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Simulations for a Novel Single-Column Cryogenic Air Separation Process Using LNG Cold Energy

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In this paper, a novel single-column air separation process is proposed to reduce energy consumption through the implementation of thermal pump technique and introduction of LNG cold-energy. Compared with conventional double-column cryogenic process, the new single-column distillation utilizes a nitrogen compressor acting as a thermal pump, which recuperates both the latent and sensible heat in the system, thereby lowers down the column operating pressure to 0.12 MPa. Meanwhile, an LNG cold energy recovery thermal recycle system is also set up to achieve further energy saving. Nitrogen, which is chemically inert, is used as the cyclic working medium to protect the highly inflammable natural gas from concentrated oxygen for operation safety. To optimize the parameters of the proposed process, several single-column processes are constructed and simulated on the Aspen Hysys® platform under the operation conditions: air flow rate at 50,000 Nm3/h, inlet quality of feed air to the distillation column at 0.98. The proposed processe provides standard liquid products of LIN (99.999%) and LOX (99.6%) at 12,368 Nm3/h and 10,250 Nm3/h, respectively. Simulation results reveal a unit power consumption of liquid products around 0.3 kWh•mol-1, and an energy saving over 25% is achieved compared with those of conventional double-column air separation unites with LNG cold energy recovery system from the latest literatures. In the end of the paper, several other sets of thermal recycle system are demonstrated for future studies and the criterion to select between systems based on varied cyclic pressure is also discussed.

Author: Mr ZHENG, Jieyu (Xi'an Jiaotong University)

Co-authors: Mr SI, Biao (Xi'an Jiaotong University); Mr LI, Guangpeng (Xi'an Jiaotong University); Prof. LI, Yanzhong (Xi'an Jiaotong University)

Presenter: Prof. LI, Yanzhong (Xi'an Jiaotong University)

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