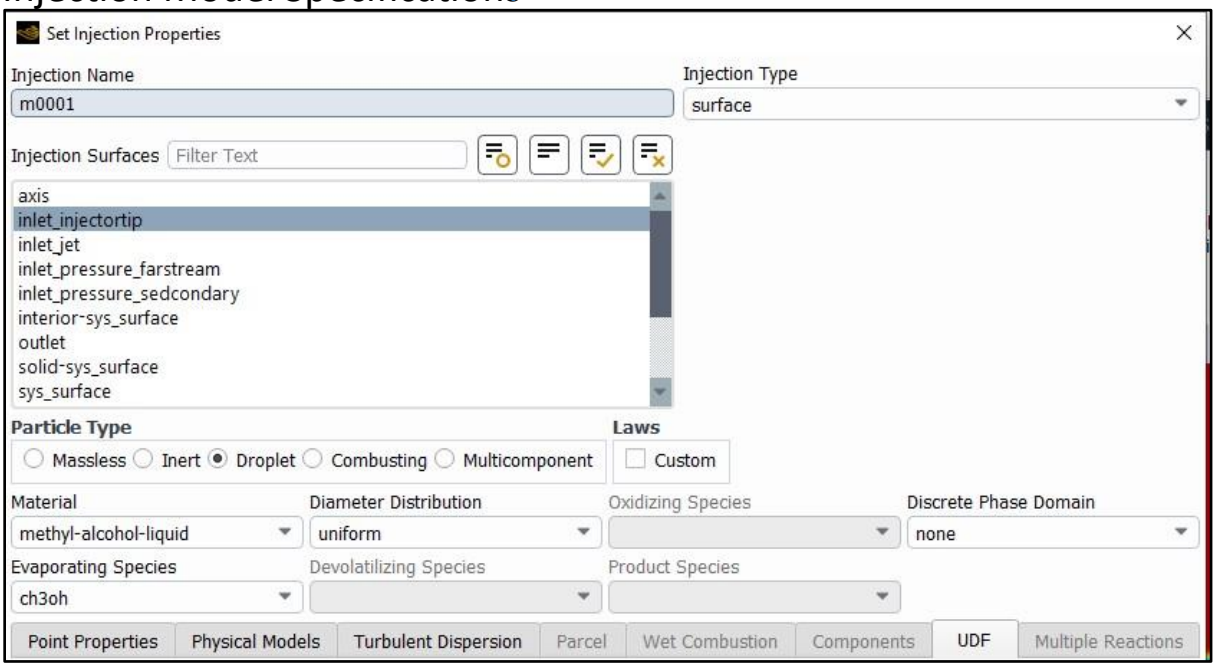
Contour of O_2

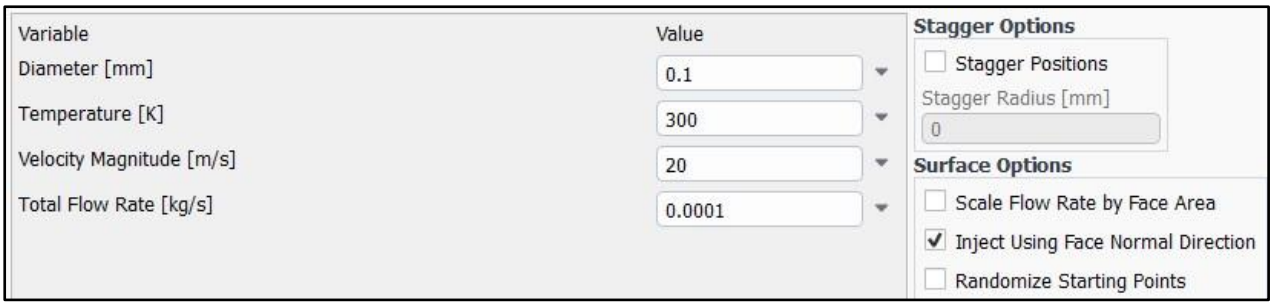
Velocity at x = 5d, 10d, and 20d:

