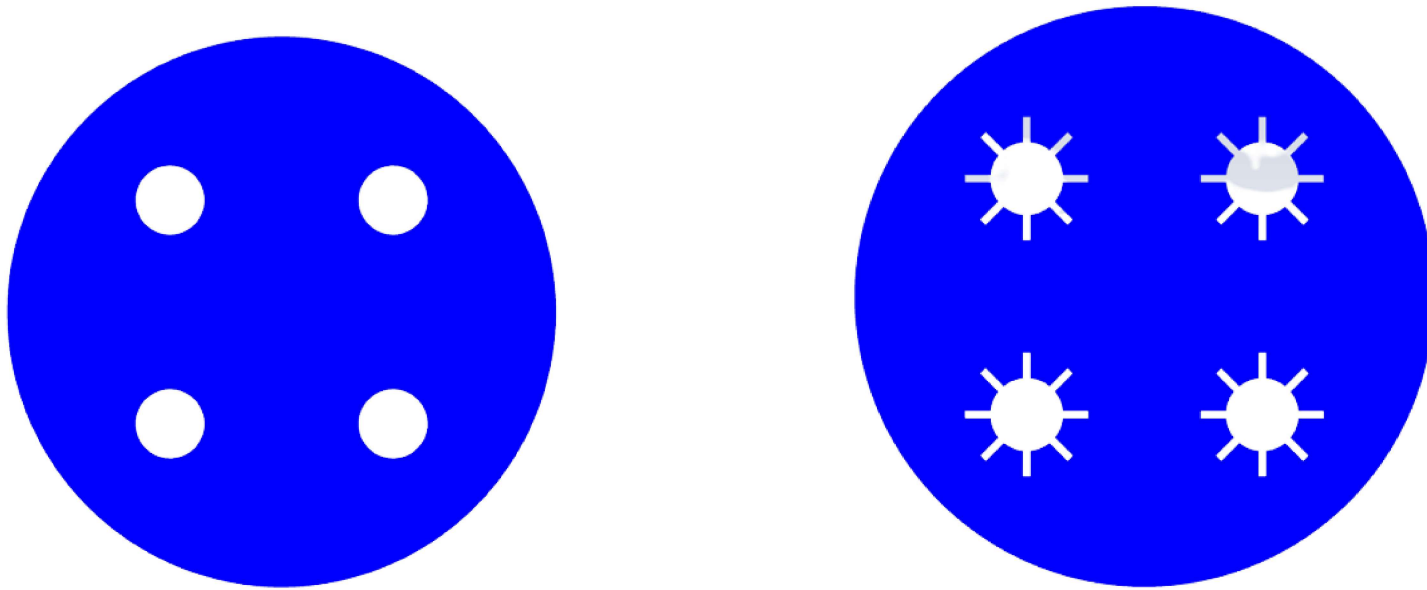

Enhancement of TMS in PCM charged heat exchanger

Aditya Birla

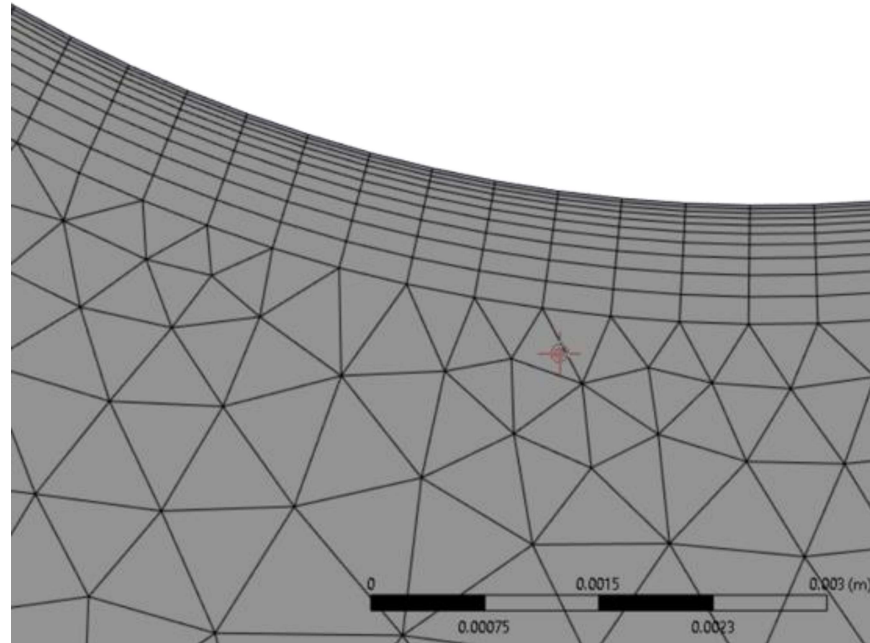
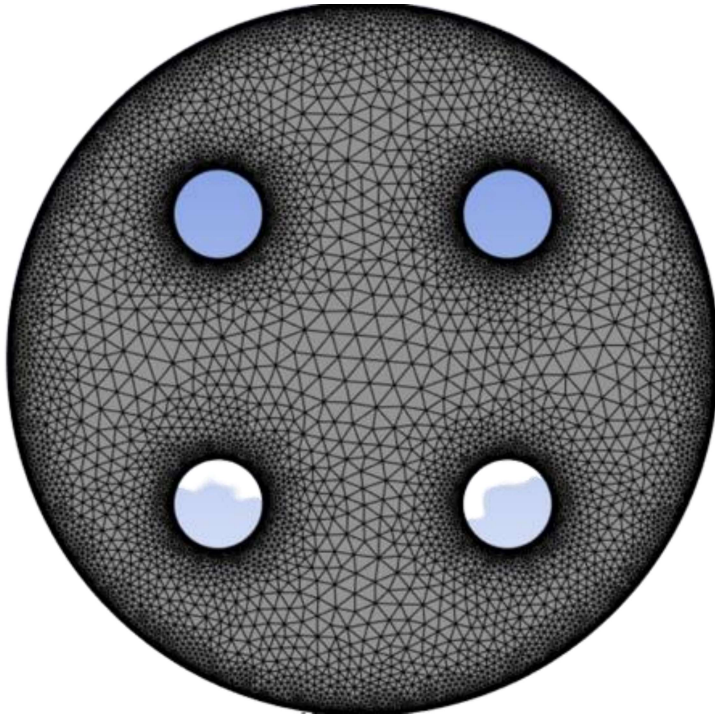
211116439

