Enhancement of TMS in PCM charged heat exchanger

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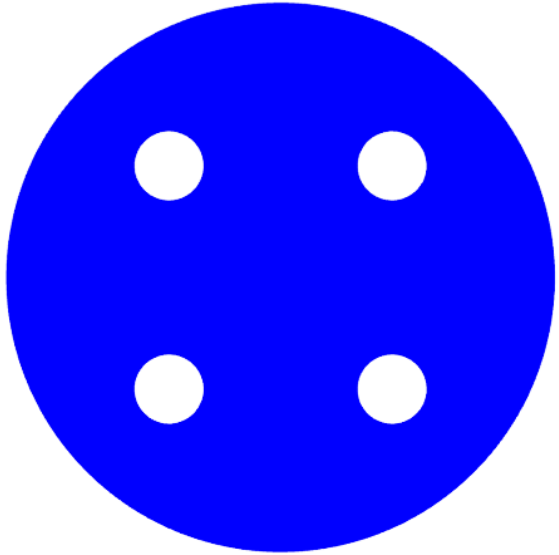
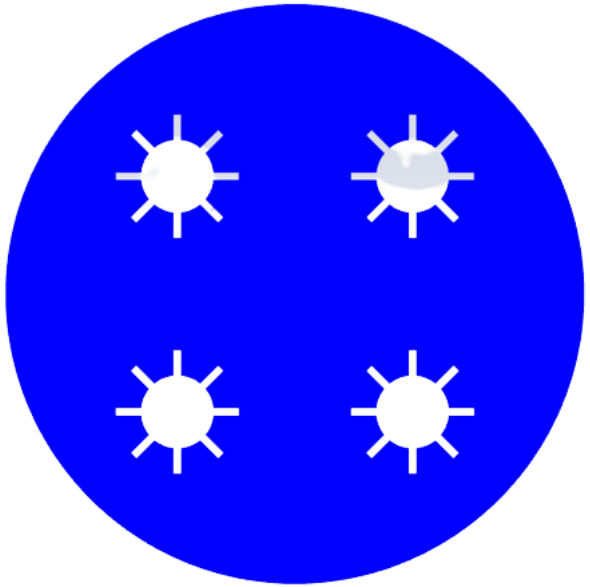
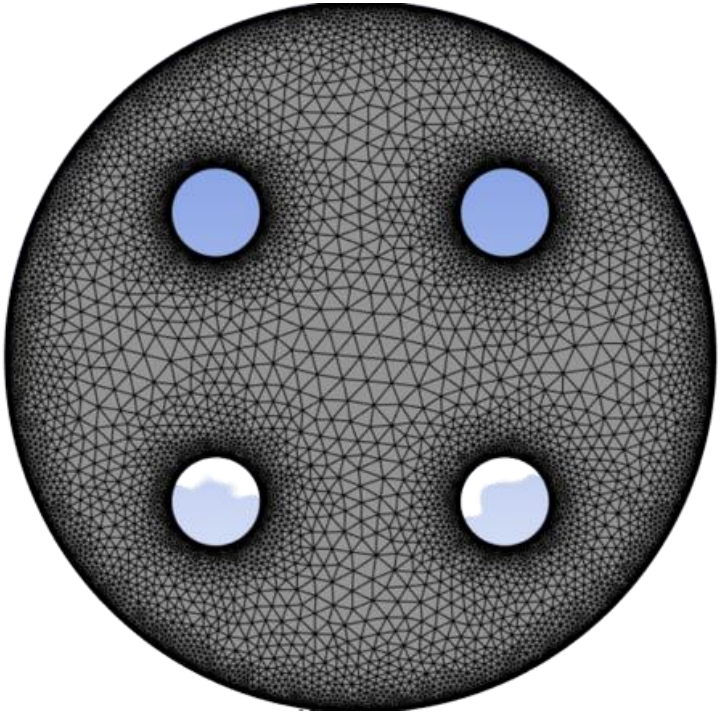
Objective

