

Experimental Study on Desalination system Using the Waste Heat of Nuclear Power Plants and Solar Energy Systems



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Introduction

- In this study a new desalination system using the waste heat of nuclear power plant or solar energy system is under consideration. An experiment study will be performed to evaluate the performance of the system.
- The experimental design of the system, steady-state and transient analysis using MATLAB and MARS code respectively are presented.

System Description

- Two main phenomena:
 1. **Condensation** of the heat water
 2. **Natural circulation** based on temperature and salinity difference.

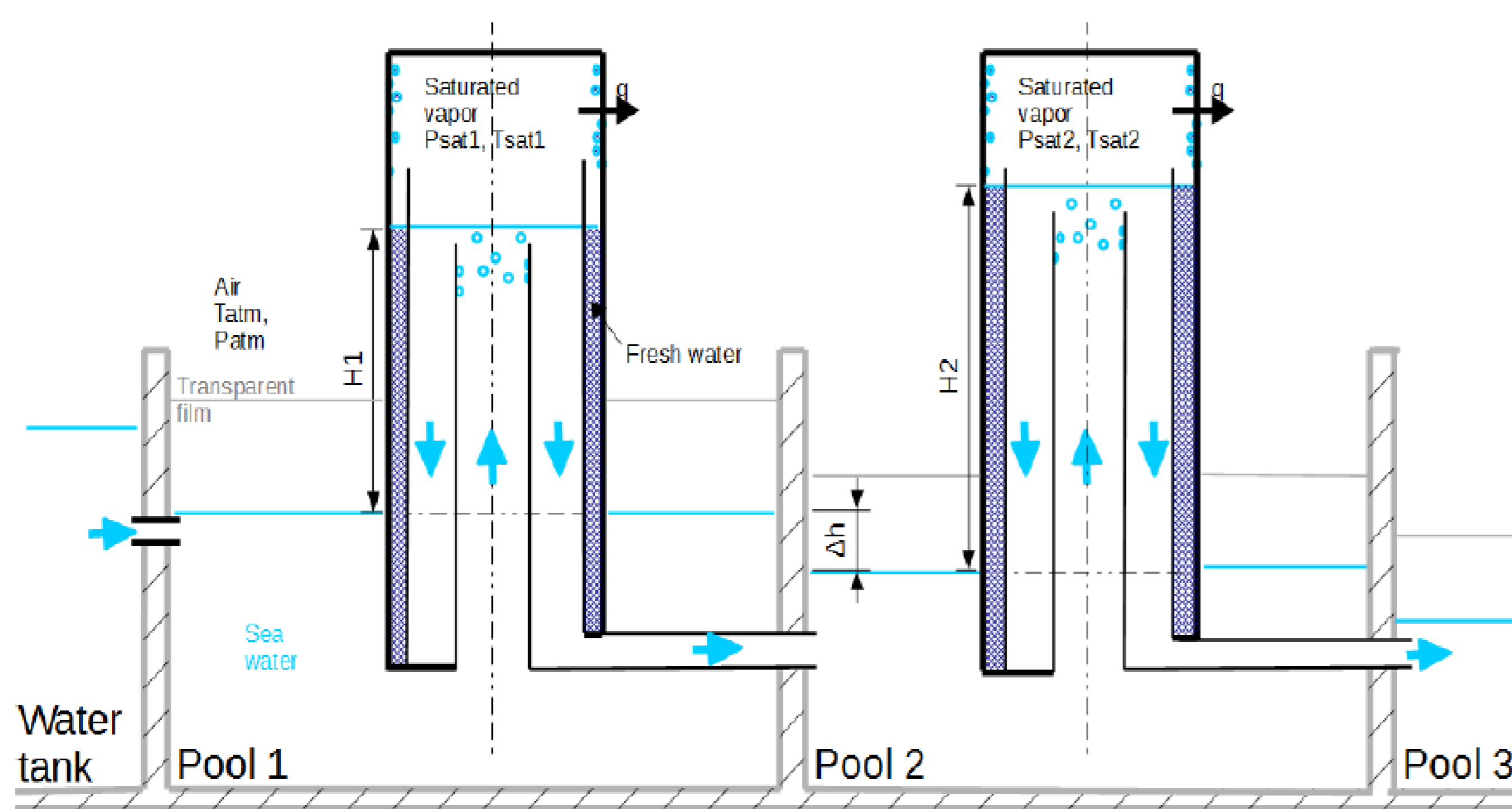


Figure 1: Desalination system schematic

- Experimental apparatus was designed to study the condensation phenomenon.

