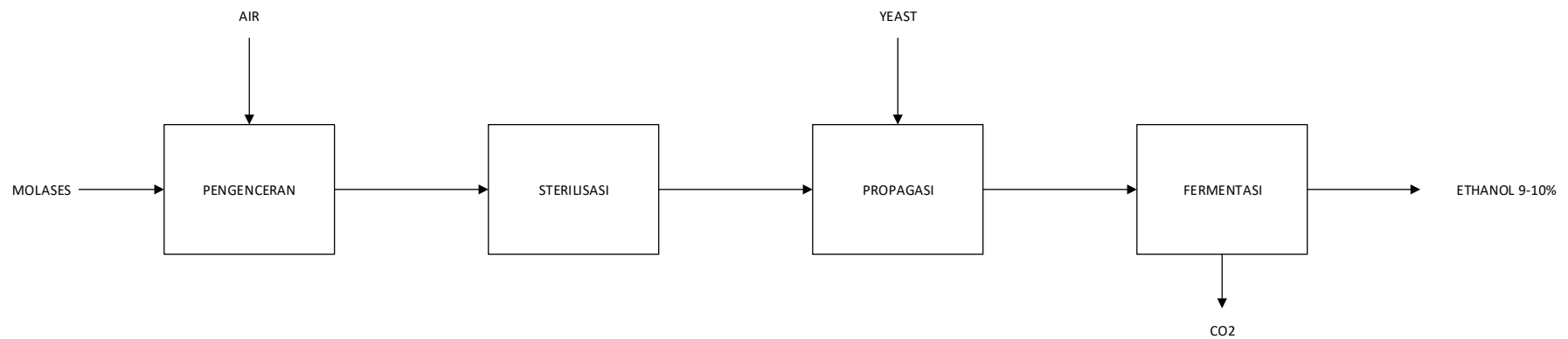
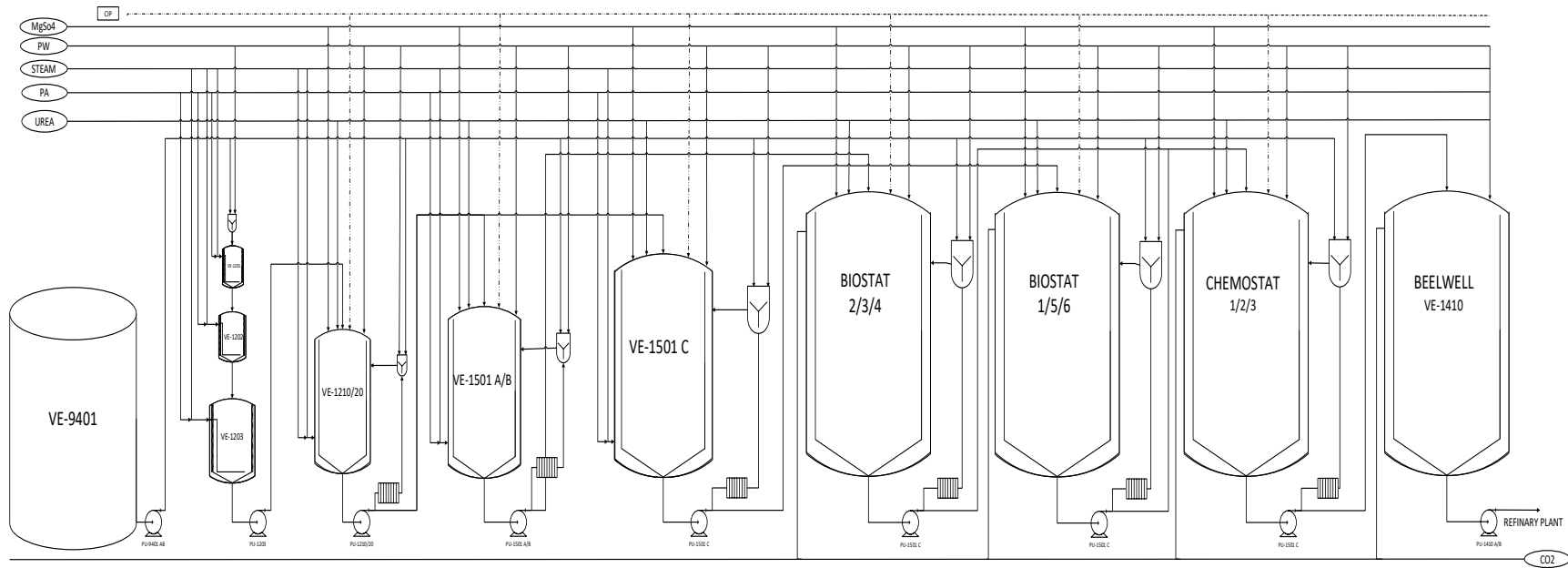