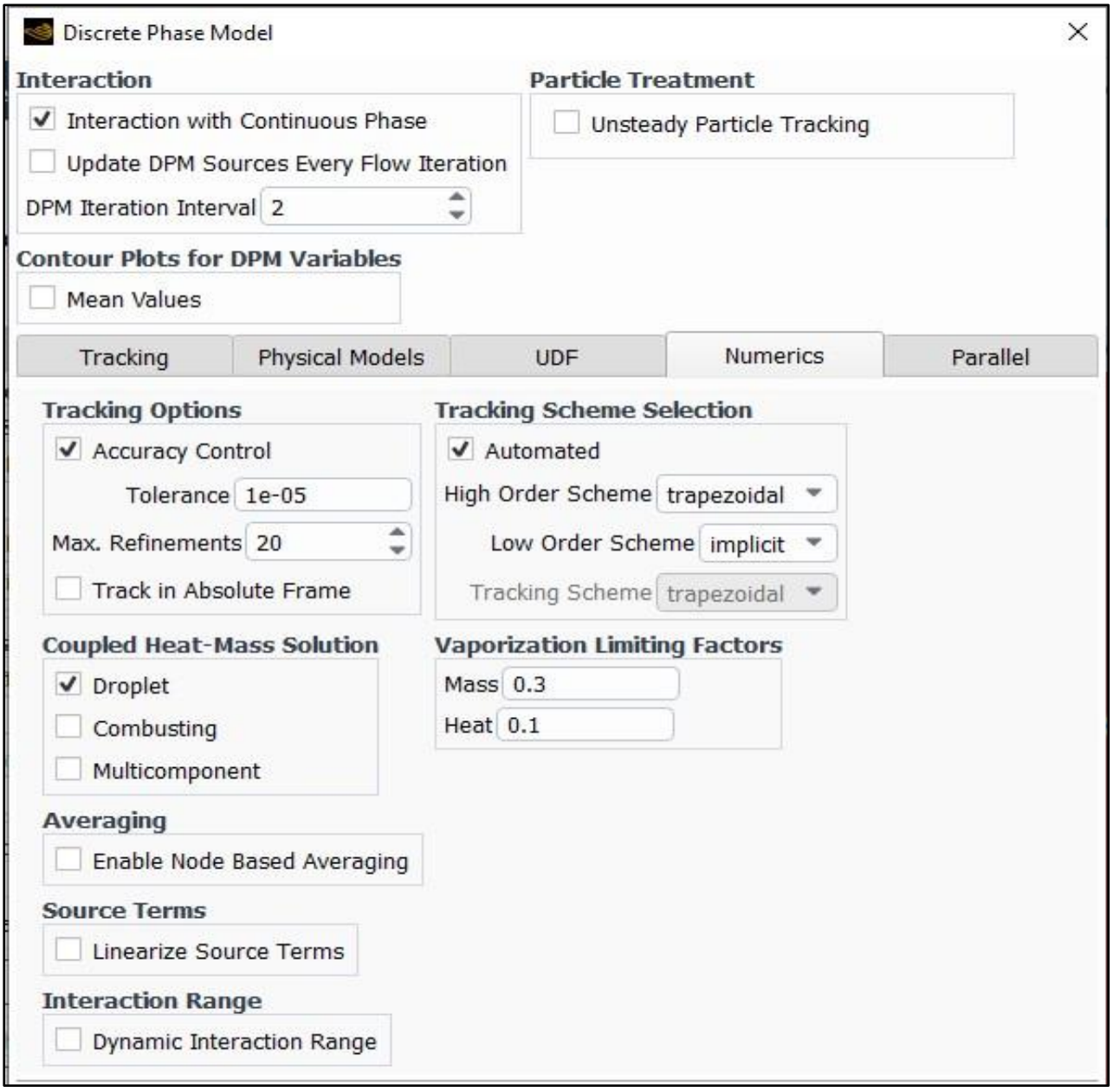


Model with droplet injection; with and without evaporation:

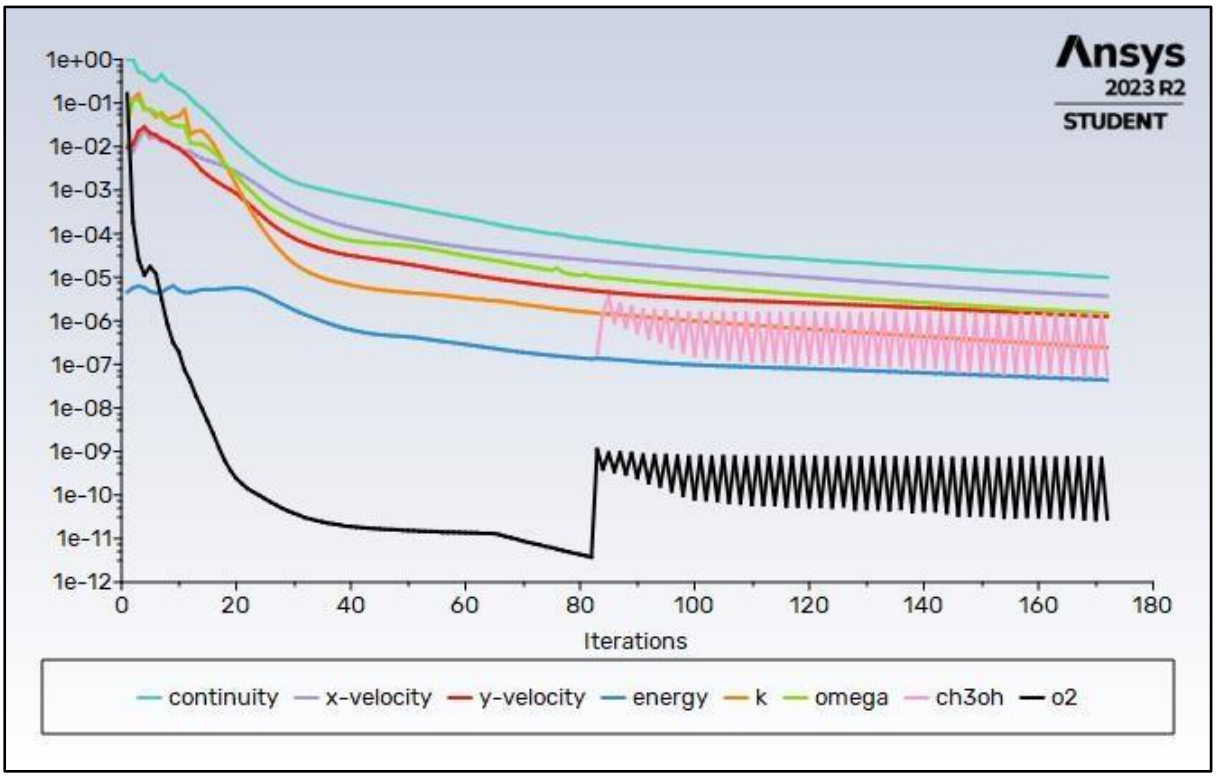
Injection Model Specifications



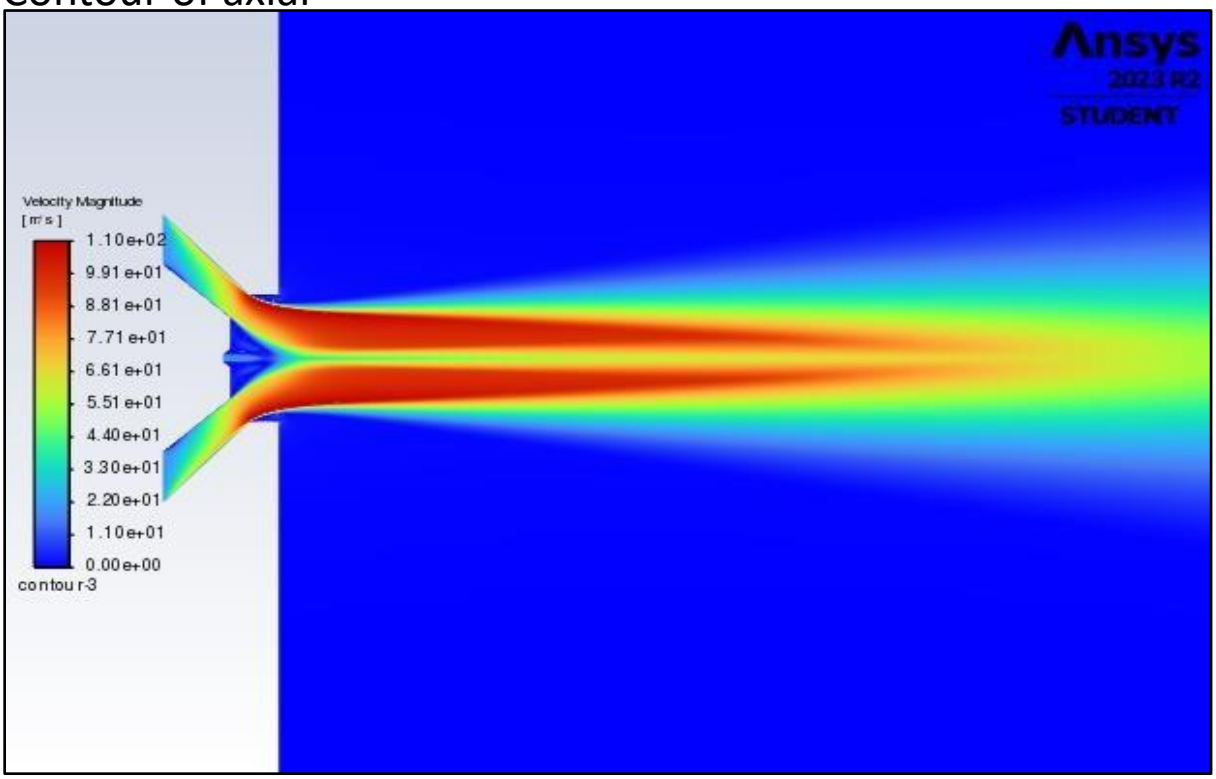

Variable
Value
Diameter [mm]
0.1
Temperature [K]
300
Velocity Magnitude [m/s]
20
Total Flow Rate [kg/s]
0.0001
Stagger Options
Stagger Positions
Stagger Radius [mm]
0
Surface Options
Scale Flow Rate by Face Area
Inject Using Face Normal Direction
Randomize Starting Points


Discrete Phase Model
Interaction
Interaction with Continuous Phase
Update DPM Sources Every Flow Iteration
DPM Iteration Interval 2
Particle Treatment
Unsteady Particle Tracking
Contour Plots for DPM Variables
Mean Values
Tracking
Physical Models
UDF
Numerics
Parallel
Tracking Options
Accuracy Control
Tolerance 1e-05
Max. Refinements 20
Track in Absolute Frame
Tracking Scheme Selection
Automated
High Order Scheme trapezoidal
Low Order Scheme implicit
Tracking Scheme trapezoidal
Coupled Heat-Mass Solution
Droplet
Combusting
Multicomponent
Vaporization Limiting Factors
Mass 0.3
Heat 0.1
Averaging
Enable Node Based Averaging
Source Terms
Linearize Source Terms
Interaction Range
Dynamic Interaction Range

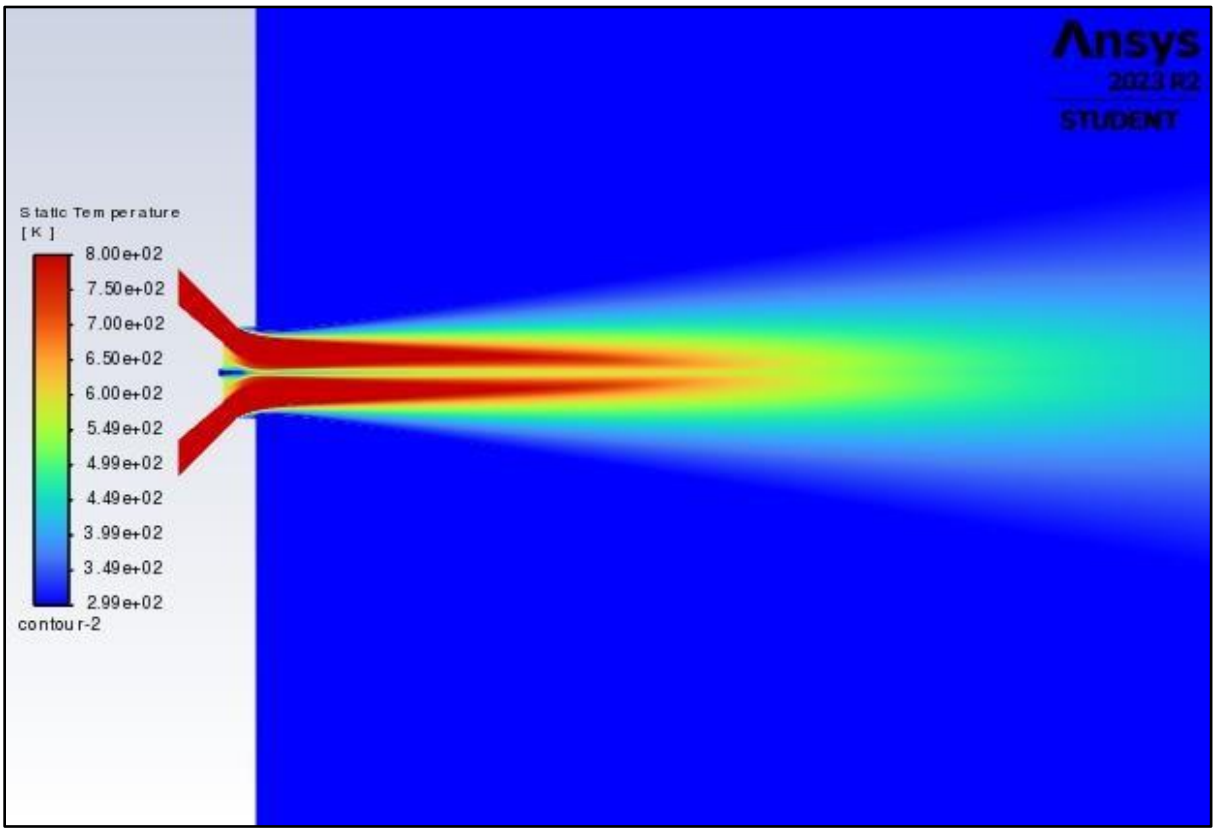
Convergence:



