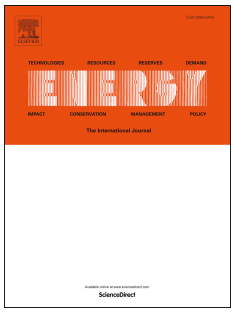
Accepted Manuscript



Step utilization of energy with ejector in a heat driven freeze drying system

Zhang Shaozhi, Jielin Luo, Qin Wang, Guangming Chen

PII: S0360-5442(18)31730-4

DOI: 10.1016/j.energy.2018.08.195

Reference: EGY 13671

To appear in: *Energy*

Received Date: 2 May 2018

Revised Date: 25 August 2018

Accepted Date: 27 August 2018

Please cite this article as: Shaozhi Z, Luo J, Wang Q, Chen G, Step utilization of energy with ejector in a heat driven freeze drying system, *Energy* (2018), doi: 10.1016/j.energy.2018.08.195.

Step utilization of energy with ejector in a heat driven freeze drying system

Zhang Shaozhi, Luo Jielin, Wang Qin, Chen Guangming*
Key Laboratory of Refrigeration and Cryogenic Technology of Zhejiang Province, Institute of Refrigeration and Cryogenics, Zhejiang University, Hangzhou, China

Abstract:

The potential of ejector in saving energy is renewed in refrigeration, power and hybrid systems. This paper presents a novel way to utilize ejector in a freeze drying system. High pressure steam is firstly used to drive a multi-stage ejector vacuum pump, then to drive an ammonia-water absorption refrigerator which offers freezing for foods and cooling for hygroscopic solution cycled to absorb sublimed water vapor from frozen stuffs. Thermodynamic analysis was made for the performance of the new freeze drying system. The optimization of the entrainment ratio distribution was investigated. It was found that equal entrainment ratio for each stage is not appropriate. Optimized unequal entrainment ratio will lead to much less energy consumption due to better match of the subsystems. Compared with traditional system driven by electricity which is produced with steam at the same pressure, the heat requirement of the new system can be reduced by 32.3% to 46.1%. The limitations of the system are discussed based on analyses of the impacts of primary steam pressure and ejector efficiency. The proposed freeze drying system with ejector will be a good choice for freeze drying agricultural products in rural areas having limited electricity and rich heat source.

Key words: ejector; freeze drying; entrainment ratio; thermodynamic analysis; energy saving