BAB IX TUGAS KHUSUS

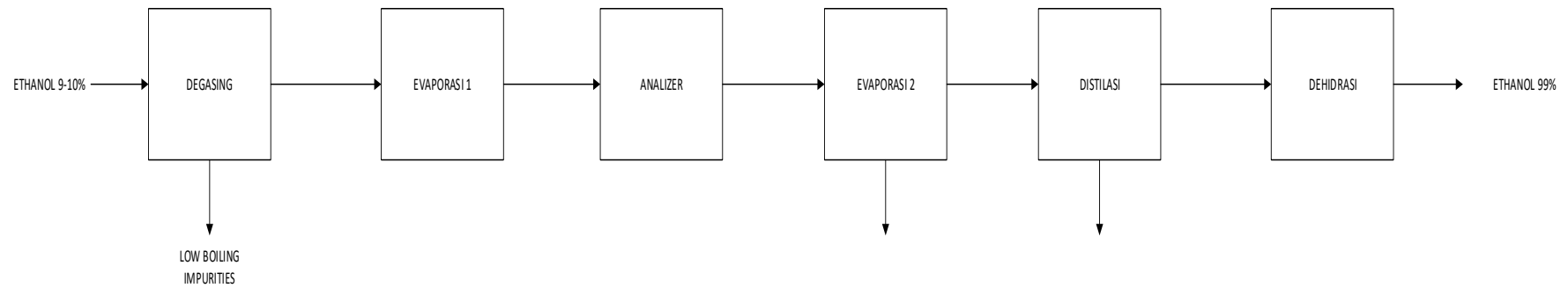
IX.1 Membuat Flow Sheet Fermentasi Plant