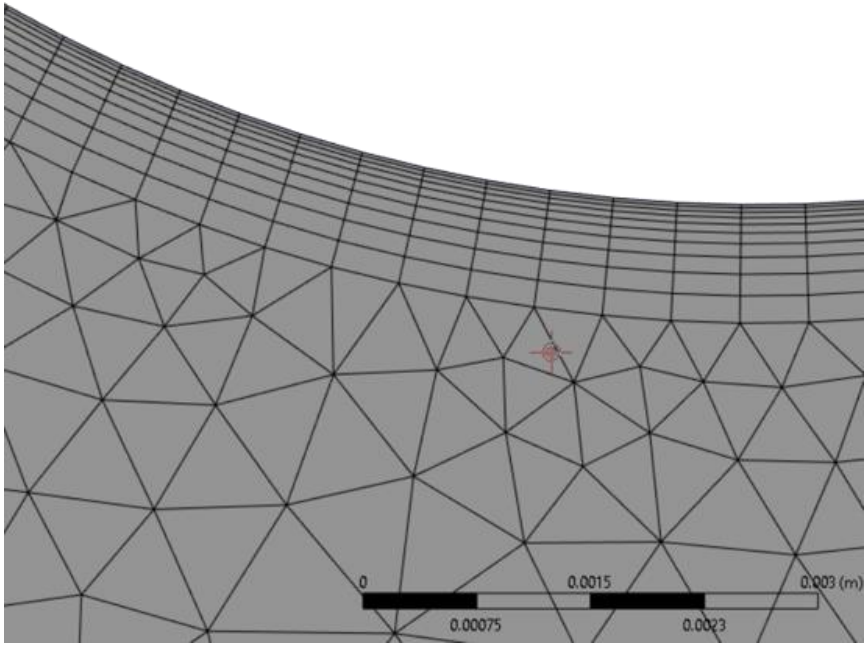
To estimate the performance capability of heat exchanger, charged with PCM (gallium) material in the shell region, with and without fin.



