

Integration of LiBr-H₂O Absorption Heat Pumps in Distillation Columns

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This paper presents a study of the possibility to reduce the input of energy in bulk separation processes, specifically in continuous binary distillation processes, by integrating LiBr-H₂O absorption heat pumps into distillation columns. Two different configurations were studied. In the first configuration, the absorber and condenser of the absorption heat pump were inserted in the stripping section of the column to substitute for the reboiler, thus obtaining a diabatic column. The second configuration has only the absorber inserted in the stripping section of the column, while the (external) reboiler uses the heat from the condenser of the absorption heat pump. A model to evaluate the performance of these two configurations is proposed and implemented, applies mass and energy balances and thermodynamic properties of the lithium-bromide water solution and column fluids, and is used for parameter analysis. With it, the tray operating conditions and COP of the heat pump cycle have been estimated. These results are used for an economic analysis based on the energy requirements of the integrated system. For both designs studied, the COP of the system increases when the heat exchangers are covering a larger number of column trays and when the temperature difference between the distillation column fluids and the working fluid of the heat pump is smaller. Since diabatic columns require a larger heating power, the largest energy savings are obtained when a minimum of trays is covered by the heat exchanger(s) of the heat pump. For the specific case considered, the energy savings can amount up to 43%.