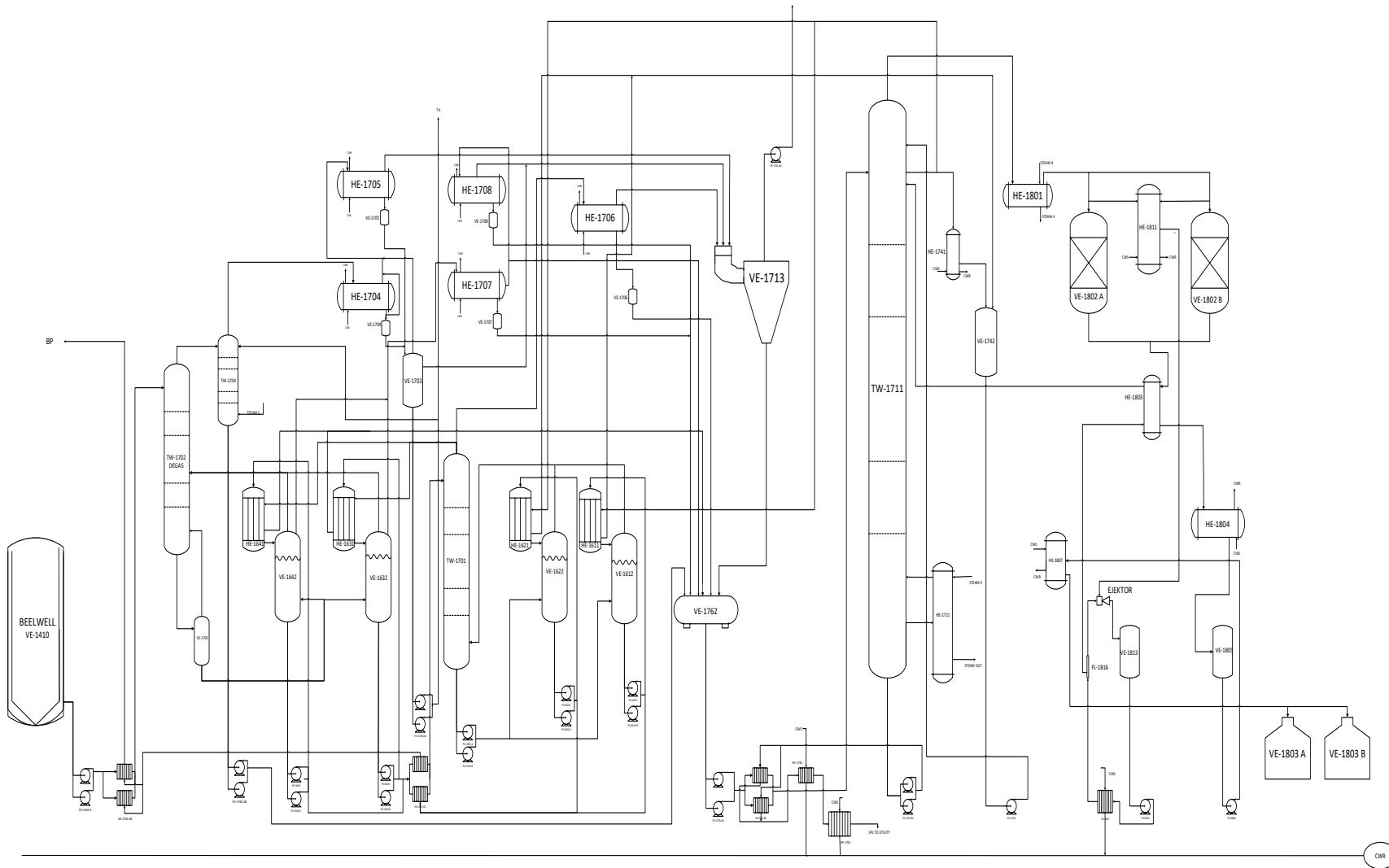






IX.2 Membuat Flow Sheet Refinery Plant







IX.2 Penentuan Jumlah Tray TW-1704 (Aldehid Column)

Fees Masuk (kg/h) = 1337

Feed : P (ATM) = 0,3948 T (°C) = 57,5

Bottom : P (ATM) = 0,0446 T (°C) = 58

Distilat : P (ATM) = 0,2961 T (°C) = 50

❖ PENENTUAN NERACA MASSA KOMPONEN $F=D+B$

❖ PENENTUAN NERACA MASSA KOMPONEN

$$X_{if} \cdot F = Y_{id} \cdot D + X_{ib} \cdot B$$

Komposisi feed masuk dalam kolom aldehid column

Komponen	Kg/jam	Kgmol/jam	% Fraksi Mol
etanol	652,4560	14,1623	0,4767
aseton	0,0267	0,0005	0,0000
asetal	0,0094	0,0001	0,0000
air	684,3742	15,5363	0,5230
asetaldehid	0,1337	0,0074	0,0002
Jumlah	1337,0000	29,7065	1,0000

Konstanta antoine yang digunakan adalah sebagai berikut :

Komponen	BM	A	B	C
etanol	46,07	4,925	1432,526	-61,819
aseton	58,08	4,424	1312,253	-32,445
asetal	118,2	6,812	1301,679	-30,494
air	44,05	3,560	643,748	-198,043
asetaldehid	18,02	3,686	822,894	-69,899

(Sumber: NIST Chemistry WebBook)