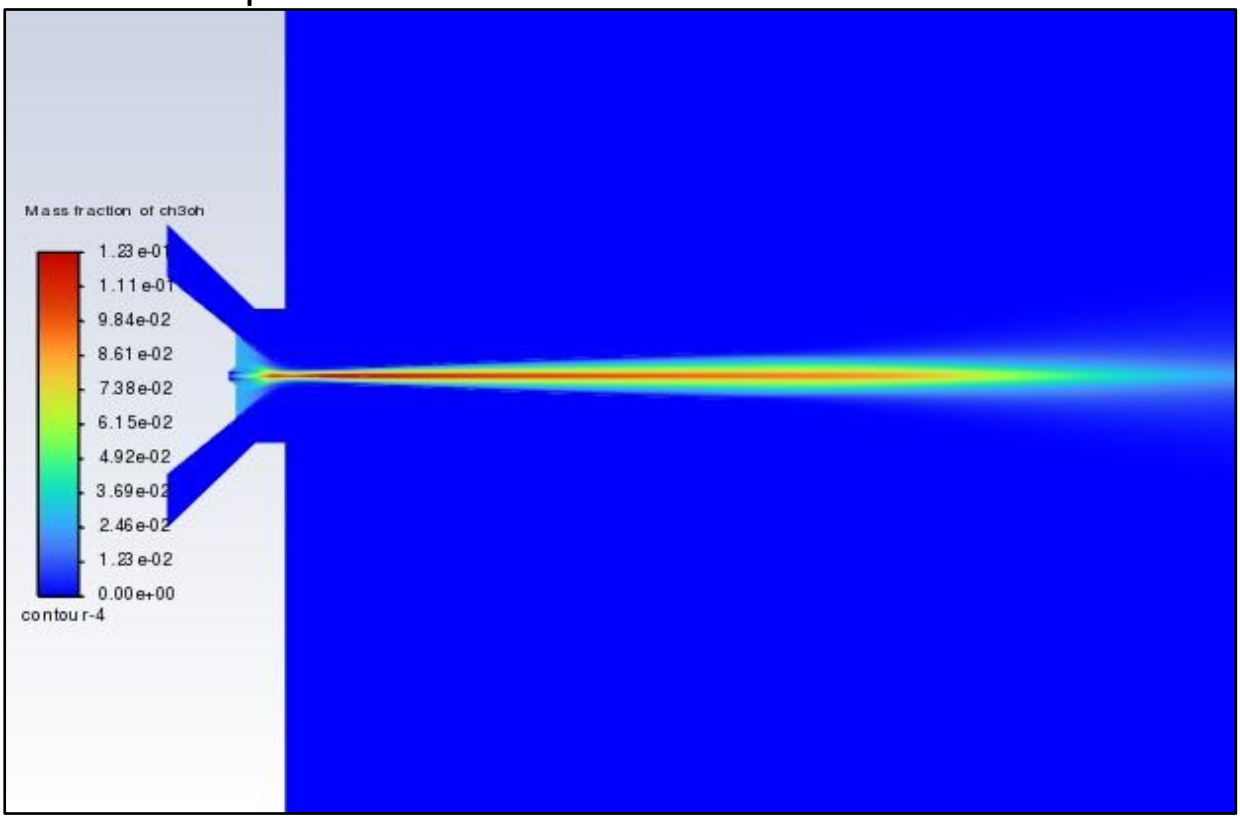
Contour of axial



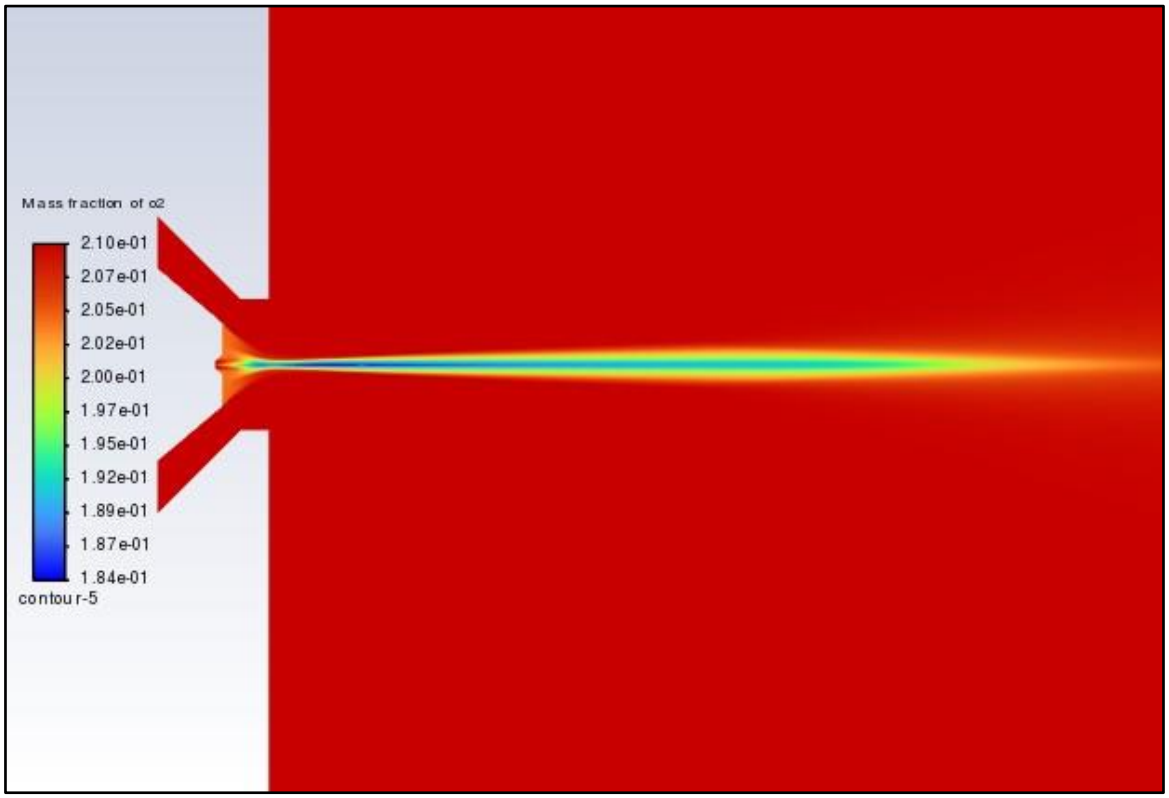
Contour of Temperature:



Contour of Species:

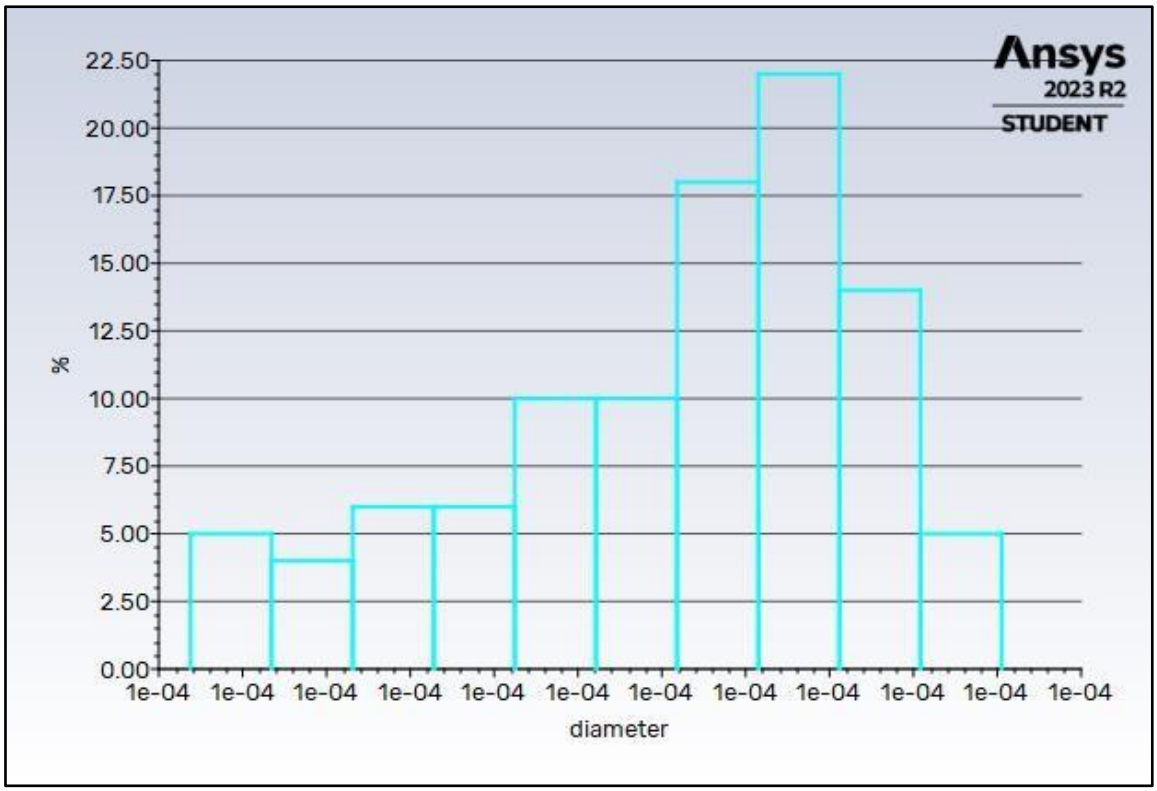


Contour of CH_3OH

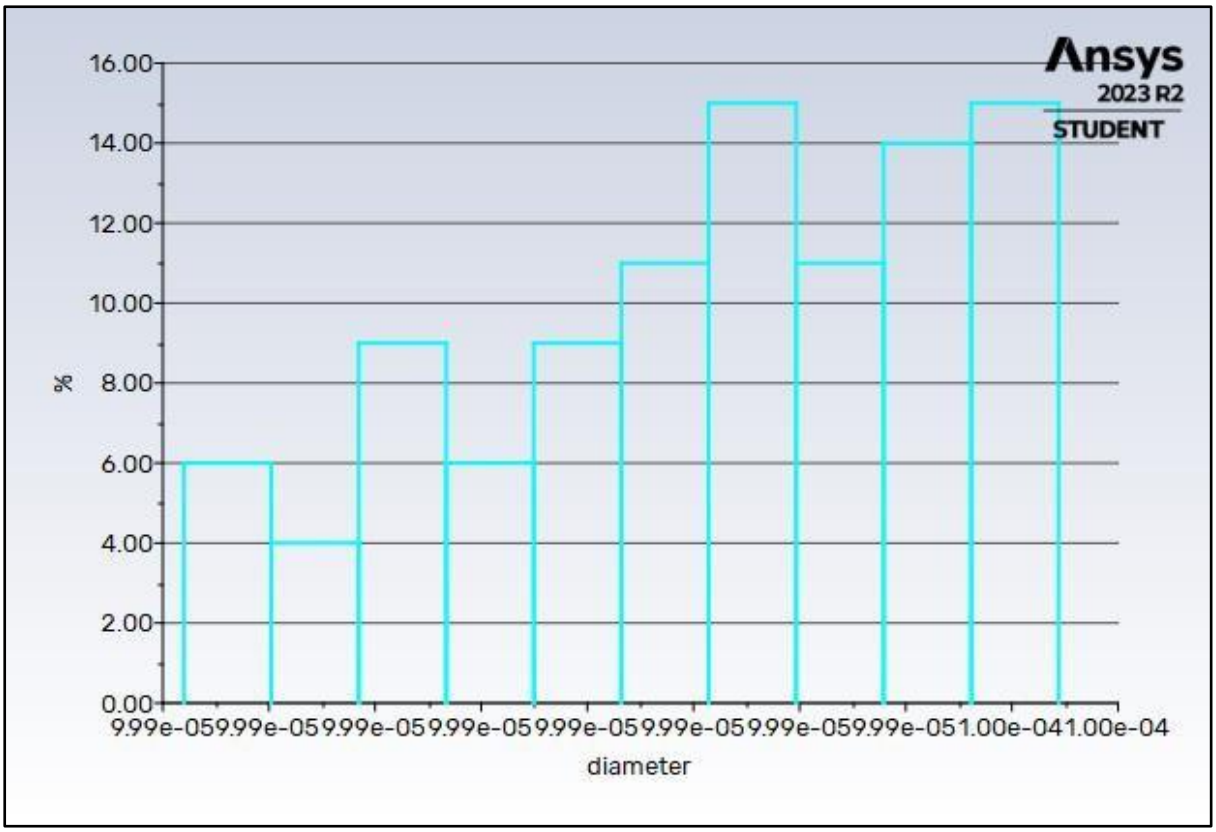


Contour of O_2

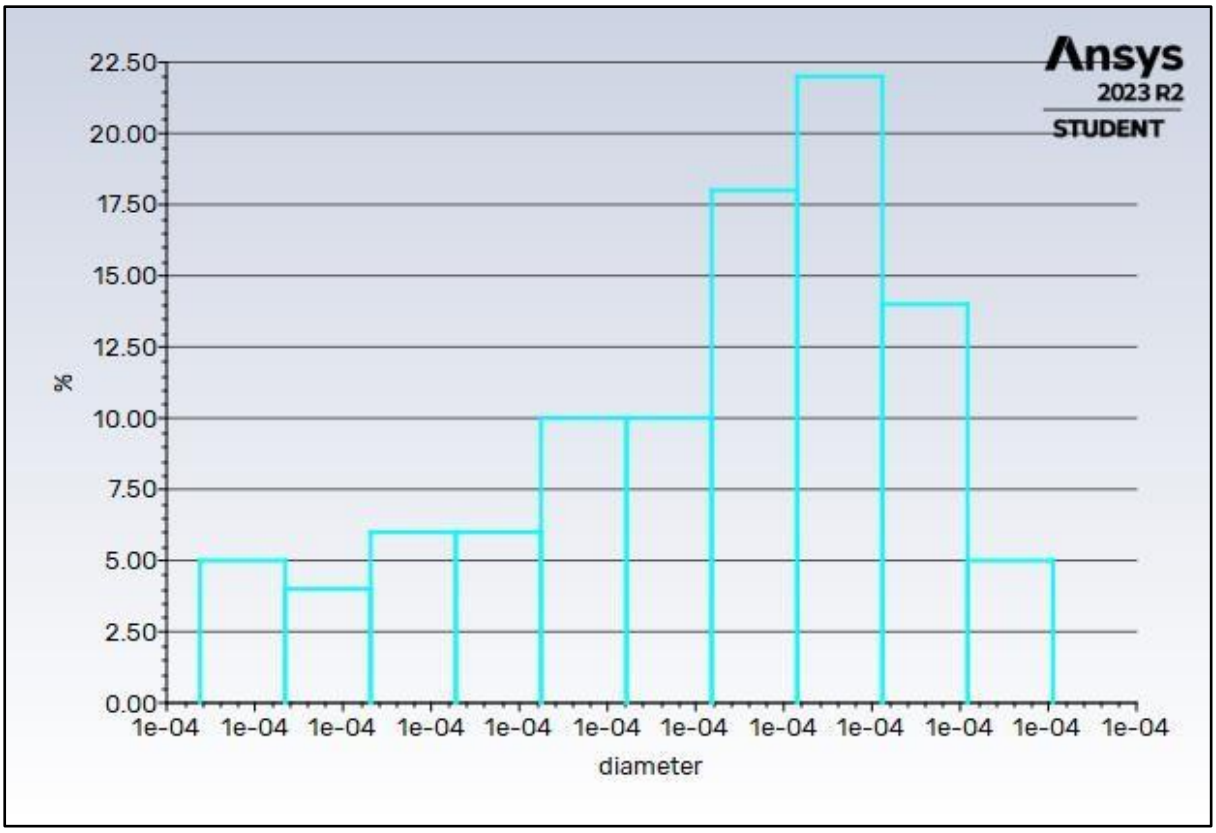
Droplet Histogram:



X = 5d