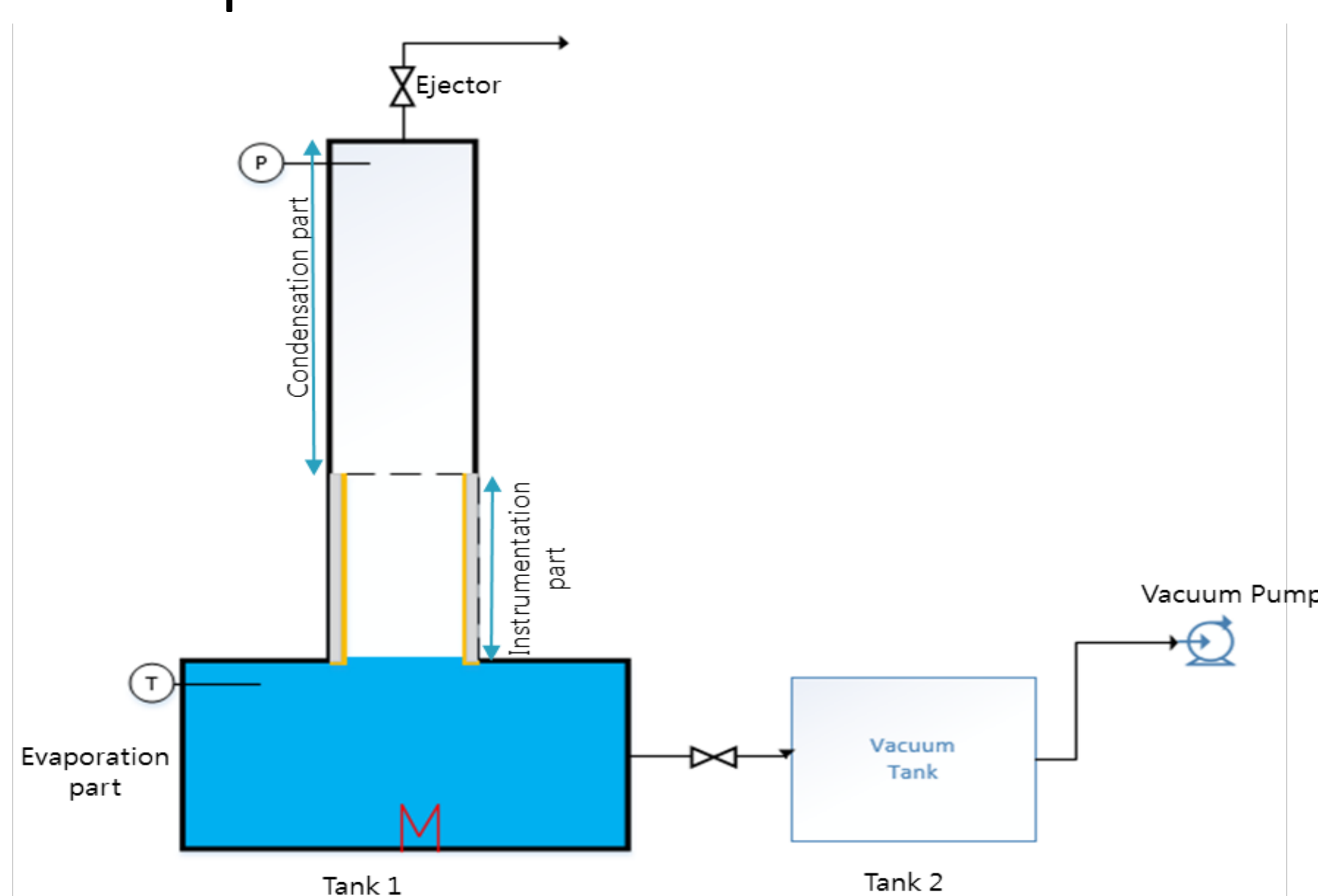


Figure 2: Experimental apparatus schematic

- The condensation part is 1.5m height and 5cm in radius, where the evaporation part is 25cm in height and 50cm in width and length. The connection pipe with the discharge system is 1/2 inch and 50cm length and the vacuum tank volume is equivalent to the condensation part volume.

