

A Refrigerant/Seawater Direct Heat Transfer Model in Desalination System Utilizing LNG Cold Energy

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With increasingly extensive utilization of LNG in today's China, effective use of LNG cold energy is becoming more and more important. In this paper, a schematic diagram of a desalination system that utilizes LNG cold energy is presented. Natural refrigerant i-butane (R600a) is chosen as the working fluid to absorb cold energy from LNG in a cryogenic heat exchanger and to freeze the seawater through direct contact. Then a basic study of the direct heat transfer between two immiscible liquids (refrigerant/seawater) is investigated. A model of a single droplet which considers the evaporation of the dispersed phase and the freezing of the continuous phase around the droplet is proposed. Based on the completely mixed dispersed phase drop and concentric annulus layer of ice, a differential equation of energy of steady-state heat transfer is established, and calculated numerically for the i-butane/seawater system. Finally, the heat transfer coefficient of the single droplet system is obtained, and the heat transfer coefficient of the multi-droplets system is further derived. The variation of the heat transfer coefficient with the parameters, such as droplet diameter and seawater temperature, is also clarified.