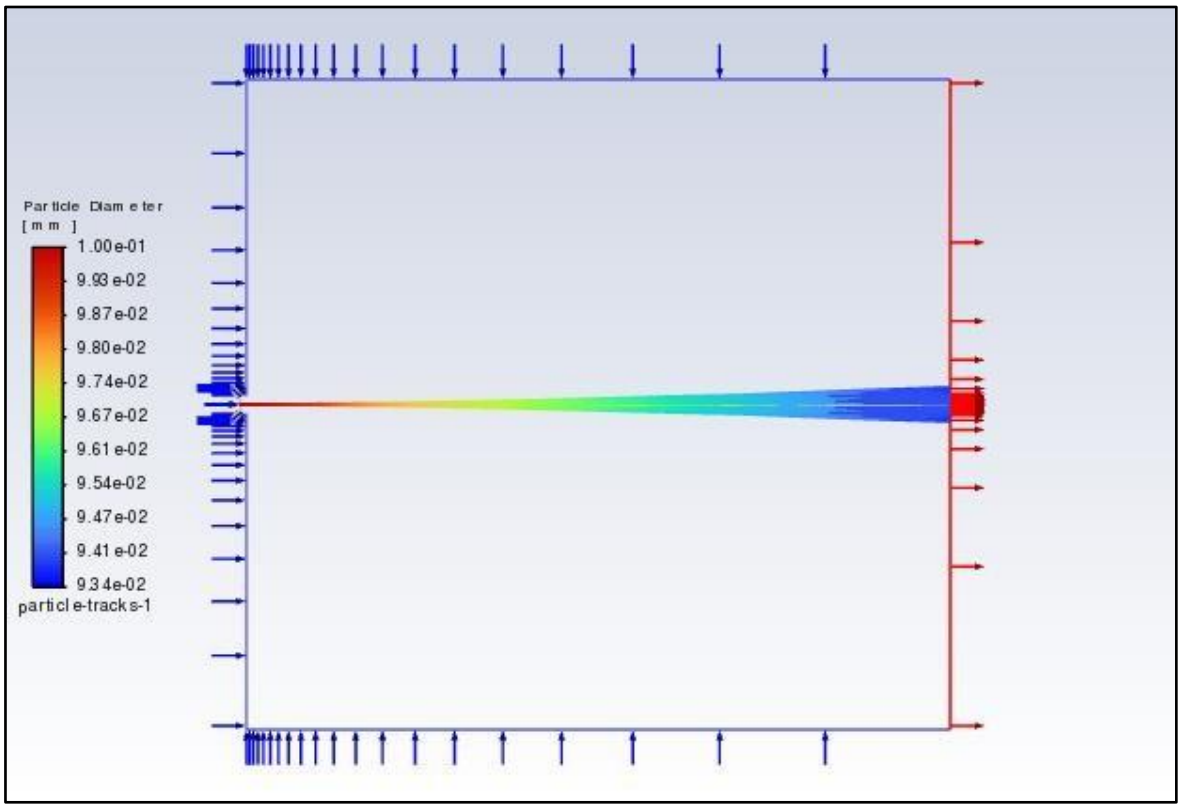

Ansys
2023 R2
STUDENT
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
%
9.99e-05
9.99e-05
9.99e-05
9.99e-05
9.99e-05
9.99e-05
9.99e-05
1.00e-04
1.00e-04
diameter