Objective

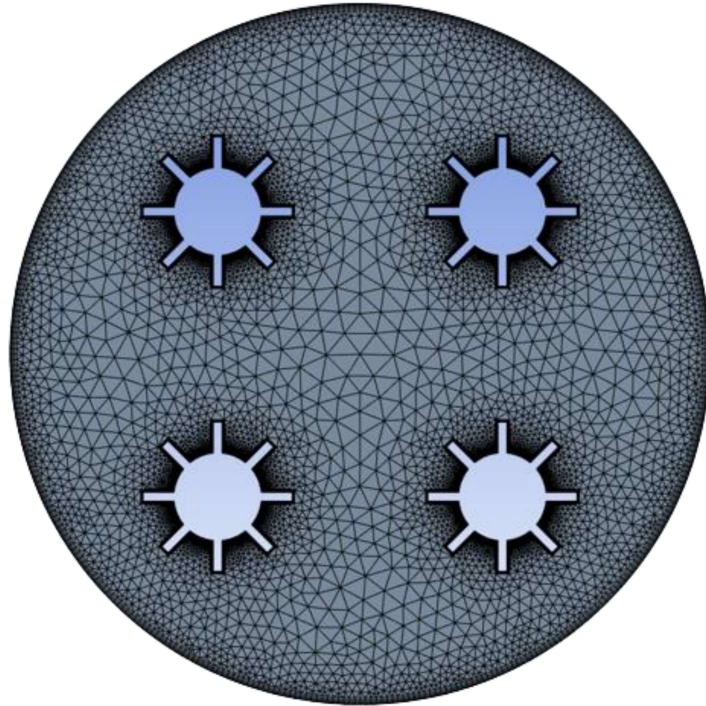
To estimate the performance capability of heat exchanger, charged with PCM (gallium) material in the shell region, with and without fin.



