$$\epsilon \leq \frac{X_{LNK,D}^{\text{assumed}} - X_{LNK,D}^{\text{calc}}}{X_{LNK,D}^{\text{calc}}} \leq \text{tolerance}$$

if not satisfactory, use

$$\left[X_{LNK,D}\right]^{i+1} = X_{LNK,D}^{\text{calc}}$$

Procedures if only HNK's present

1. Calculations proceed from bottom-up (number from bottom as "1")

2. Use $y_{ji} = \dfrac{x_{ji}\alpha_{i\,ref}}{\sum_i x_{ji}\alpha_{i\,ref}}$

3. Use inverted BOL & TOL to get $x_{j-1\,i}$ i.e. $x = f(y)$

4. Etc.

5-15a

Example of tolerance calculation.

D	200	X_1	0.500
	100	X_2	.495
	99	X_3	.005 ← $X_{LNK,D}$ assumed
	1		

300 ① 100
② 100 99 ↗
③ 100 99 ↘

	0	$X_1 = 0,000$
	1	$X_2 = 0.02$
	99	$X_3 = 0,98$
	100	

	X_1	X_2	X_3
stage 14	0.04	0.13	0.83
15	0.02	0.06	0.92
16	0.003	0.015	0.982

Amount LNK in B = $X_B(B)$
$= 0.003(100) = 0.3$

Amount which should have been in distillate
Feed
$100 - 0.3 = 99.7$

Calc concentration of LNK in distillate

$$X_{LNK,D\ calc} = \frac{99.7}{(99.7 + 99 + 1)} = 0.49924$$

$$\frac{0.5000 - 0.49924}{0.49924} = 0.00152$$

if we desired to know compositions to 0.001 we need to make another pass.

5-16

Topic: How to get α's

If one point use "feed" conditions

If two points use average of top & bot
(based on dp or bp of product with "approximately" known composition)

The geometric average should be used

$$\alpha_{i,Ref} = \sqrt{\alpha_{i\,Ref}_{TOP} \cdot \alpha_{i\,Ref}_{BOT}}$$

If three points use TOP, FEED, BOT

$$\alpha_{i_{Ref}} = \sqrt[3]{\alpha_{i\,Ref}_{TOP} \cdot \alpha_{i\,Ref}_{FEED} \cdot \alpha_{i\,Ref}_{BOT}}$$

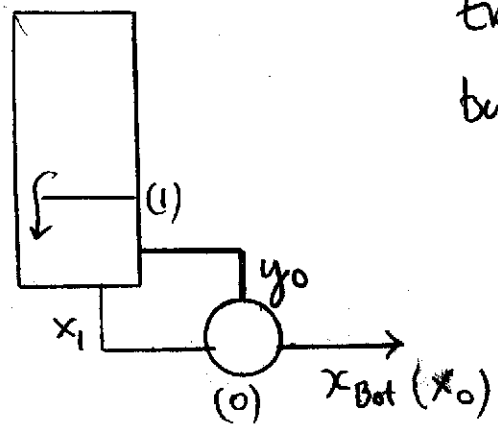
How to handle EE for NCRV
(non-constant relative volatility)

Case I - Stepping up column

1. Let reboiler be stage 0

x_{i_0} = known = x_{i_B}

5-17



"PR"

2. Find K_{ref} and y_i values by trial & error determination of bubble-point.

(a) assume To (try weighted avg of boiling points at P_{col})

(b) Find K_{o_i} at To (charts)

(c) check $\Sigma y_{o_i} = 1$

where $y_{o_i} = K_{o_i} x_{o_i}$

(d) if not $\Sigma = 1$ use

$$K_{ref}(T_{new}) = \frac{K_{ref}(T_{old})}{\Sigma K_i x_i}$$

(e) repeat until $\Sigma y_i = 1$. This will be To.

(f) Finish by finding

$$y_{a_i} = x_{o_i} \cdot K_{o_i}$$

3. Find x_{1_i} from BOL.

4. Determine T_1 using bubble point of x_{1_i} compositions.

Case II - Stepping down

1. Let condenser be stage "0"

y_{1i} is known

$y_{1i} = x_{Di}$ (Total Cond)

$y_{1i} = x_{Di} K_{Di}$ (Part. Cond)

2. Do dew-point calculations on each stage

(a) Assume T_1 (wgt'd boiling point)

(b) Find K_{1_i} from T_1

(c) Check $\Sigma x_i = 1$

(d) Adjust w/

$$K_{ref}(T_{new}) = K_{ref}(T_{old}) \cdot \Sigma \frac{y_i}{K_i}$$

(e) When $\Sigma x_i = 1$ $T = T_1$

(f) Get $x_{1_i} = y_{1i} K_{1i}$

3. Find y_{2_i} from TOL

4. etc. find T_2 similarly.

Checking initial guess and detecting "bottom" of column:

We need to continue stepping down the column until we meet or exceed requirements for LK & HK, that is,

$$X_{HK,\,N+1} \geq X_{HK,\,BOT} \leftarrow \text{spec}$$

$$X_{LK,\,N+1} \leq X_{LK,\,BOT} \leftarrow \text{spec}$$

We will also have values for LNK's via

$$y_{i_{N+1}} = \frac{\bar{L}}{\bar{V}} x_{i_N} - \left(\frac{\bar{L}}{\bar{V}} - 1\right) x_{i_{Bot}}$$

If our "guessed" distribution at the top is correct, our bottom distribution will be in agreement via mass balances.

Therefore, compute values for LNK at top from values available at bottom. Check for sufficient accuracy via