X = 10d

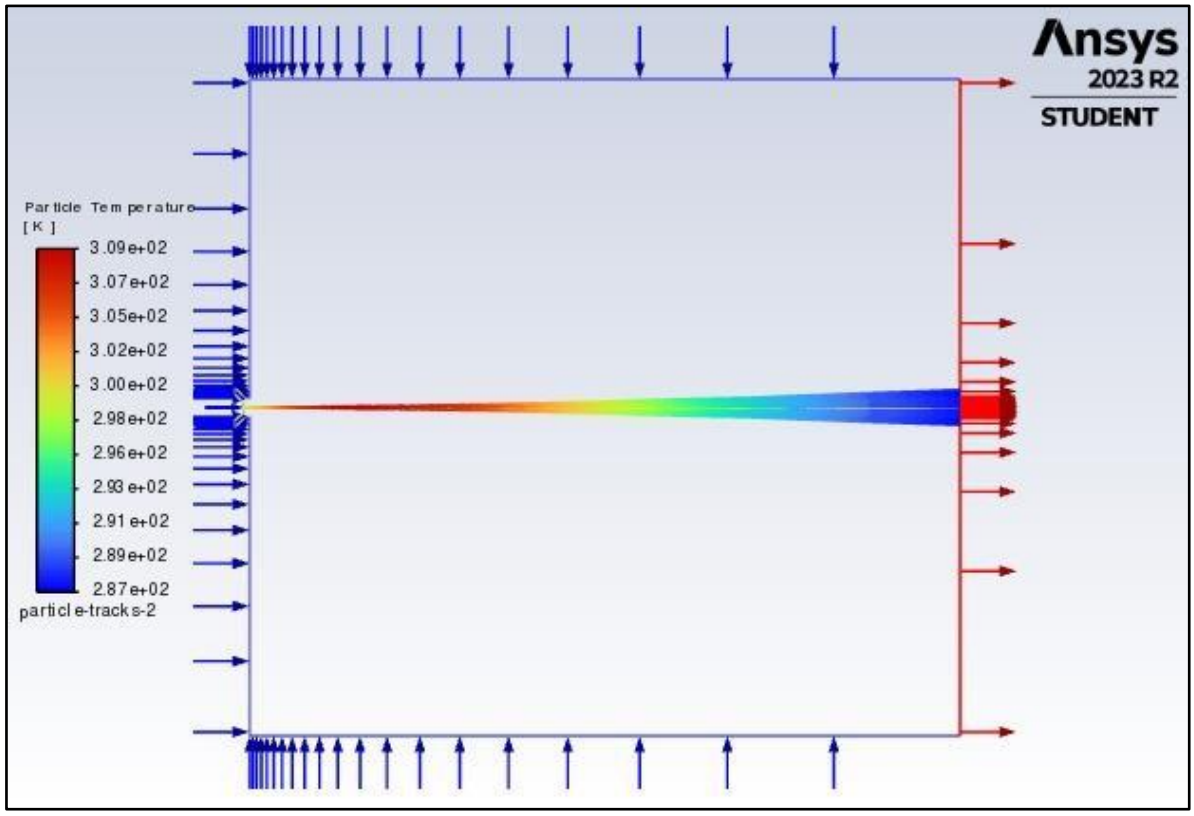

Ansys
2023 R2
STUDENT
22.50
20.00
17.50
15.00
12.50
10.00
7.50
5.00
2.50
0.00
%
1e-04
1e-04
1e-04
1e-04
1e-04
1e-04
1e-04
1e-04
1e-04
1e-04
1e-04
1e-04
diameter

X = 20d

Droplet tracking graph:



Particle Diameter

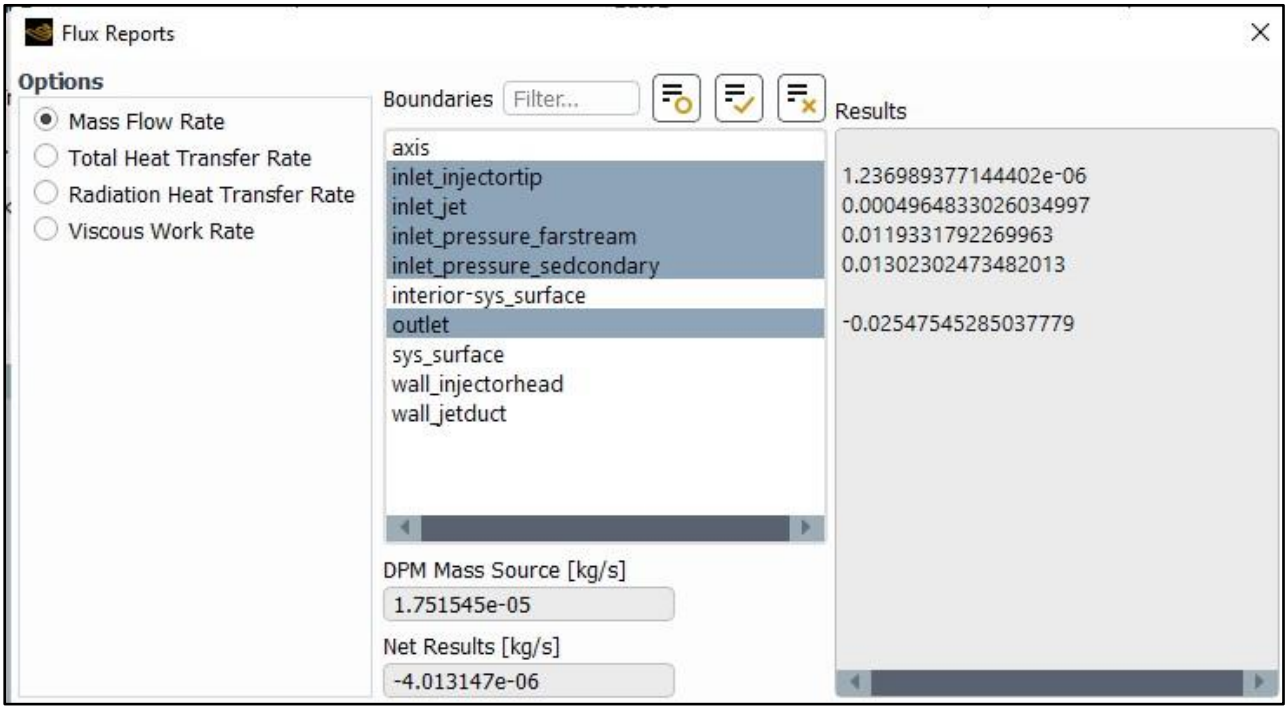


Particle Temperature

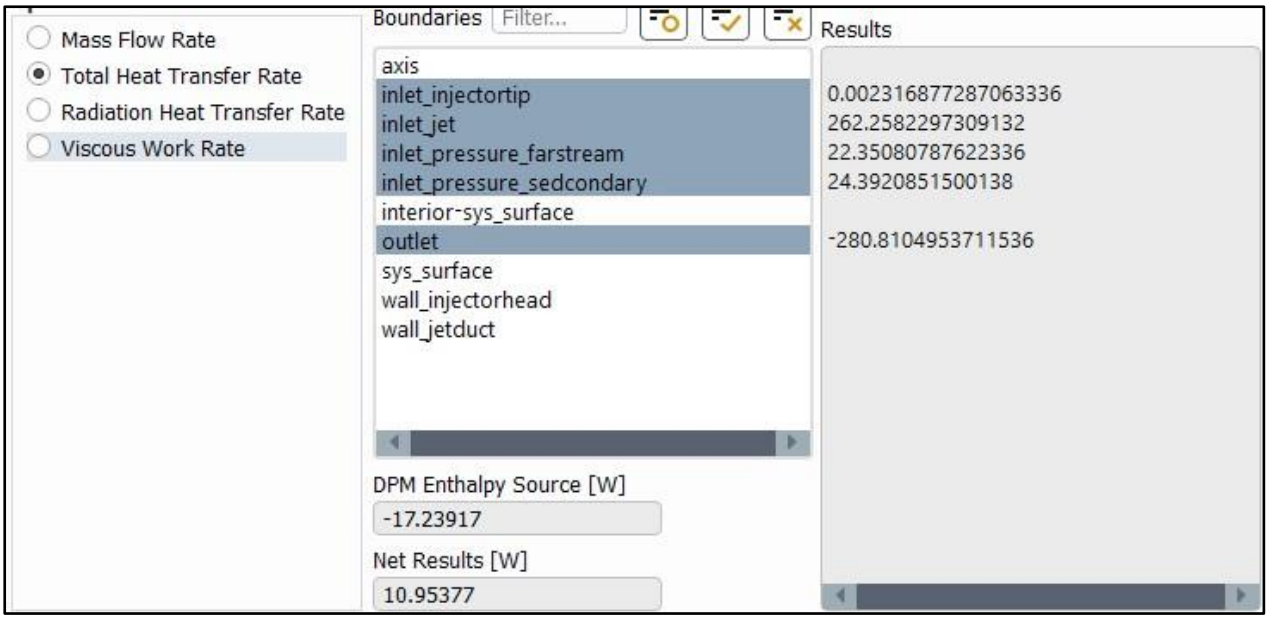
Report of Mass and Energy Balance:

Mass Flow Rate	[kg/s]
inlet_injectortip	1.2369894e-06
inlet_jet	0.0004964833
inlet_pressure_farstream	0.011933179
inlet_pressure_sedcondary	0.013023025
outlet	-0.025475453
DPM Mass Source	1.751545e-05
Net	-4.0131467e-06

Total Heat Transfer Rate	[W]
inlet_injectortip	0.0023168773
inlet_jet	262.25823
inlet_pressure_farstream	22.350808
inlet_pressure_sedcondary	24.392085
outlet	-280.8105
DPM Enthalpy Source	-17.23917
Net	10.953775

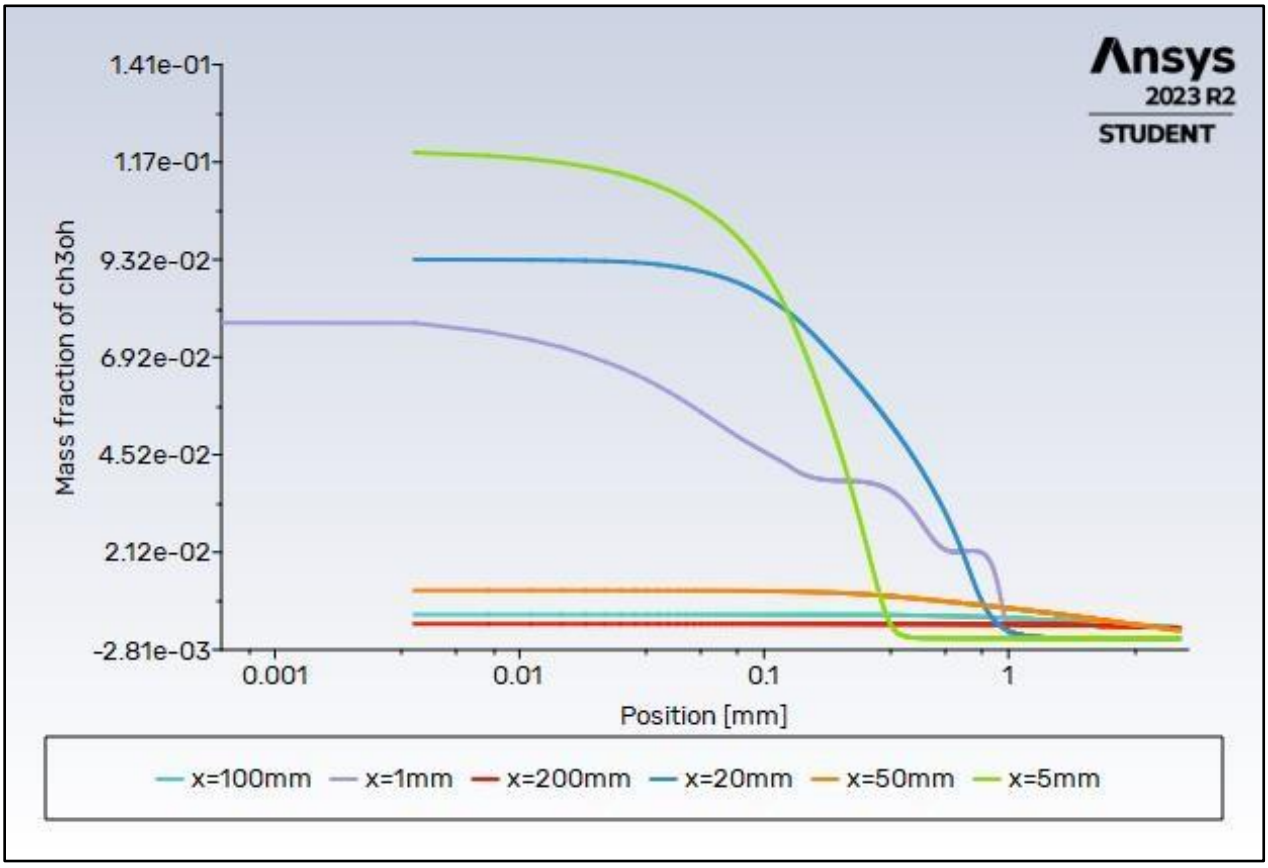


Mass Balance Report



Energy Balance report

Mass Fraction of CH_3OH:



Summary:

The flow's maximum velocity is approximately 110 m/s, which falls short of Mach 0.3, where the velocity reaches 170.08 m/s.

When droplet particles are introduced, they absorb energy from the surrounding fluid, leading to a drop in temperature near the axis line.

Along the axis line, the injection of droplets causes a reduction in flow velocity compared to scenarios lacking injection. This decline may stem from droplets absorbing energy from nearby particles, triggering evaporation and subsequently reducing velocity in the surrounding region.

Increasing the reference pressure will diminish the evaporation rate as the thermal energy required to surpass the boiling point escalates.

Lowering pressure and elevating temperature will amplify the evaporation rate. Moreover, a heightened inlet mass flow rate will bolster evaporation.