Steady-State Analysis

- The steady-state heat transfer rate and the condensed water mass flow rate were calculated.
- The Nusselt's film theory and the Churchill and Chu correlations were used to approximate the condensation and convective heat transfer coefficients.

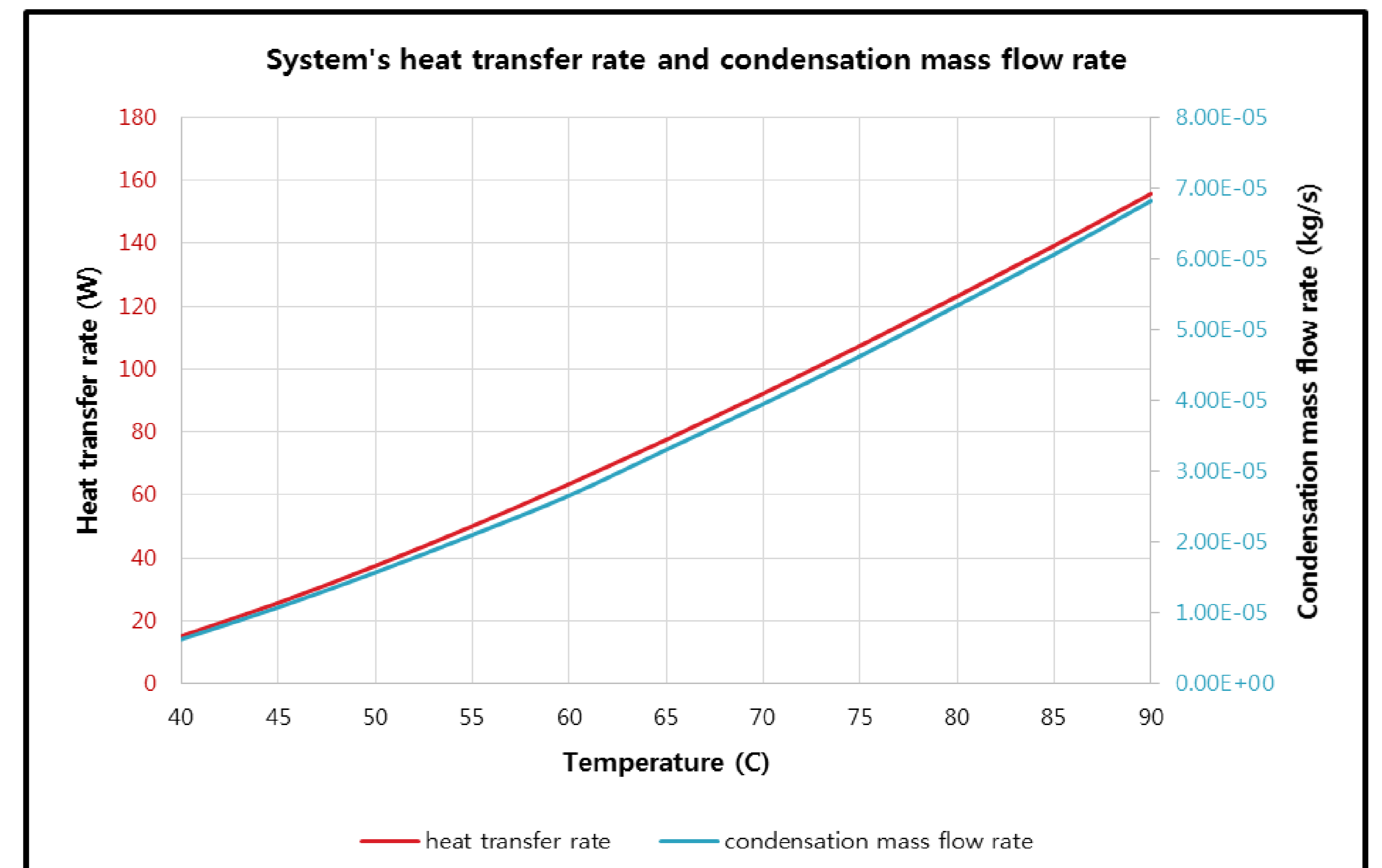


Figure 3: Steady-state results

Transient Analysis

- Using MARS code; the water discharge process (fig. 4), where the system's pressure after water discharge was calculated, and the condensation process (fig. 5), where the fluid mass flow rate was calculated, have been simulated.