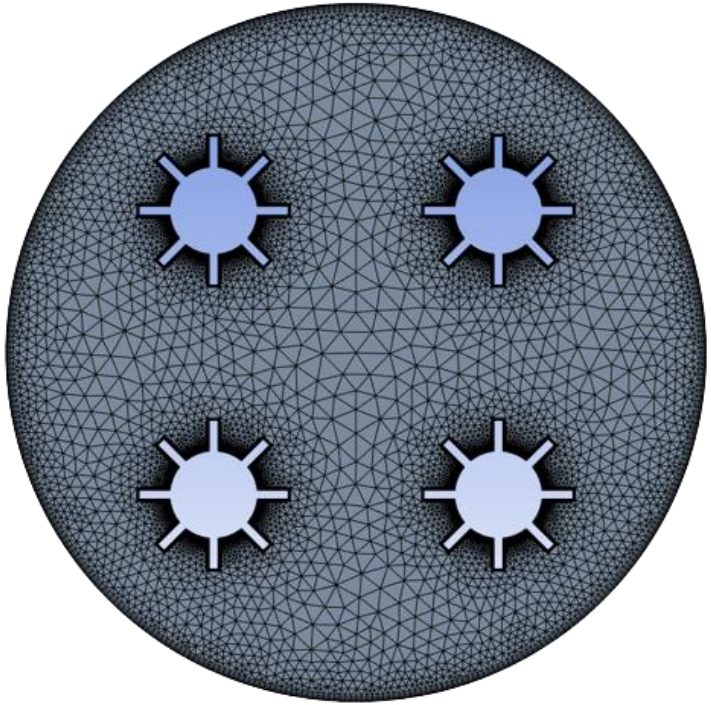


Meshing





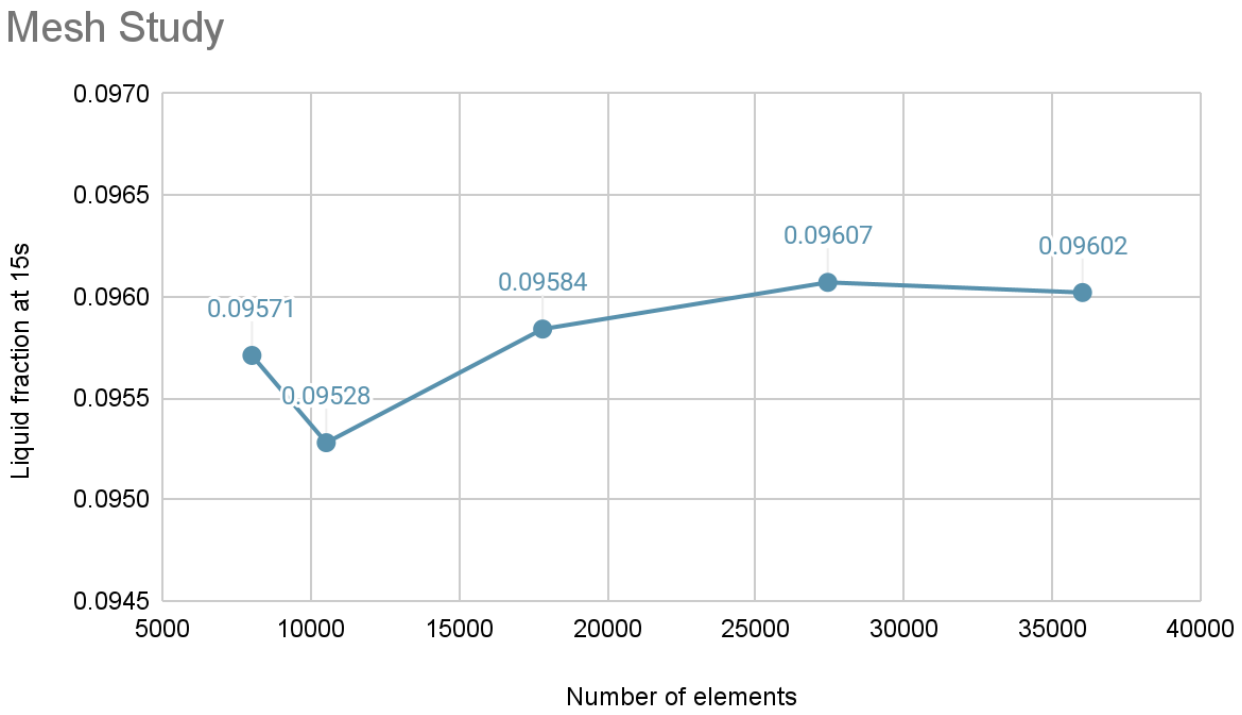
Meshing



Meshing quality and inflation

Quality	
Check Mesh Quality	Yes, Errors
Target Skewness	Default (0.9)
Smoothing	Medium
Mesh Metric	Element Quality
Min	0.10598
Max	1.
Average	0.63723

