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Energy saving in atmospheric crude process using modified crude distillation units

Young Han Kim
Dong-A University, South Korea

Crude oil is the starting material for petroleum and petrochemical processes, and contains hundreds of hydrocarbons used as fuel and feedstock in the chemical processes. A crude distillation unit (CDU) is the first step in the refinery processing of crude oil, which consumes a large amount of energy due to the large processed amount and the high processing temperature. Refinery engineers handling the crude oil have many years of experience using the CDU, and therefore, the distillation columns currently in operation are considered to be optimized and consume minimum amount of energy. When a typical crude distillation unit is compared with a common distillation column processing multiple products, its operation is quite different with respect to the separation process of benzene, toluene, and xylene mixtures as an example. The common arrangement of distillation columns is in a direct or indirect sequence, in which the products are produced one by one in the column until the final two products, in the sequence of component volatilities. In contrast, the CDU processes all the 5 products in a single column, which lowers its thermodynamic efficiency due to the mixing of the feed and products. The problem of the large energy demand associated with the single column operation of the conventional CDU was solved with the two-column operation, a prefactionator and the main column, in the proposed CDU. The two-column operation reduces feed tray mixing, and thus raises the thermodynamic efficiency of the CDU. In the present study, the performance of the proposed CDU was examined by comparing the energy consumption, investment and utility costs, and thermodynamic efficiency with those of the conventional CDU. A novel crude distillation system was proposed for reduced energy use. The problem associated with the single-column operation of the conventional crude distillation unit was solved with a two-column operation. The single column operation reduced the thermodynamic efficiency of the system due to the feed tray mixing requiring more energy. The computed results of performance evaluation indicate that the proposed system saved 35% of heating duty over the conventional system, with a reduction in cooling duty of 23%. The economic analysis shows that a 22% decrease in investment cost and a 39% reduction in utility cost were found from the proposed system compared with the conventional system. The comparison of thermodynamic efficiency demonstrates a 5% improvement over the conventional system.

Biography

Young Han Kim has many years' experience in process development towards industrial applications. Especially energy-efficient processes are among his current developments. Distillation and extraction processes of large processing throughput are the projects of his recent publications. His experience includes not only simulation studies, but also distillation experiments and process control practices.

yhkim@dau.ac.kr

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