Control and design optimization of coupled IPA/NPA distillation columns

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Traditional analysis of distillation column design and operation is based on steady state analysis. In reality however, distillation processes are continuously subject to disturbances, caused by variations in feedstock, changes in product requirements, the availability of utilities, etc.

Dynamic modelling is a key technology for optimising column design and operation. It can be used to understand the effects of feed and product quality changes, periodic feed upsets and abnormal operation, and then to design and tune control schemes capable of dealing with such disturbances.

Accurate quantification of column transients allows engineers to minimise the effects on off-spec product, energy requirements and purity giveaway, in order to maximise process economics.

This paper provides an overview of recent developments in advanced process modelling that now make dynamic optimization of distillation columns easier than ever before.

For this purpose, an industrial distillation system for the separation of iso-propanol and propanol, designed in a traditional manner without considering the effect of feed fluctuations on the design is introduced and shown to be severelly ill-conditioned. A new control scheme is proposed to overcome the operational difficulties. Moreover, using an optimisation approach that takes operability of the design into account, it is shown that significant economic and operability benefits can be obtained if design and control interactions are systematically considered.