Meshing



Meshing

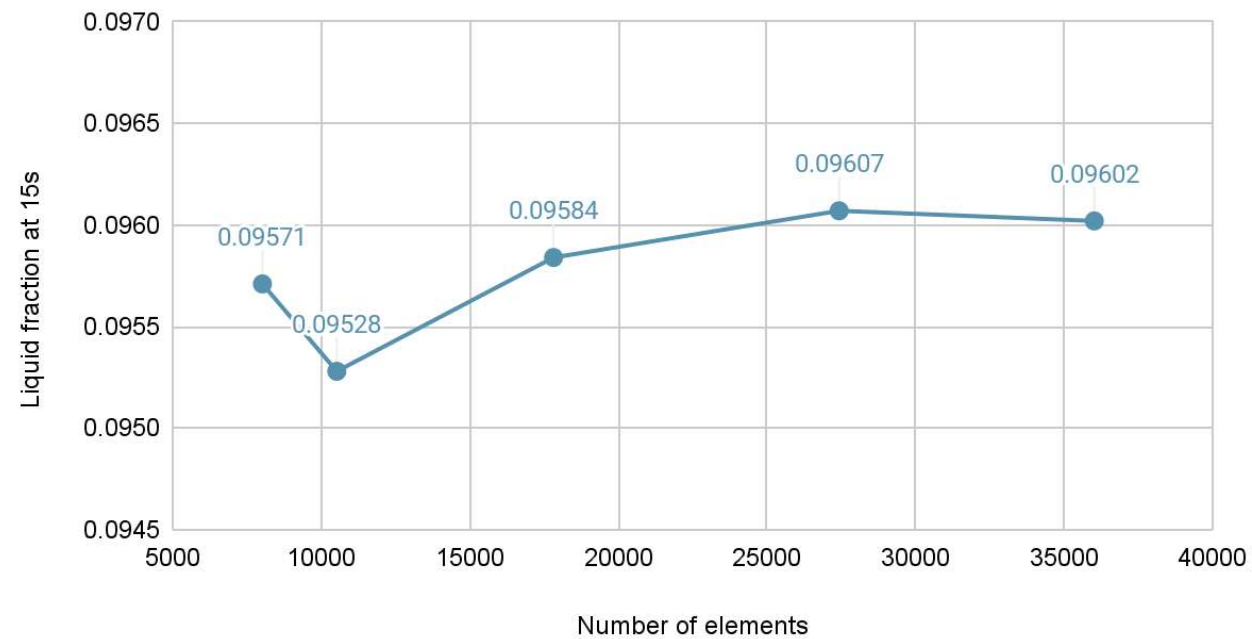


Meshing quality and inflation

[-] Quality	
Check Mesh Quality	Yes, Errors
<input type="checkbox"/> Target Skewness	Default (0.9)
Smoothing	Medium
Mesh Metric	Element Quality
<input type="checkbox"/> Min	0.10598
<input type="checkbox"/> Max	1.
<input type="checkbox"/> Average	0.63723

