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Ivonne Rodríguez-Donis, Vincent Gerbaud, Xavier Joulia

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Finding batch extractive distillation product sequence from thermodynamic insights

RODRIGUEZ DONIS Ivonne, GERBAUD Vincent, JOULIA Xavier

For more information, please contact: ivonne.rdguez@infomed.sld.cu · Vincent.Gerbaud@ensiacet.fr

Motivations:

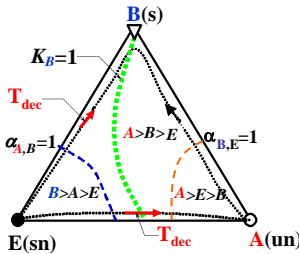
- ✓ Few papers have been devoted on the effect of $K_i=1$ and $\alpha_{ij}=1$ on the design of homogeneous extractive distillation
- ✓ The product sequence are classically determined by computing the extractive profile map at given F/V and total reflux ratio.
- ✓ Separation low α_{AB} mixture always considered as a simple case: Light (resp. Heavy) component is the first top (bottom) cut.
- ✓ Influence of $K_i=1$ and $\alpha_{ij}=1$ on the separation of low α binary mixture (diagram 0.0-1) has not been studied so far.

Objectives: to study the role of unidistribution ($K_i=1$) and univolatility lines ($\alpha_{ij}=1$) along with the residue curve map on feasibility of batch homogeneous extractive distillation process. → New general feasibility criterion.

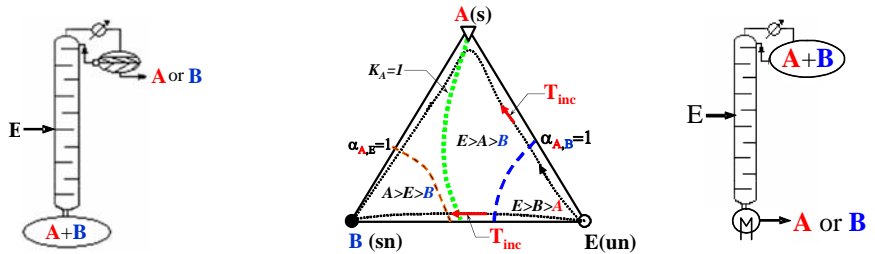
Separation of Close Boiling Mixture. Ternary Diagram 0.0-1 : Residue Curve Map + ($K_i=1$ and $\alpha_{ij}=1$)

($A>B>E$: A more volatile than B more volatile than E)

Case I: Heavy Entrainer: E(sn)



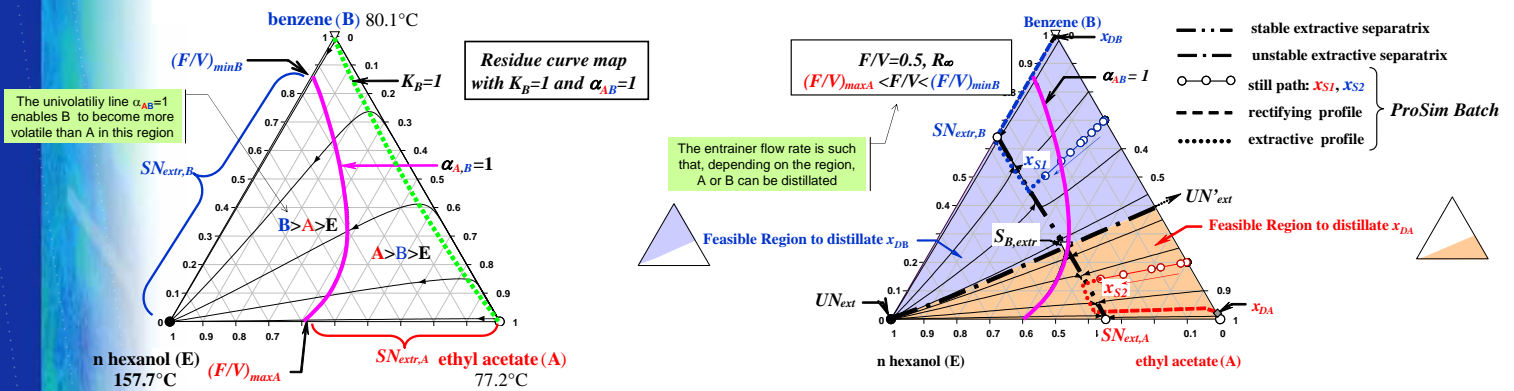
Case II: Light Entrainer: E(un)



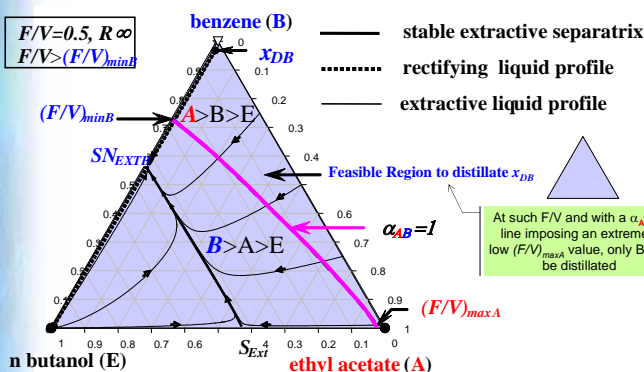
General Feasibility Criterion

“existence of the residue curve connecting E to A or B following a decreasing (T_{dec}) (resp. increasing (T_{inc}) temperature direction inside the region where A or B are the most (resp. the less) volatile component of the mixture. A or B can be recovered as first distillate (resp. bottom) product using a heavy (resp. light) entrainer in the rectifying (resp. stripping) batch column”

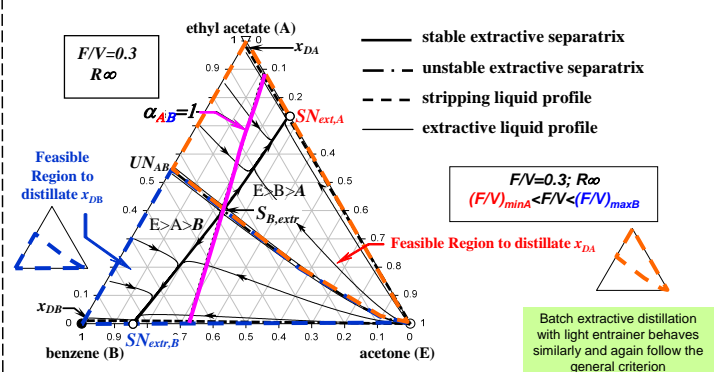
Case I(a) : Separation of ethyl acetate – benzene using n-hexanol



Case I(b): ethyl acetate – benzene using n-butanol



Case II: ethyl acetate – benzene using acetone



CONCLUSIONS

- ❖ Combined analysis of the residue curve map and the univolatility lines is essential for determining the original component to be drawn as the first product cut.
- ❖ α_{AB} determines the existence of the limiting values for the entrainer flowrate. Separation of A or B depends on the location of the still composition.
- ❖ Existence of α_{AB} in low volatility binary mixture allows the separation of the saddle original component (B in Case I and A in Case II) as first product cut. An unexpected result before this study...