Mesh independent study

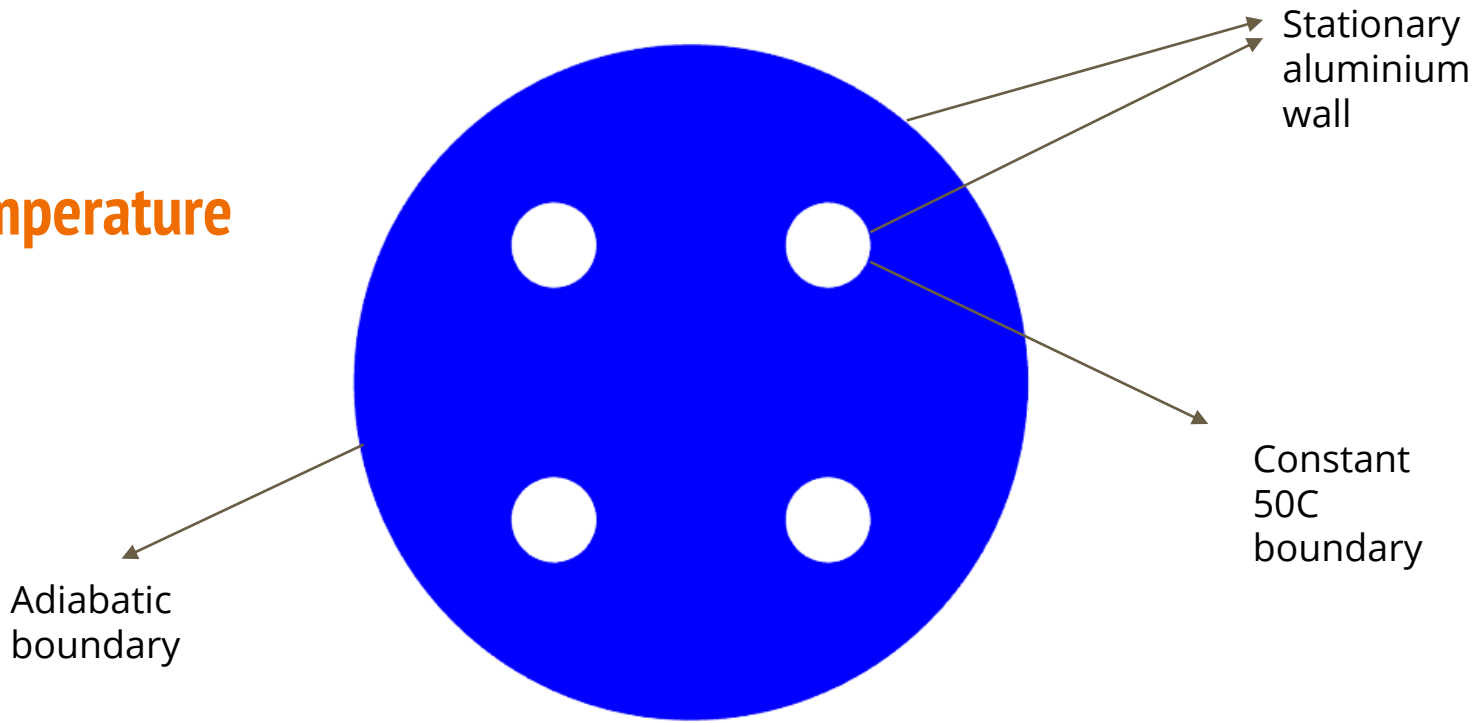


Setup

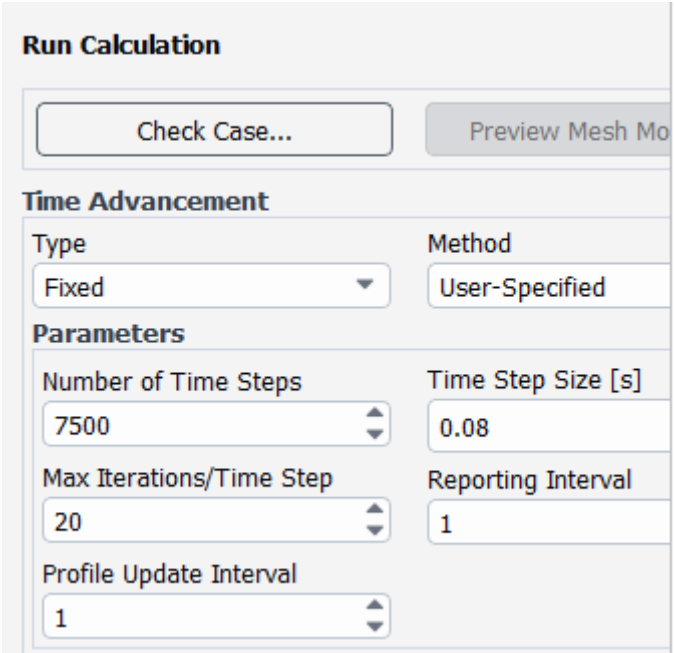
- Transient
- Viscous(Laminar) model (movement of gallium in melting region is laminar)
- Gravity (-9.81m/s^2) in y direction
- Boussinesq approximation for density
- PCM material is gallium
- Melting point of gallium = 29.2 C