Mesh independent study

Mesh Study

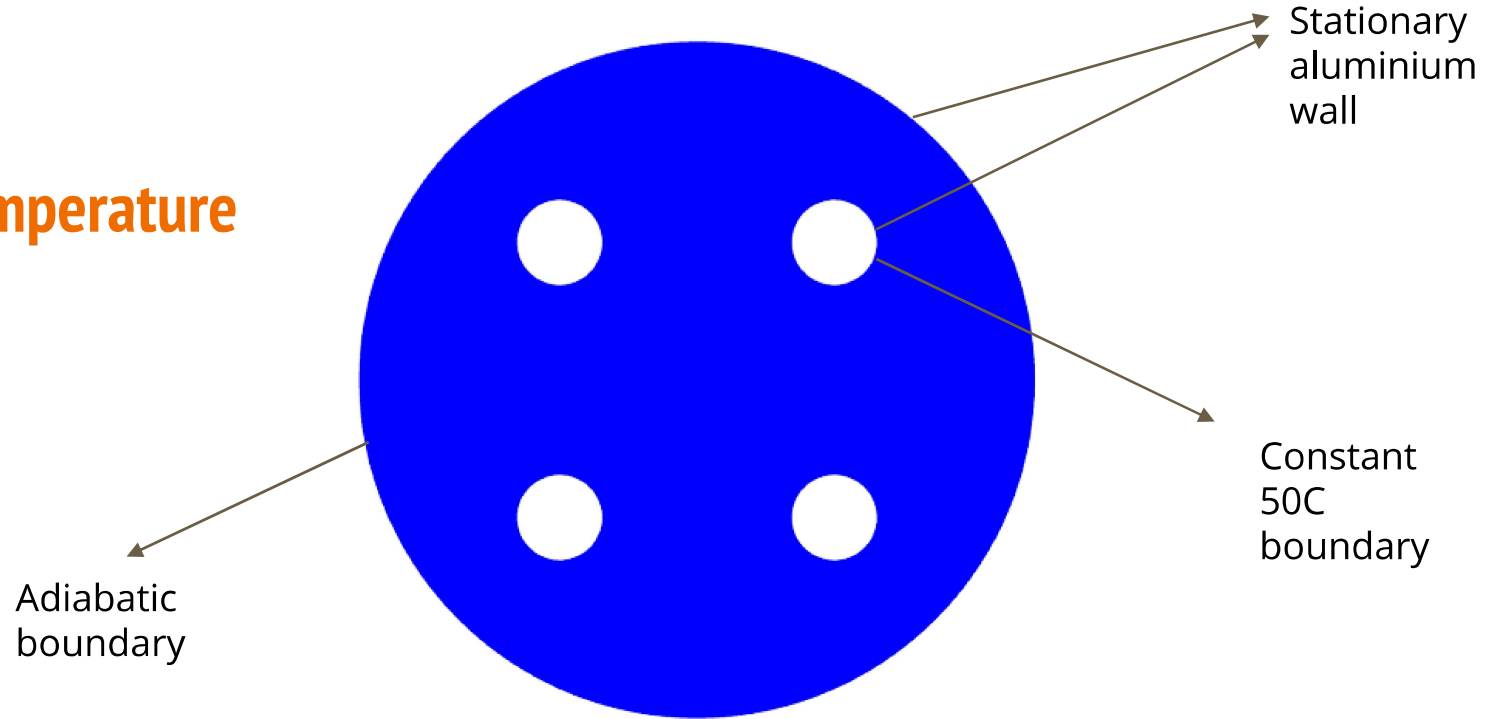


Setup

- Transient
 - Viscous(Laminar) model (movement of gallium in melting region is laminar)
 - Gravity (-9.81 m/s^2) in y direction
 - Boussinesq approximation for density
 - PCM material is gallium
 - Melting point of gallium = 29.2 C
-

Boundary Condition

Initial temperature
27C



Calculation settings

Run Calculation

Check Case...

Preview Mesh Mo

Time Advancement

Type

Fixed

Method

User-Specified

Parameters

Number of Time Steps

7500

Time Step Size [s]

