Interpreting a Ternary Liquid-Liquid Triangle Diagram

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Where are we?

- In the textbook, this is Section 5 of Chapter 4
- In the notes, this is the set on Single Stage Equilibrium
- Just finished flash drums
Example Problem

• We’ll do an example problem involving water, ethylene glycol, and furfural.

• Furfural completely dissolves ethylene glycol, but only partially dissolves water.

We’re using furfural to separate ethylene glycol from water.
Triangle Diagram: Basics

If you forget how to read the compositions, use the zero lines.
Triangle Diagram:
Miscibility Boundary

We need to be in the two-phase region (extract & raffinate)

made by adding water to ethylene glycol & furfural mixture until there is cloudiness (2nd phase)
Feed + Solvent $\rightarrow$ Mix composition $\rightarrow$ Tie Line $\rightarrow$ Extract and Raffinate composition at two-phase equilibrium

Triangle Diagram: Tie Lines & Plait Point

Plait Point
Tie lines converge to the Plait Point, where both liquid phases (extract and raffinate) have the same composition.

Tie Lines
Tie lines connect equilibrium points on the miscibility boundary.

At 2-phase equilibrium, these are our extract and raffinate compositions!
Triangle Diagram: Getting the Input Point

Points S and F define the line
the mix point M is found with the inverse-lever-arm rule

\[ \frac{F}{S} = \frac{SM}{MF} \]
Triangle Diagram: Getting the Outflows

Find the tie line that point M lies on

Extend to the extract and raffinate compositions

Use the inverse-lever-arm rule again...

unknown flow rates

Ethylene Glycol

Furfural

Water

Total mass/mole balance to complete

\[ E + R = F + S \]

geometrically:

\[ EM + RM = ER \]