Boundary Condition

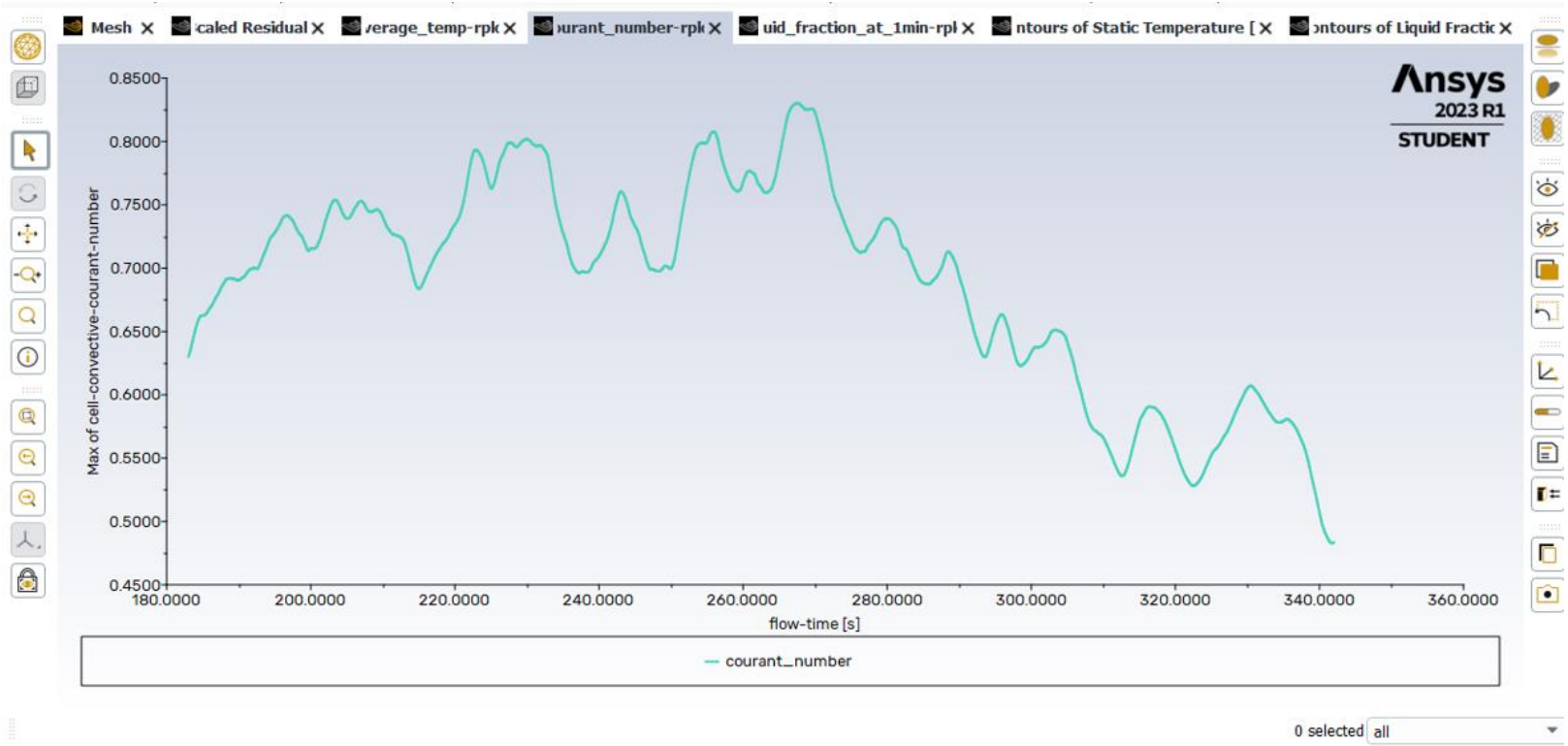
Initial temperature 27C



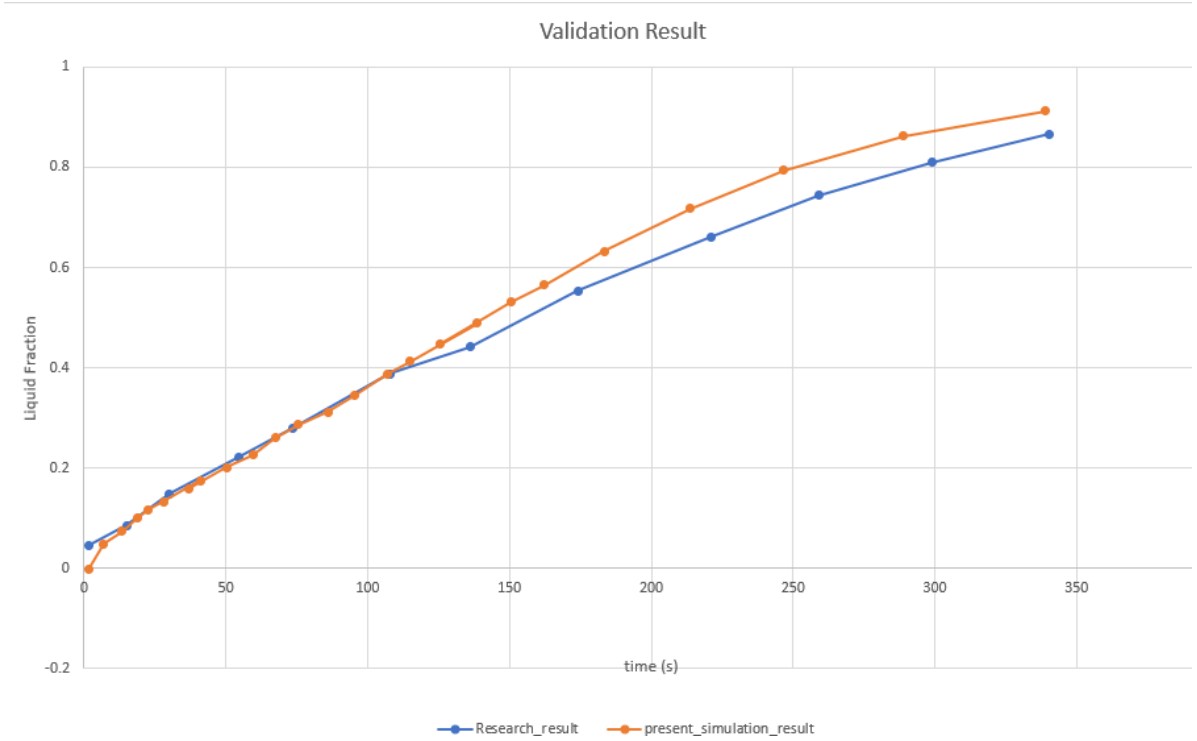
Calculation settings