0.08

Max Iterations/Time Step

20

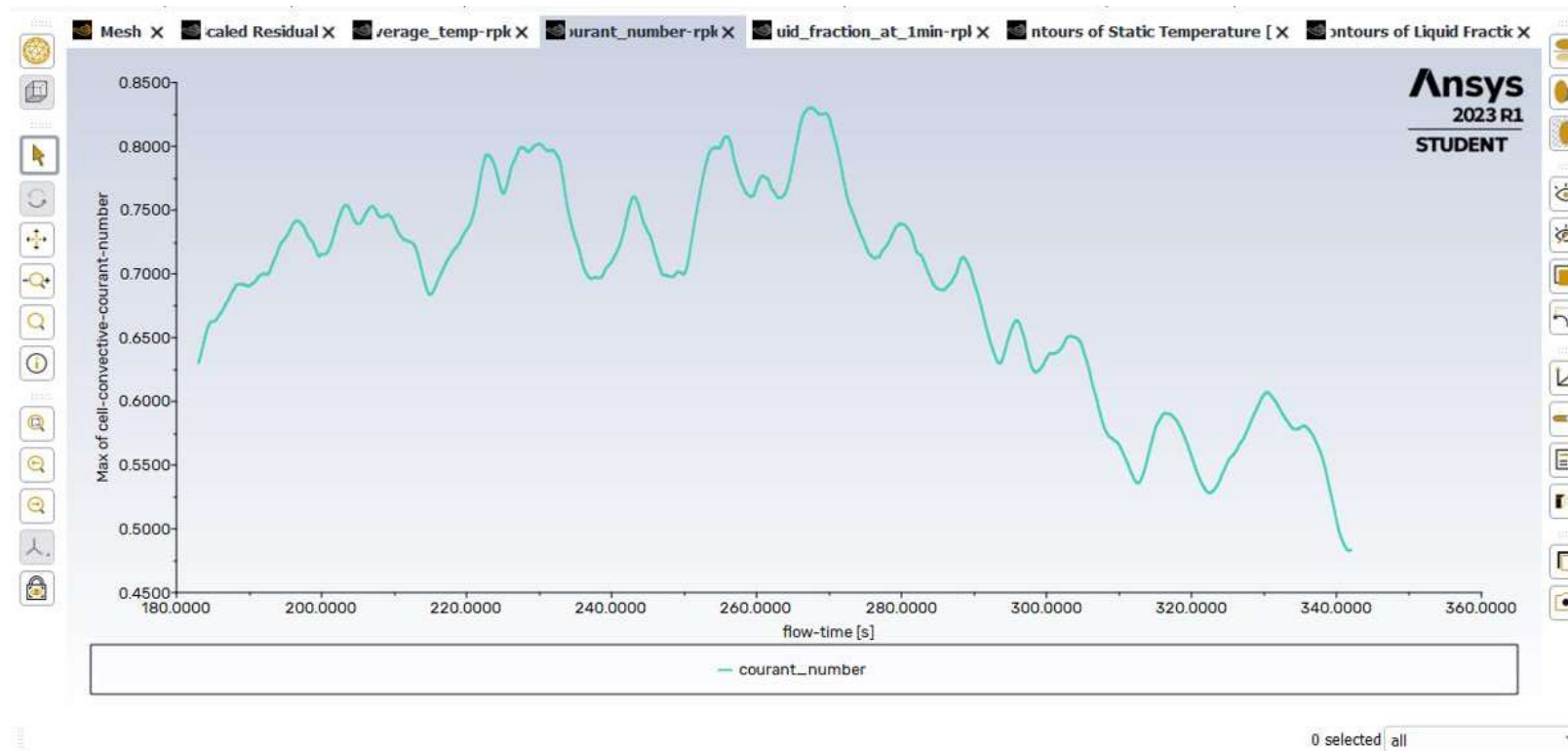
Reporting Interval

1

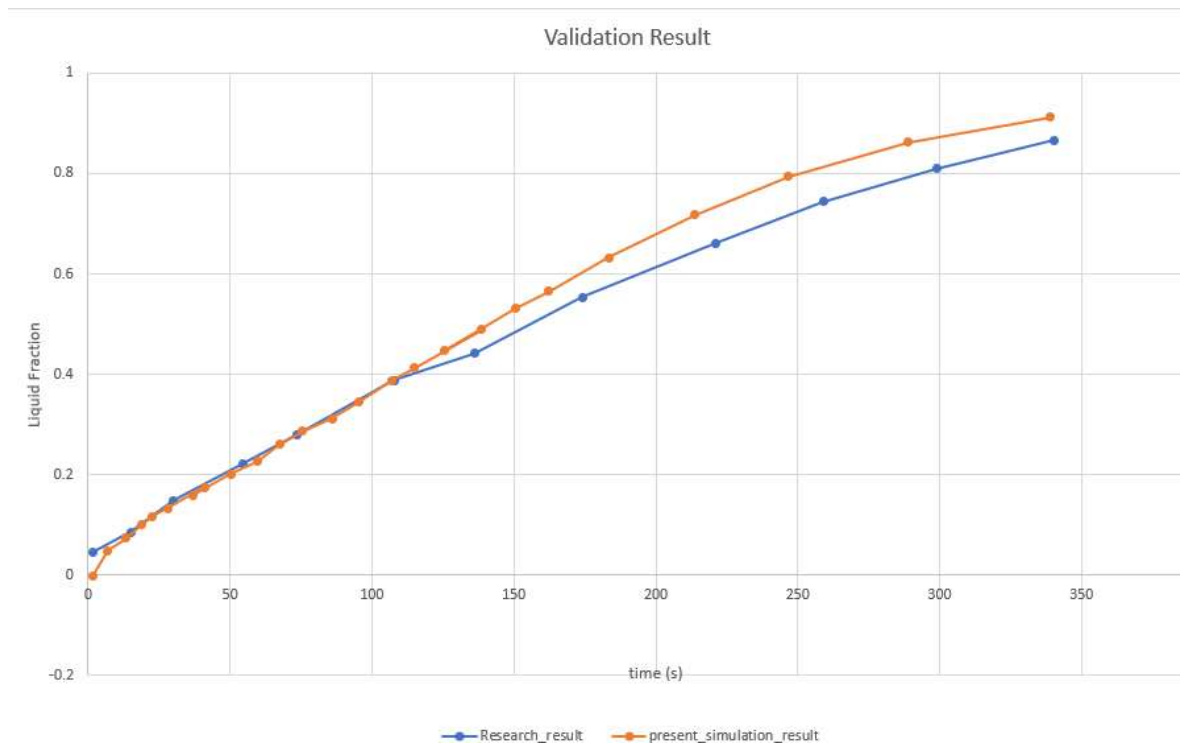
Profile Update Interval

1