Trial bubble point Feed = $95,8046^{\circ}\text{C} = 368,9546^{\circ}\text{K}$

Komponen	log 10 Pi sat	Pi sat atm	Pi sat mmhg	Ki Feed	xi=zi	yi
etanol	0,2612	1,8246	1386,6747	1,5205	0,4767	0,7249
aseton	0,5249	3,3487	2545,0282	2,7906	0,0000	0,0000
asetal	2,9664	925,5483	703416,6824	771,2902	0,0000	0,0021
air	-0,2070	0,6209	471,8971	0,5174	0,5230	0,2706
asetaldehid	0,9347	8,6049	5765,3043	6,3216	0,0002	0,0016
Total					1,000	0,999

Trial bubble point Feed memenuhi, $y_i = 95,805^{\circ}\text{C} = 368,9546^{\circ}\text{K}$

Distribusi produk atas

etanol	93,00%
aseton	0,01%
asetal	0,01%
air	7%
asetaldehid	0%

Distribusi produk bawah

etanol	7,00%
aseton	99,99%
asetal	99,99%
air	93,03%
asetaldehid	99,99%

Distribusi mol masing masing komponen

Komponen	Feed (Kgmol)	Xf	Distilat (Kmol)	X _D	Bottom (Kmol)	X _B
etanol	14,1623	0,4767	13,1709	0,9240	0,9914	0,0642
aseton	0,0005	0,0000	0,0000	0,0000	0,0005	0,0000
asetal	0,0001	0,0000	0,0000	0,0000	0,0001	0,0000
air	15,5363	0,5230	1,0829	0,0760	14,4534	0,9353
asetaldehid	0,0074	0,0002	0,0000	0,0000	0,0074	0,0005
Jumlah	29,7065	1,0000	14,2538	1,0000	15,4527	1,0000



Distribusi berat masing masing komponen

Komponen	Feed (Kg)	Xf	Distilat (Kg)	X _D	Bottom (Kg)	X _B
etanol	652,4560	0,4880	606,7841	0,9271	45,6719	0,0669
aseton	0,0267	0,0000	0,0000	0,0000	0,0267	0,0000
asetal	0,0094	0,0000	0,0000	0,0000	0,0094	0,0000
air	684,3742	0,5119	47,7009	0,0729	636,6733	0,9328
asetaldehid	0,1337	0,0001	0,0000	0,0000	0,1337	0,0002
Jumlah	1337,0000	1,0000	654,4850	1,0000	682,5150	1,0000

Kondisi puncak menara Distilasi pad Dew Point Distilat

Komponen	Log Pi sat	Pi sat mmHg	Pi sat atm	Ki destilat	y _i	x _i =y _i /k _i
etanol	0,1497	1072,7573	1,4115	1,1763	0,9240	0,7856
aseton	0,4400	2093,1713	2,7542	2,2951	0,0000	0,0000
asetal	2,8832	580747,3628	764,1413	636,7844	0,0000	0,0000
air	-0,3719	322,8009	0,4247	0,3539	0,0760	0,2146
asetaldehid	0,8672	5597,2707	7,3648	6,1374	0,0000	0,0000
Total					1,000	1,000

Trial bubble point Feed = 88,7853°C = 361,7853°K



Kondisi puncak menara Distilasi pad Bubble Point Bottom

Komponen	Log Pi sat	Pi sat mmHg	Pi sat atm	Ki bottom	xi	yi=ki*xi
etanol	0,4330	2059,5592	2,7099	2,2583	0,0642	0,1449
aseton	0,6564	3445,2087	4,5332	3,7776	0,0000	0,0001
asetal	3,0954	946675,5029	1245,6257	1038,0214	0,0000	0,0053
air	0,0352	824,2410	1,0845	0,9038	0,9353	0,8453
asetaldehid	1,0387	8309,0280	10,9329	9,1108	0,0005	0,0044
Total					1,000	1,000

Trial bubble point Feed = 107,70 °C = 380,70°K

Berdasarkan bubble point feed didapatkan harga ki feed

Komponen	Ki feed
etanol	1,520
aseton	2,791
asetal	771,290
air	0,517
asetaldehid	6,322