Courant number for previous step size



Validation



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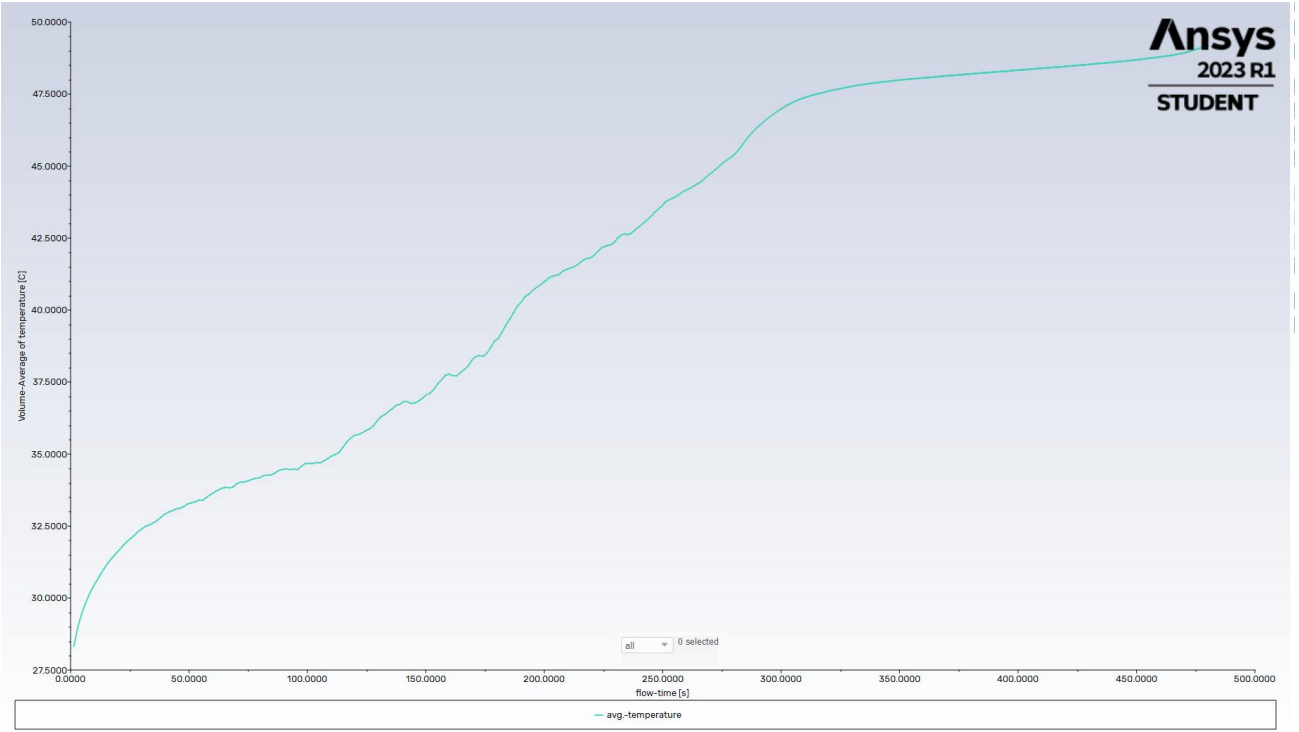
Result