Courant number for previous step size



Validation



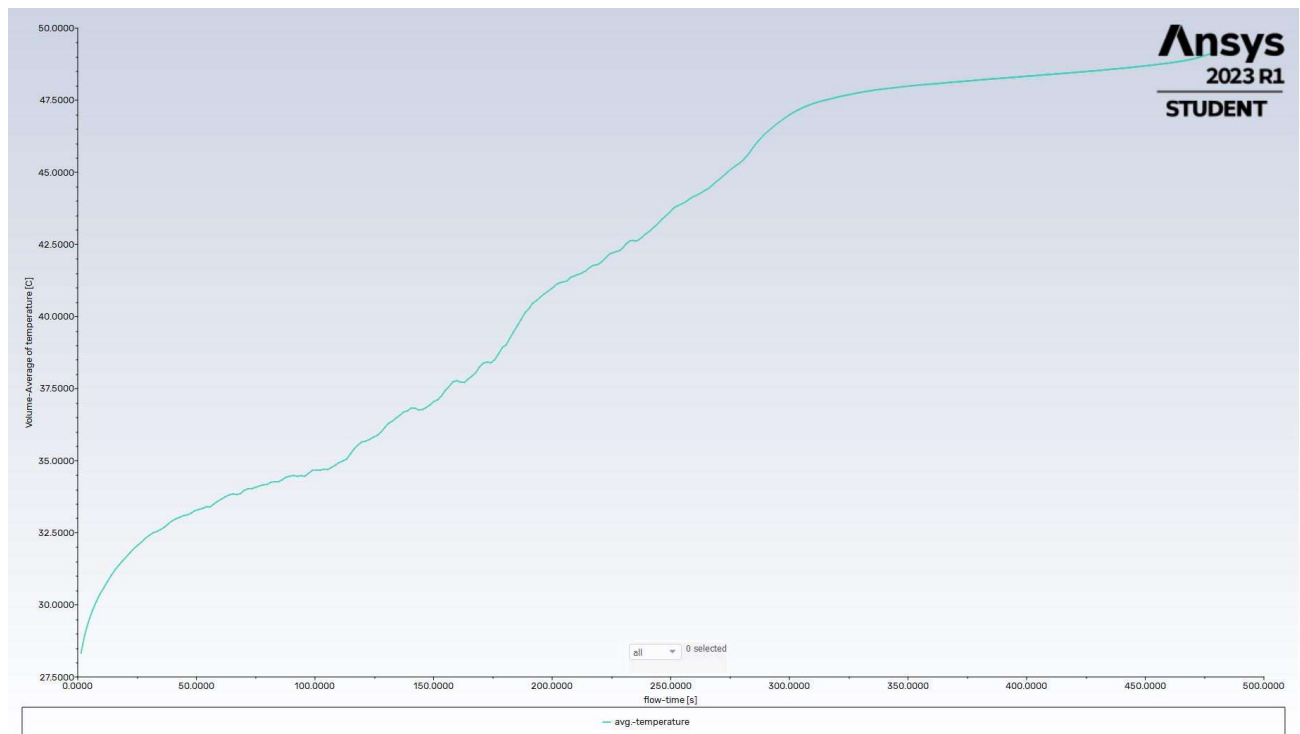
Ref - S. Rana, M. Zunaid, R. Kumar Case Studies in Thermal Engineering 33 (2022) 101921