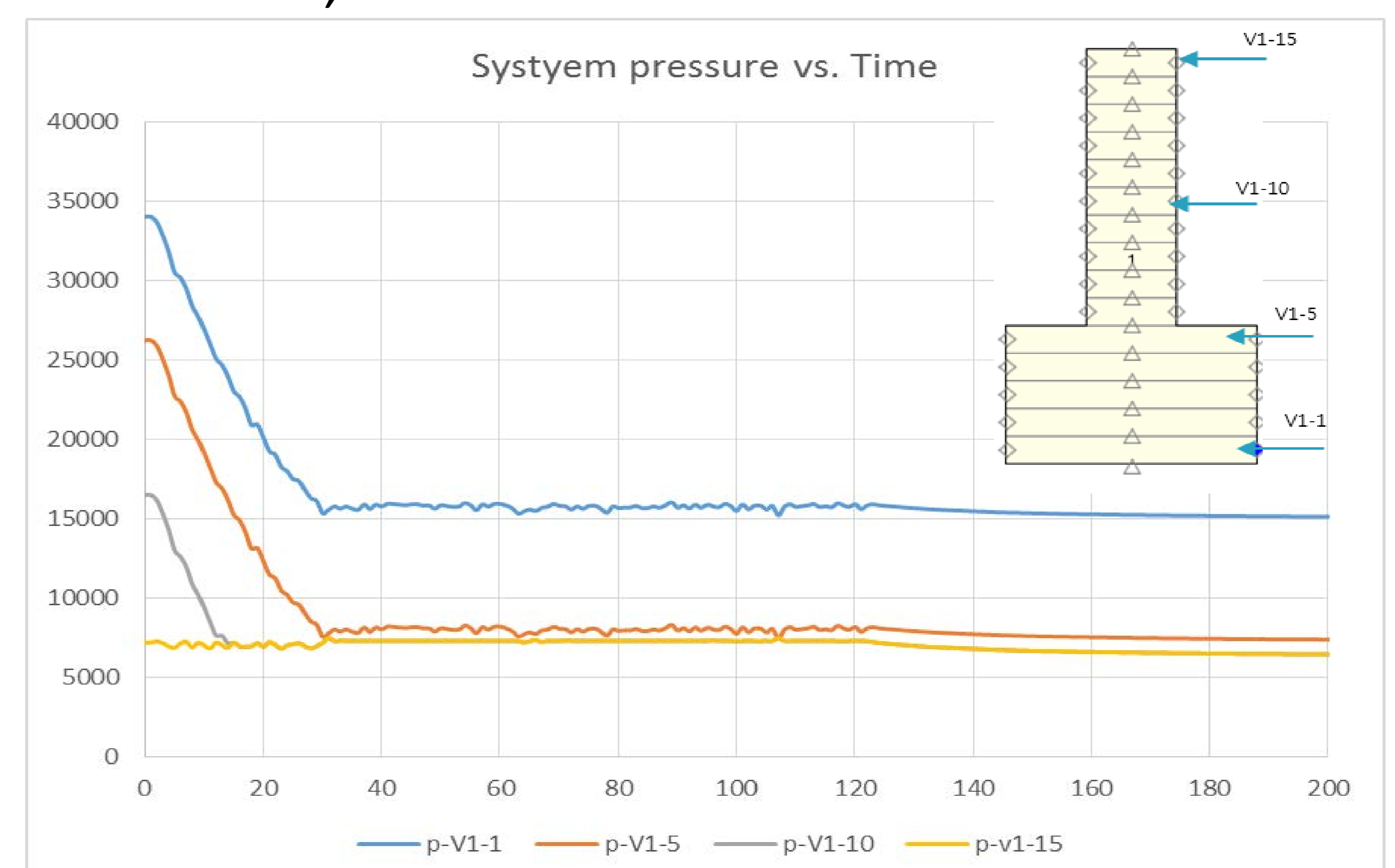


Figure 4: Discharge process MARS simulation

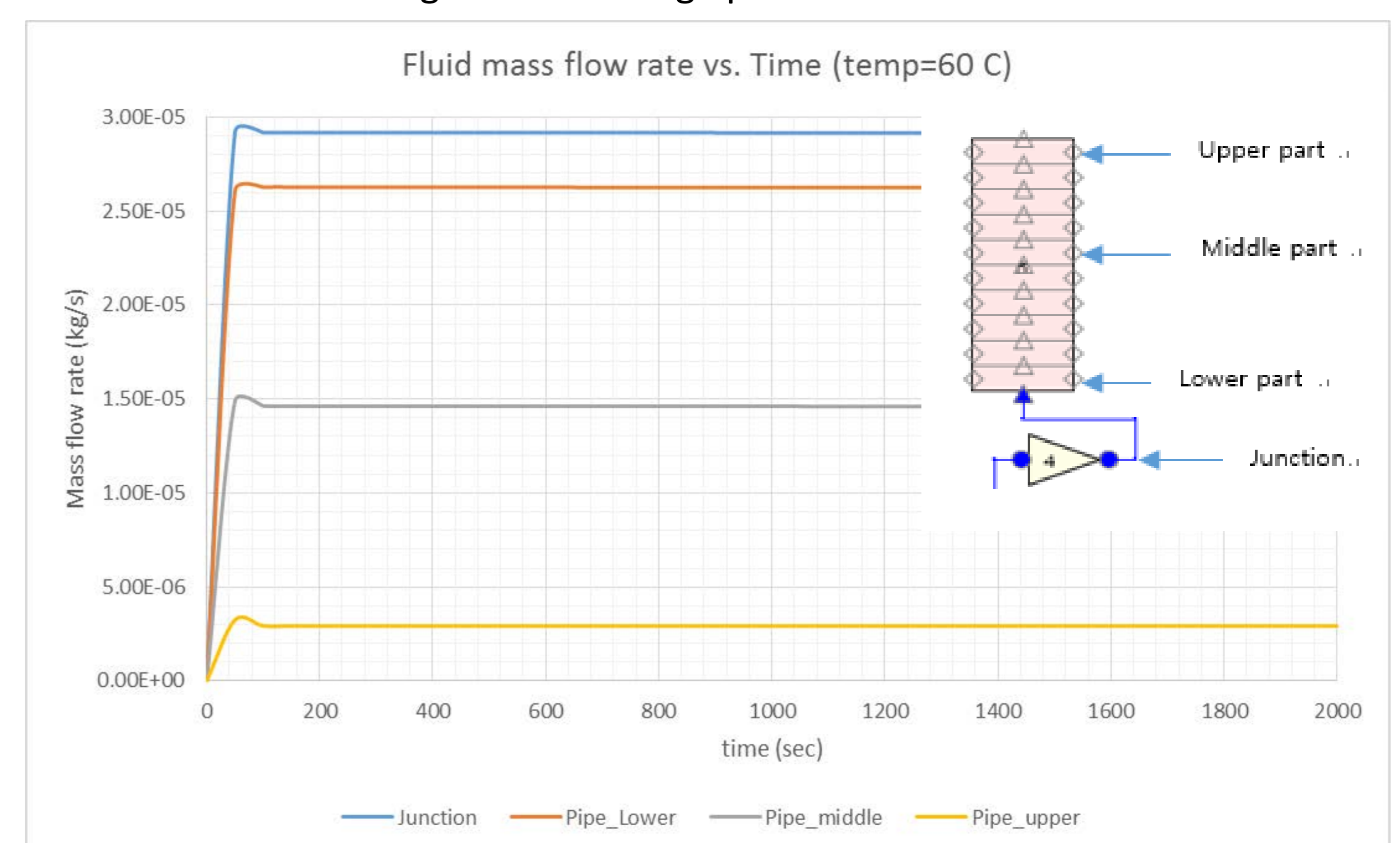


Figure 5: Condensation process MARS simulation

Future Work

- Experiment will be performed to verify the model.
- A feasibility study for the proposed design and a comparison with the conventional desalination system will be performed.