Research topics

Dividing Wall Distillation Columns

Prof Robin Smith and Dr Megan Jobson

Abstract

The fully thermally coupled distillation arrangements known as Petlyuk and dividing wall columns can bring energy savings of typically 30% when compared with a conventional arrangement. In addition, the dividing wall column can, in new designs, save up to 30% in capital cost in addition to the 30% energy saving, compared with a conventional arrangement. This project has developed new design methods and control arrangements for such columns.

Project description

Heat integration has proven to be successful in reducing the energy costs for conventional distillation arrangements. However, the scope for integrating conventional distillation columns is often limited. Such limitations call for non-conventional column designs to be considered. One of the most important non-conventional distillation arrangements involves thermal coupling. The use of thermal coupling has until recently been almost exclusively restricted to side-strippers in the petroleum industry.

While such partial thermal coupling can reduce energy consumption, the use of fully thermally coupled arrangements can be much more effective. It has been established that, when fully thermally coupled arrangements can be applied, energy savings of 30% are typical when compared with a conventional arrangement. In addition, the fully thermally coupled design, known as the dividing wall column, can in new designs save up to 30% of the capital cost compared with a conventional arrangement.

New design methods have been established for fully thermally coupled design, based on semi-rigorous models. These semi-rigorous models give much better agreement with rigorous simulation results than do shortcut models. The new models are especially useful for optimisation of all of the degrees of freedom simultaneously and for initialisation of rigorous simulations. The new design methods are to be extended to evaluate application of dividing wall columns to azeotropic mixtures, separation of which is particularly energy intensive, and to reactive mixtures.

Control of dividing wall columns has been studied theoretically using dynamic simulation and in a pilot plant (0.3m diameter, 11m height).