Time taken for liquid fraction to reach 1

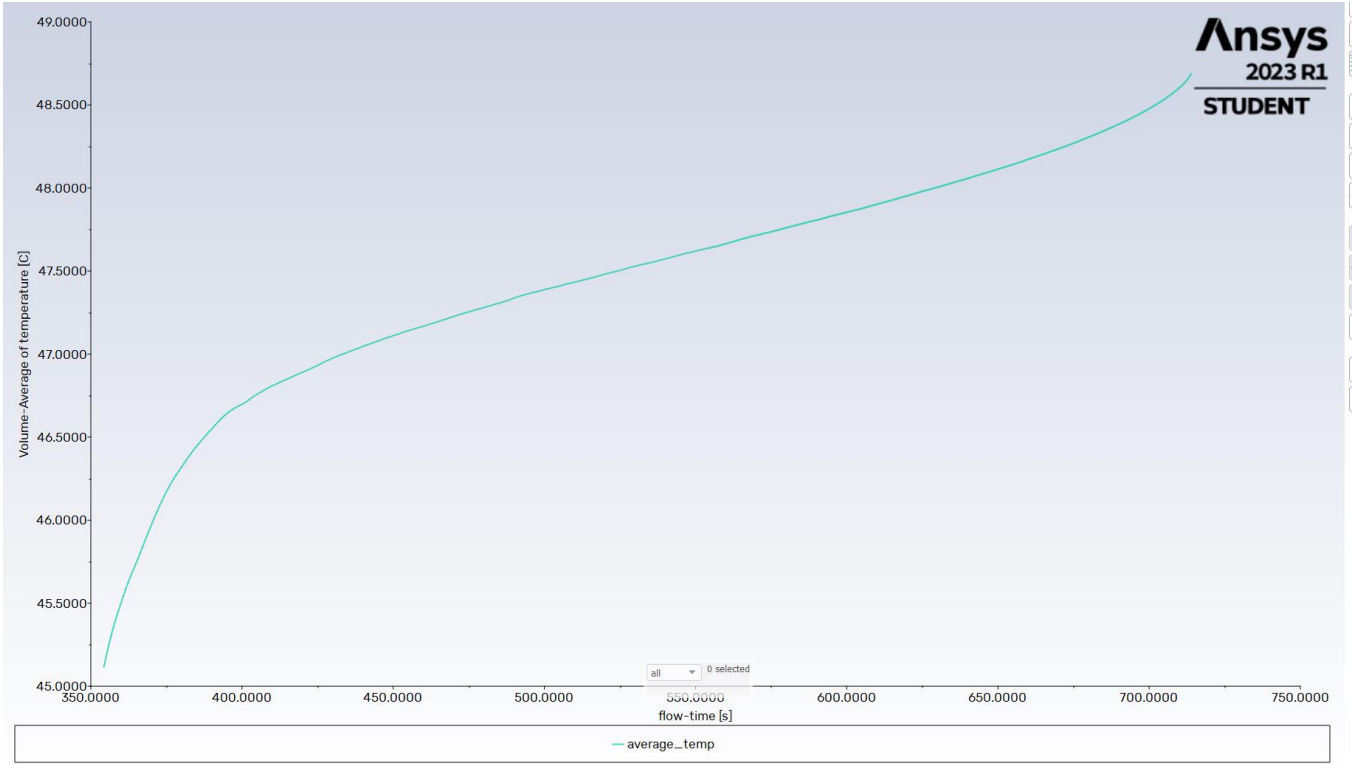
- Without fin = 719s
- With hex fin = 481s