Sehingga diketahui entanol = Light key (mudah menguap)

Air = heavy key (tidak mudah menguap)



$$\alpha_{ij} = \frac{k_i \text{ light key (etanol)}}{k_i \text{ heavy key (air)}}$$

Komponen	Ki feed	α_{ij} feed	ki destilat	α_{ij} destilat	ki bottom	α_{ij} bottom
etanol	1,5205	2,9385	1,1763	3,3233	2,2583	2,4987
aseton	2,7906	5,3932	2,2951	6,4844	3,7776	4,1799
asetal	771,2902	1490,6146	636,7844	1799,0883	1038,0214	1148,5422
air	0,5174	1,0000	0,3539	1,0000	0,9038	1,0000
asetaldehid	6,3216	12,2173	6,1374	17,3397	9,1108	10,0808

$$\begin{aligned} \alpha \text{ average} &= (\alpha_{L \text{ destilat}} \times \alpha_{L \text{ bottom}})^{0,5} && \text{(Geankoplis eq 11.7-13)} \\ &= (3,3233 \times 2,4987)^{0,5} \\ &= 2,8817 \end{aligned}$$

Menentukan Nm

$$\begin{aligned} Nm &= \frac{\log \left(\frac{X \text{ light key destilat} \times D}{X \text{ heavy key destilat} \times D} \frac{X \text{ light key bottom} \times B}{X \text{ heavy key bottom} \times B} \right)}{\log(\alpha \text{ average})} \\ Nm &= \frac{\log (12,6782 \times 14,5794)}{0,4596} \end{aligned}$$



Untuk perhitungan Refluks minimum destilasi, T yang digunakan adalah $T \text{ average} = \frac{(T \text{ dew point } d + T \text{ bubble point } b)}{2}$

Komponen	Log Pi sat	Pi sat mmHg	Pi sat atm	Ki	Xf	Xd
etanol	0,2957	1501,2982	1,9754	1,6462	0,4767	0,9240
aseton	0,5512	2704,1493	3,5581	2,9651	0,0000	0,0000
asetal	2,9922	746516,1023	982,2580	818,5484	0,0000	0,0000
air	-0,1572	529,1877	0,6963	0,5802	0,5230	0,0760
asetaldehid	0,9556	6862,0776	9,0290	7,5242	0,0002	0,0000

$$T = 98,24^{\circ}\text{C} = 371,24^{\circ}\text{K}$$

Menentukan Nilai Rm

$$1 - q = \sum \frac{\alpha_i x_{if}}{\alpha_i - \theta} \quad (\text{geankoplis 11.7-19})$$

$$R \text{ min} + 1 = \sum_1^n \frac{X_d}{(\alpha_{ij} - \theta) / \alpha_{ij}} \quad (\text{geankoplis 11.7-20})$$

Trial $\theta = 1,6505$

aij	1-q	R min + 1
2,837	1,1400	2,2095
5,110	0,0000	0,0000
1410,683	0,0000	0,0000
1,000	-0,8039	-0,1168
12,967	0,0003	0,0000
total	0,3364	2,092738843

$$R_{\text{min}} + 1 = 2,0927$$

$$R_{\text{min}} = 1,0923$$



$$\begin{aligned} \text{Optimum Reflux Ratio} &= 1,1 \text{ s/d } 1,3 \times R_{\min} \quad (\text{Perry 6ed,p.13-34}) \\ &= 1,3 \times R_{\min} \\ &= 1,4206 \end{aligned}$$

