Industrial Refrigerator Modeling

Case Study Summary

Goals:

Design a viable refrigerator across all modes of operation, and evaluate the hydraulic resistance in the system by incorporating accurate pump and compressor equipment selections.

Requirements:

Perform a detailed calculation of the heat exchangers (domain discretization) while avoiding heat transfer coefficient (HTC) calculation errors during refrigerant phase transition, as these errors could reduce surface safety. Heat leakage in the transport network must be accounted for by incorporating all thermal elements.

Parameters:

P* (propylene glycol loop) = 3 bar
T* (propylene glycol loop) = -4.61 °C
G (Refrigerant) = 0.09726 kg/s

Results of the Study:

By accurately discretizing the heat exchangers and accounting for the pump and compressor characteristics, the fluid-thermal model of the refrigerator was successfully applied. The heat transfer coefficients of the heat exchangers were determined. The preliminary design of the refrigerator was compared with accurate modeling in AxSTREAM NET.

Accurate System Estimation

The refined thermal and hydraulic calculations of the complete scheme were performed by accurately discretizing all the HEXs, heat gains in transport networks, etc.
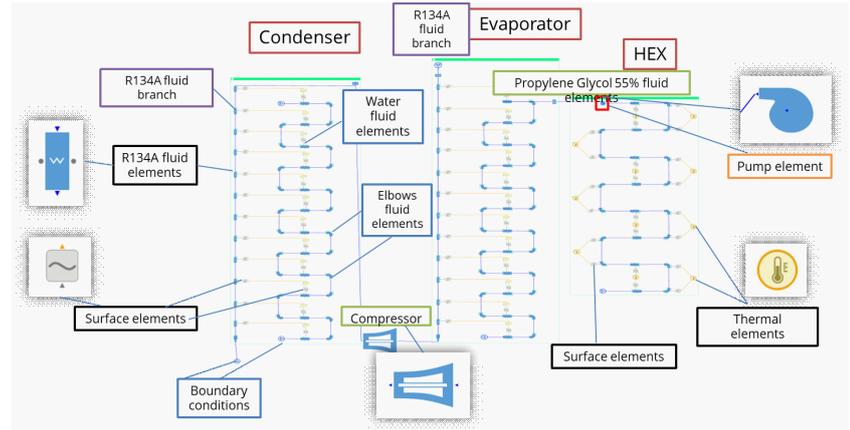
Off-design analysis of the developed scheme (including transient operation) was performed. Examples include loading products into a refrigerator, or a transient analysis of extensive hydraulic networks with an intermediate coolant.
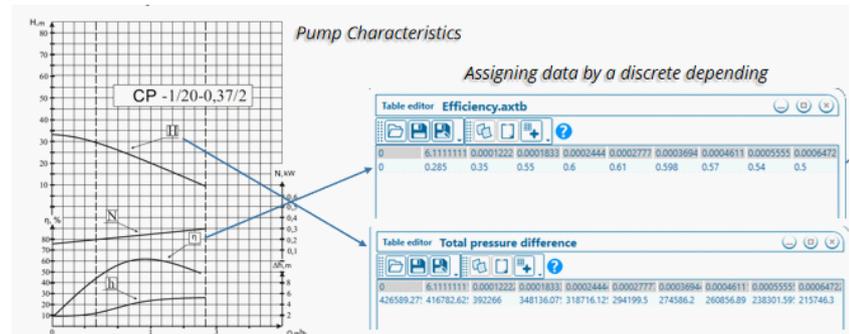
The difference between the HTC values of the preliminary design and detailed analysis is very small.