Thermal integration of industrial distillation columns for bioethanol concentration

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Bioethanol distillation is a subject frequently discussed in the literature. The investigations on this topic are focused only on the behavior of the binary mixture ethanol + water. Nevertheless, the actual wine to be distilled includes a series of minor components that decisively affects the distillation process and the final product quality. Distillation accounts for a large part of total energy consumption in the industry. Thus, an important motivation to study the system of distillation columns is the reduction of energy consumption. Considering these points, this work aims to investigate, by computational simulation, the influence of minor components in the energy consumption of a double-effect system with split feed of wine. The software Aspen Plus was used to simulate a ABB_1 process in which part of the wine is fed to the top of column A, and the other part is mixed with the condensed phlegm from the top of column A, resulting in a rich wine, which is fed to the top of column B_1. The heat generated in phlegm condensation is used as heating source for columns B and B_1, which operate under vacuum, so that their bottom temperature is lower than the phlegm temperature. The wine was considered a multicomponent mixture. It was given special attention to the volatile components propanol, isopropanol, isobutanol and isomyl alcohol. Compared to a conventional process, it was observed a reduction of energy consumption from 1.78 to 1.19 kg steam/L hydrated alcohol, but some operational adjustments may be necessary, for instance in relation to the feed tray of rich wine and mass flow of side product, since isoamyl alcohol profile changes compared to the traditional process. Based on this, it could be concluded that it is not possible to represent appropriately the industrial distillation without taking into account such minor compounds.

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