Result



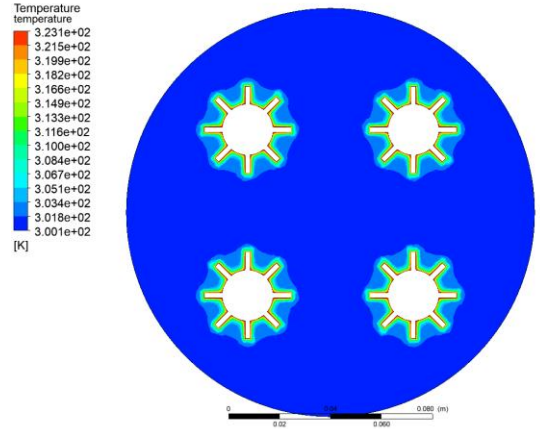
Average temperature hex finned pipe

Result

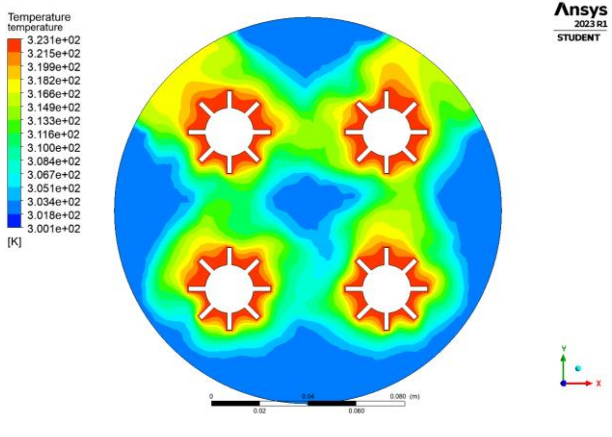


Average temperature without fin

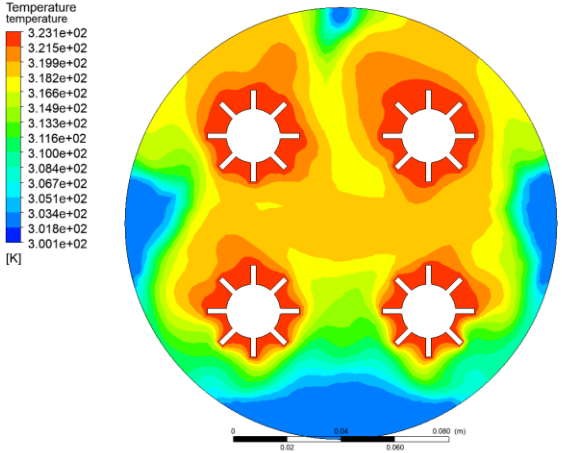
Temperature Contour



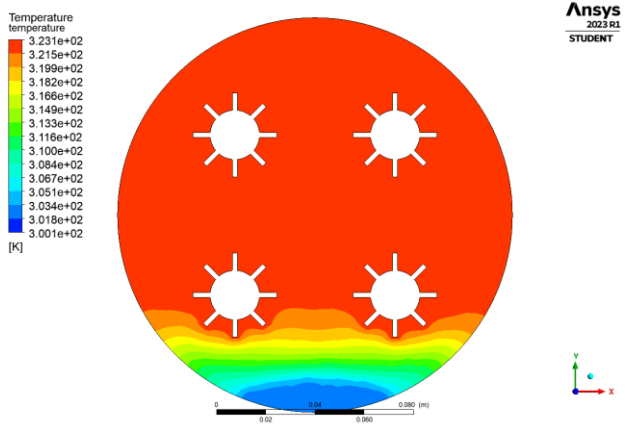
1s



140s

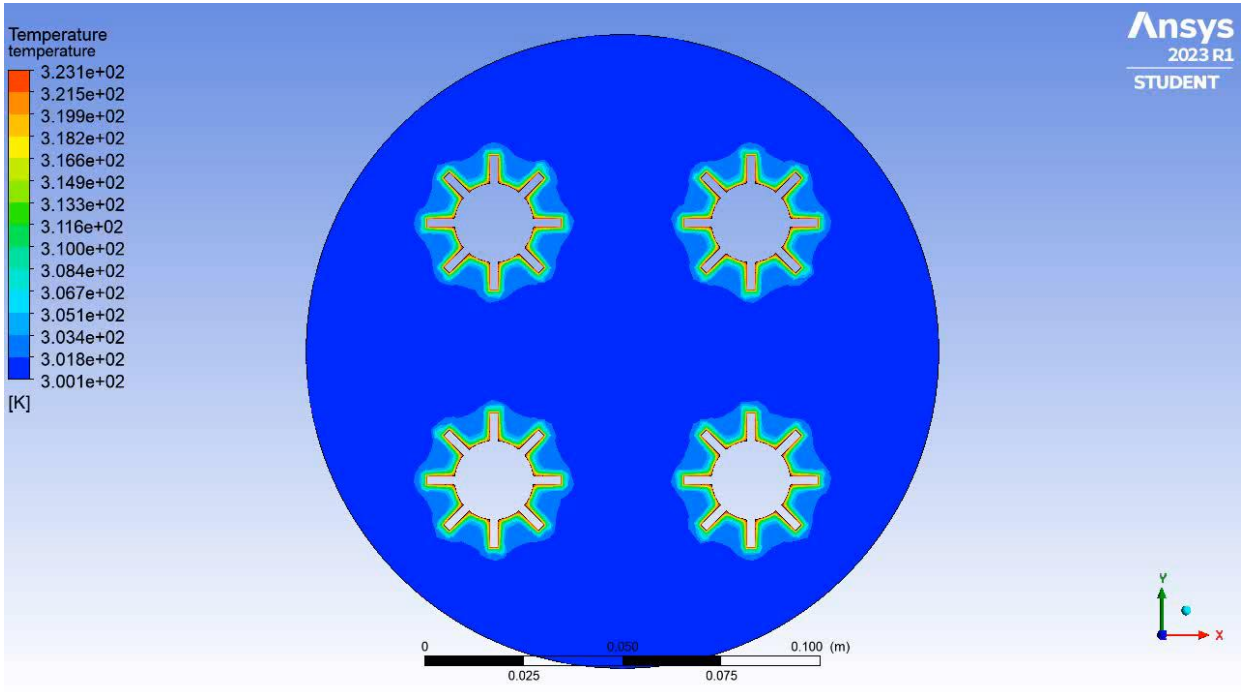


240s



340s

Result


Temperature
temperature
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
[K]
Ansys
2023 R1
STUDENT
0
0.050
0.100 (m)
0.025
0.075
Y
X

Reference

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