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Techno-economic Analysis of Heat Pumping Technology for Oleochemical Fatty Acid Fractionation

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Abstract

Distillation unit is often known as a major energy consumer in chemical refineries. Recent researches have shown an increased interest in heat pumping technology. So far, previous studies of heat pump integrated column have not dealt with industrial oleochemical separation. The aim of this research paper has therefore been to investigate the implications of using heat pumping technology on oleochemical fractionation. This work takes the form of an industrial case-study of palm kernel oil (PKO) fatty acid fractional distillation. Two different arrangements of mechanical vapour recompression (MVR); namely direct vapour recompression (VRC) and bottom flashing heat pump (BFHP), were introduced to the process and their performances were assessed for technological efficacy as well as cost effectiveness. All simulations were carried out using Aspen Plus process simulator and UNIQUAC was chosen as the most suitable thermodynamic package. Economic analysis in terms of capital expenses (CAPEX) and operational expenses (OPEX) was evaluated. Though both MVR systems have shown relative reduction in energy load, however the CAPEX performance demonstrated in this study was not very appealing due to the additional equipment to satisfy the energy requirement. One anticipated finding was that the OPEX for the VRC showed only 50% from the conventional column (CC). On the contrary, the BFHP was ruled out for its CAPEX and OPEX, which showed twice as much as the CC.

Keywords: Oleochemical, vapour recompression, bottom flashing, fractional distillation.

1. Introduction

In the new global economy, energy consumption has become a central issue in chemical plants. One of the most significant discussions in this alarming issue is the energy utilization in major separation units. Distillation is commonly known as a prominent technology for separation process; however, it suffers from low thermodynamic efficiency which directly contributes to a large energy consumption. In view of this, any method of minimizing this associated energy would be of great advantage. Apparently, there is a large volume of published studies describing the important role of heat integration in energy saving. A number of mature heat-integrated technologies have already made a debut decade ago in chemical refineries. Heat pump assisted distillation has evolved to become one of those promising technologies that is commercialized for industrial practice.