Study of Characteristics about Pressure Applied CO2 Operation in Vertical Small Circular Tube

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1. Introduction

The main purpose of our experimental study is focused on the thermo-physical characteristics about the supercritical carbon-dioxide (SCO_2) that have characteristics about liquid and gas at the same time because of higher temperature and pressure than critical point. For this, in our experiment we will maintain constant pressure and change other values-inlet temperature, heat flux, mass velocity - and obtain the tube's wall temperature distribution, and by use this values we will be able to suppose SCO_2's characteristics. CO_2's critical parameters that temperature and pressure are about 31.06℃ and 7.38MPa respectively as follows.

Table I: Critical parameters of Fluids

Fluid	Pressure (MPa)	Temperature(℃)	Density (kg/m^3)
Air	3.8	-140.5	333.3
Helium(He)	0.23	-267.9	69.3
Water(H_2O)	22.10	374.1	315
Carbon-dioxide(CO_2)	**7.38**	**31.06**	**468**

2. Methods and Results

Before conduct an experiment, we make test section's 3D model with modeling program-CATIA-, and adapt it to analysis program-ANSYS- for get theoretical property about CO_2.

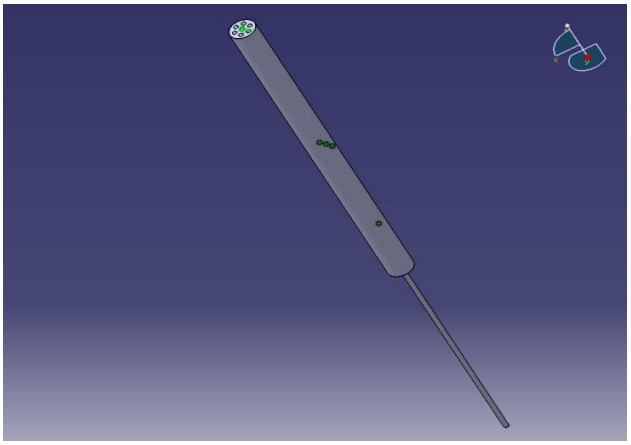

Fig. 1. Test section modeling with CATIA

Table II: Critical parameters of Fluids

Parameters	Value
Diameter (m)	0.008
Heated length (m)	1.2
Entrance length (m)	0.8
Thickness (mm)	1

Fig.1 is based on real test section dimensions as table II. This modeling file is transferred for ANSYS can accept it. In this program the modeling is divided like mesh with points and elements for analysis. Test section installed vertical direction.

In this computer pretest, we remove heating and heat transfer part in the test section in the modeling before adapt to ANSYS to make analysis easily. In this program, we fix inlet temperature and pressure 304.5° K and 8MPa respectively. And range of outlet mass flow rate is from 0.02kg/s to 0.04kg/s. We disregard about friction effect between inside wall of tube and SCO_2.

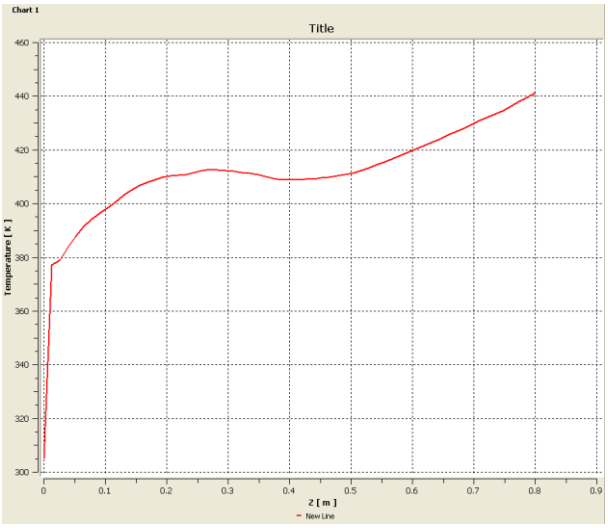

Fig. 2. Temperature distribution of test section wall at 150kW/m^2 heat flux and 0.02kg/s mass flow rate

At this result the wall temperature increasing is not steady. And from here we can imagine that something have an effect on it. It's because of buoyancy and gravity effects.

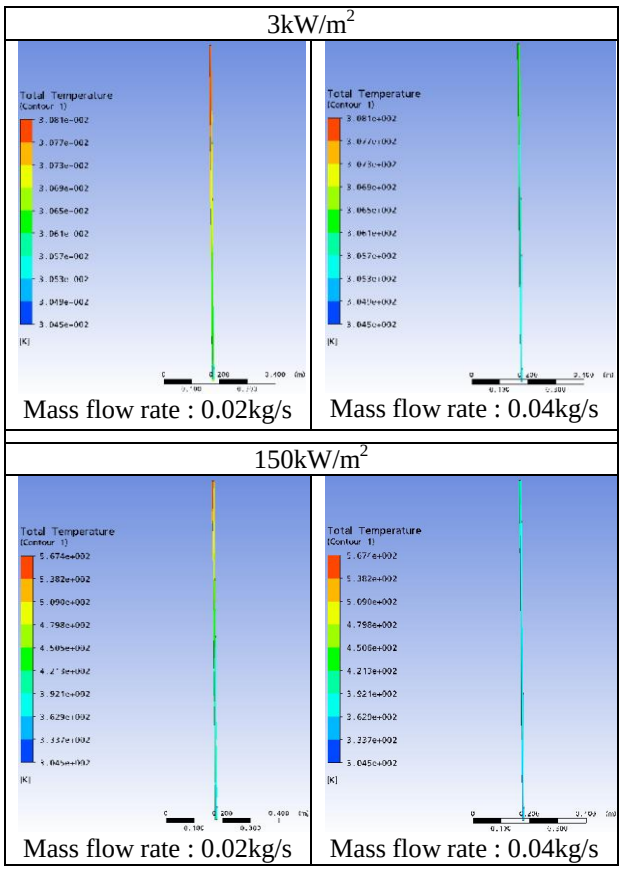

Fig. 3. Various temperature distributions by heat flux and mass flow rate

From these result, we know that high mass flow rate make lower wall temperature and high heat flux make opposite result.

3. Conclusions

This experiment's purpose is compare real test result with computer analysis. But now, we didn't do real test yet. So we prepare this and as soon as possible and do this experiment. After we finished it, we can understand SCO_2's characteristics more. Real test and study will start from near days and I hope it will complete well and its results can be satisfied us.

REFERENCES

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