$$R/R+1 = \frac{1,4206}{1,4206+1} = 0,5869$$

$$R_m/R_m+1 = \frac{1,0927}{1,0927+1} = 0,5222$$

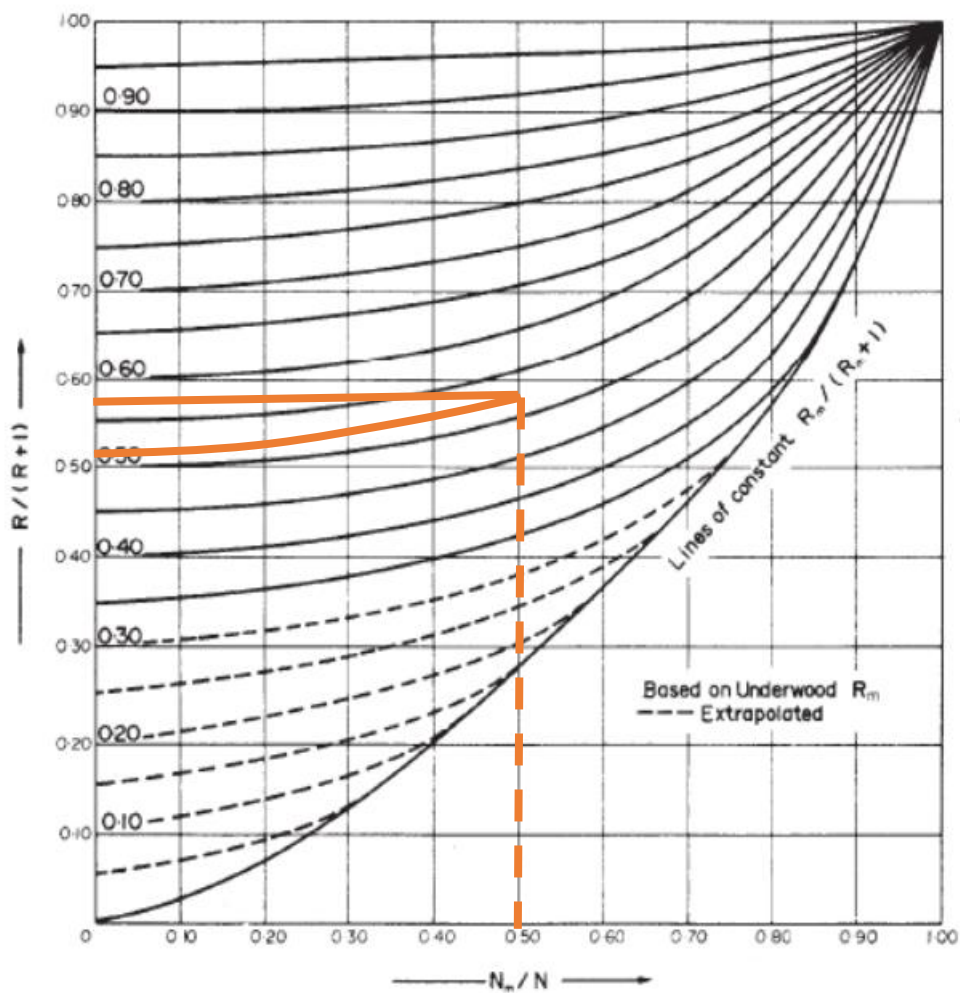


Figure 11.11. Erbar-Maddox correlation (Erbar and Maddox, 1961)



Komponen	A	B	C	D	log10μ	μ
Ethanol	-6,4406	1,12E+03	1,37E+02	-1,55E-05	-0,7029	0,1982
Aseton	-7,2126	9,03E+02	1,84E-02	-2,04E-05	-0,7599	0,1738
Asetal	-6,7319	9,04E+02	1,64E-02	-1,75E-05	-0,6269	0,2361
Asetaldehid	-6,6171	6,81E+02	2,00E-02	-2,56E-05	-0,8882	0,1294
Air	-10,2158	1,79E+03	1,77E-02	-1,26E-05	-0,5461	0,2844
Rata-rata					-0,7048	0,2044

Menentukan E_o

$$E_a = 51 - 32.5 \log(\mu_a \alpha_a)$$

$$E_o = 58,47\%$$

$$N_{aktual} = \frac{N_{ideal} - 1}{E_o}$$

$$N_{aktual} = 15 \text{ stage}$$