# Research topics

## Azeotropic Distillation

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### Abstract

Azeotropic distillation is required to separate mixtures that form azeotropes. In many cases, an additional species (the solvent, or entrainer) will be introduced to facilitate the separation. Process synthesis includes selecting the entrainer, choosing the sequence of separations and recycle structure, and selecting suitable column design and operating conditions. Ternary and multicomponent systems have been studied. Flowsheets involving liquid-liquid phase splitting and the use of complex distillation alternatives are the subject of future research.

### Project description

Many industrial distillation problems involve the separation of non-ideal, azeotrope-forming mixtures. To break the azeotrope, a mass separation agent, or entrainer can be added. The entrainer affects the phase equilibrium behaviour of the system and the structure of the flowsheet that facilitates the separation. A new classification system for ternary mixtures allows feasible entrainers and the associated flowsheet to be identified directly. Once an entrainer has been selected, the sequence and columns can be designed using graphically-based methods. Important degrees of freedom in flowsheet design, including the sharpness of splits, column operating pressures and recycle flow rates, can be optimised.

For multicomponent mixtures, new methods for the synthesis and evaluation of azeotropic distillation sequences have been developed. Splits, classified in terms of sets of product compositions, are evaluated for feasibility in multicomponent composition space according to the existence and location of distillation boundaries and compartments. Based on feasibility, sequences of potentially feasible splits can be generated. Suitable recycle flows and connections are considered in the following step and the minimum energy requirements of the sequence are assessed. The columns comprising promising sequences can then be designed.

Future work will consider opportunities to exploit the formation of a second liquid phase within the flowsheet (heterogeneous distillation) and the use of complex distillation arrangements, including two-feed columns and thermally coupled columns, as well as non-sharp splits.