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Dynamic simulation of mixed refrigerant process for small-scale LNG plant

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With the increase demand of energy, natural gas has remained the fastest increasing fossil energy resource in the world recently. Since the gap between natural gas consumption and production is very large, more and more attentions have been shifted to some isolate small natural gas reservoirs which were previously considered to be too remote and costly to develop. Due to the small flow rate of natural gas, it is a good option to build small-scale LNG plant to liquefy the natural gas. Most of optimization studies concentrated on designing mixed refrigerant liquefaction process with lower energy consumption at steady-state simulation. Only a few studies have addressed dynamic simulation of natural gas liquefaction process. The main aim of this study was to conduct a dynamic simulation of mixed refrigerant liquefaction process for small-scale LNG plant and to investigate the dynamic responses of disturbances. The purpose of the small-scale LNG plant was to produce LNG at specified LNG temperature. Meanwhile, the process could tolerate several kinds of disturbances. Thus, the variations of natural gas composition, temperature, pressure, flow rate and environment temperature were adapted as disturbances. Then, these different kinds of disturbances were added to the process to test its stability and dynamic responses. The dynamic responses of LNG temperature and total energy consumption were the criteria to investigate the influences of disturbances on the process. In addition, the dynamic simulation results were compared with steady-state simulation results to verify the accuracy of dynamic model. Finally, the dynamic responses of disturbances were obtained and discussed. The results showed that LNG temperature could go back to its specified value and compressor duty varied with the disturbances. It indicated that the mixed refrigerant liquefaction process for small-scale LNG plant could overcome the disturbances and operate at stable state.

Primary author: Mr HE, Tianbiao (Institute of Refrigeration and Cryogenics, Shanghai Jiao Tong University)

Co-author: JU, Yonglin (Shanghai Jiao Tong University)

Presenter: Mr HE, Tianbiao (Institute of Refrigeration and Cryogenics, Shanghai Jiao Tong University)

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