Result

Time taken for liquid fraction to reach 1

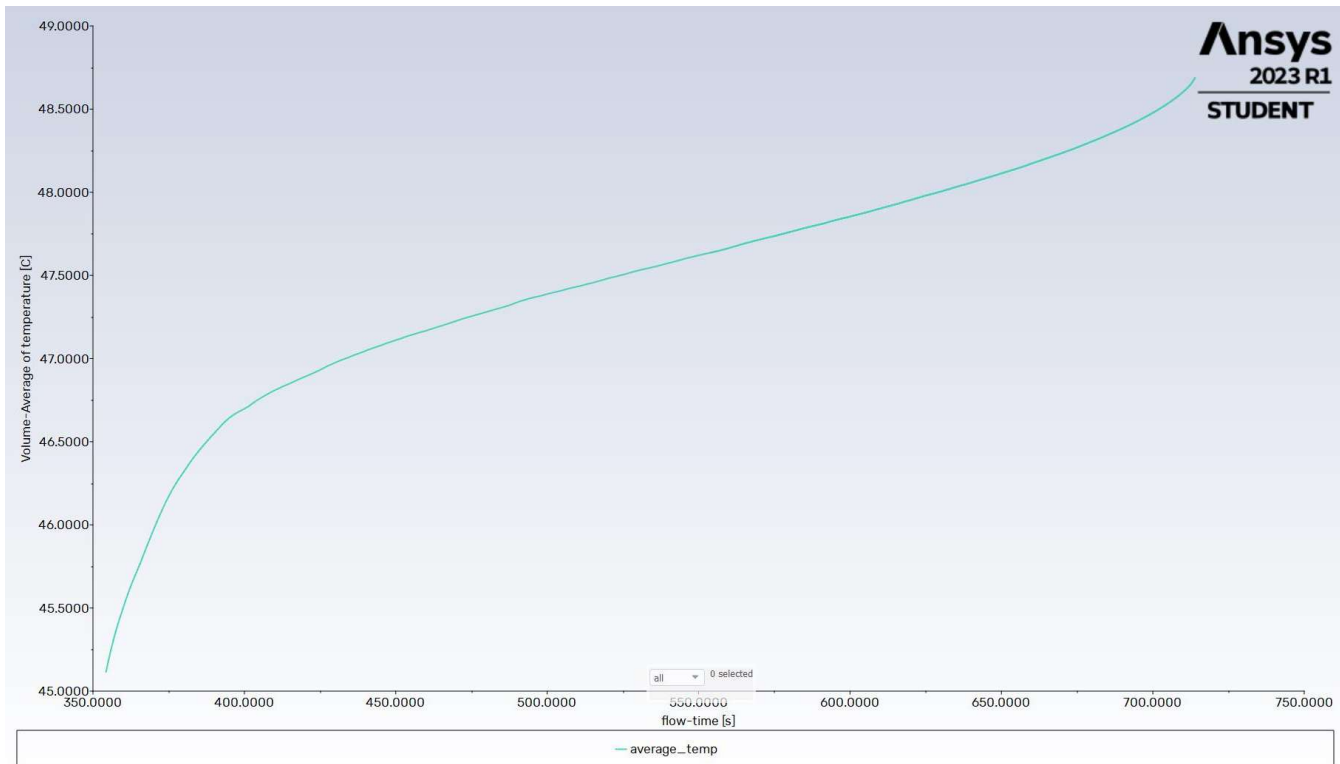
- Without fin = 719s
 - With hex fin = 481s
-

Result



Average temperature hex finned pipe

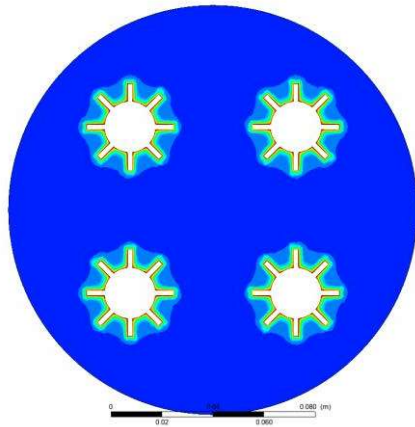
Result



Average temperature without fin

Temperature
temperature
[K]

3.231e+02
3.215e+02
3.199e+02
3.182e+02
3.166e+02
3.149e+02
3.133e+02
3.116e+02
3.100e+02
3.084e+02
3.067e+02
3.051e+02
3.034e+02
3.018e+02
3.001e+02



Ansys
2023 R1
STUDENT

1s

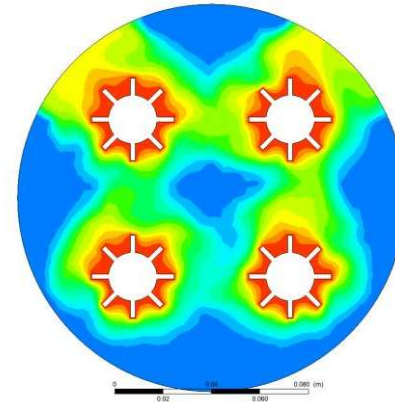


Temperature
Contour

140s

Temperature
temperature
[K]

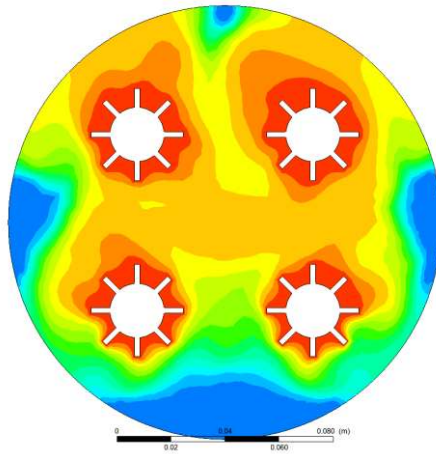
3.231e+02
3.215e+02
3.199e+02
3.182e+02
3.166e+02
3.149e+02
3.133e+02
3.116e+02
3.100e+02
3.084e+02
3.067e+02
3.051e+02
3.034e+02
3.018e+02
3.001e+02



Ansys
2023 R1
STUDENT

Temperature
temperature
[K]

3.231e+02
3.215e+02
3.199e+02
3.182e+02
3.166e+02
3.149e+02
3.133e+02
3.116e+02
3.100e+02
3.084e+02
3.067e+02
3.051e+02
3.034e+02
3.018e+02
3.001e+02



Ansys
2023 R1
STUDENT

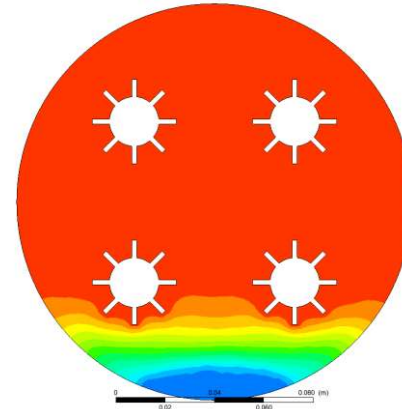
240s



340s

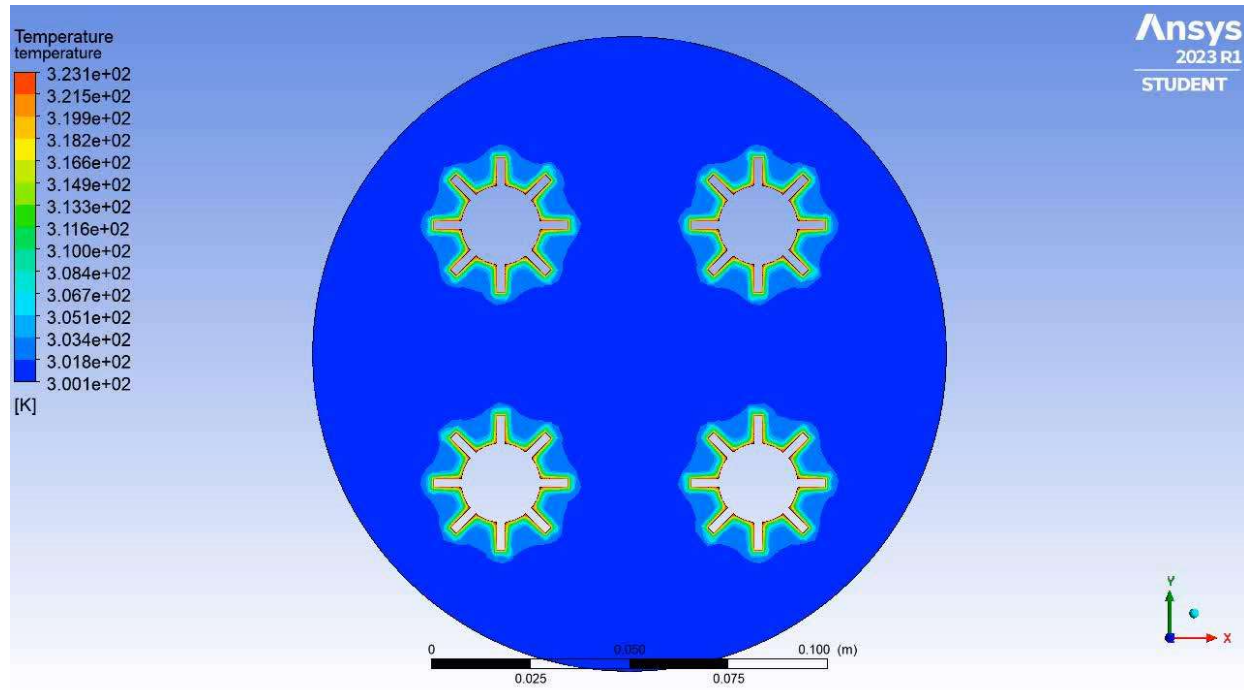
Temperature
temperature
[K]

3.231e+02
3.215e+02
3.199e+02
3.182e+02
3.166e+02
3.149e+02
3.133e+02
3.116e+02
3.100e+02
3.084e+02
3.067e+02
3.051e+02
3.034e+02
3.018e+02
3.001e+02



Ansys
2023 R1
STUDENT

Result



Reference

- Ref - S. Rana, M. Zunaid, R. Kumar Case Studies in Thermal Engineering 33 (2022) 101921
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