

## EXP8 Ternary Phase Equilibrium : All Liquid Diagram

1. The percentages by weight of toluene, glacial acetic acid, and water for each of the mixtures that showed the first indication of clarity are calculated and plotted on triangular graph paper. The densities of each liquids are  $d_{\text{toluene}}=0.867$ ,  $d_{\text{HOAc}}=1.049$ ,  $d_{\text{H}_2\text{O}}=0.996$  g/ml.

(Sol)

$$W = V \times d \quad W_x\% = W_x / W_{\text{total}} \times 100\%$$

先由 mL 求每樣品的克數，再算重量百分率

完成表一(10 組 30 個數據)

2. The tie lines should pass through each three points which are calculated from the steps B-(3), B-(4), and the original composition given by step B-(1).

(Sol)

(1) 計算 4 組比例:中間兩相區的點，先由 mL 求每樣品的克數，再算重量百分率

	Toluene(g)	HOAc(g)	H <sub>2</sub> O(g)	Toluene(%)	HOAc(%)	H <sub>2</sub> O(%)
(40,20.40)						
(40,30.30)						
(40,40.20)						
(40,50.10)						

(2) 由完成表二標定得平均 NNaOH，計算 4 組比例取下層液 5mL，計算所含 HOAc 的 g 數， $W' = W_{\text{HOAc}} / 5\text{mL}$  重量

	$W_{\text{sol}}(\text{g})$	$V_{\text{NaOH}}(\text{mL})$	$W_{\text{HOAc}}(\text{g})$	$W_{\text{HOAc}}(\%)$
(40,20.40)				
(40,30.30)				
(40,40.20)				
(40,50.10)				

(3) Determine the plait point (critical point) on the curve.

(Sol)

繪三相圖

Step 1 點出 10 個原始組成的點 Step 2 繪製一條圓滑線 Step 3 對應 Part B (表四) 之數據點出四個點(四個點應位於圓滑線中) Step 4 將 Part B (表三)對應之組成與圓滑線相交的點點出來 Step 5 將 step 4 和 step 5 的點連線後找出中點 Step 6 將中點之趨勢連成一條線，此直線與圓滑線之相交點即為臨界點(critical poin

## Exp.08

$d_{\text{toluene}}$	0.867	g/ml	$T_{\text{Room}}$	23.2	$^{\circ}\text{C}$
$d_{\text{water}}$	0.9975	g/ml	$P_{\text{Room}}$	752.3	mmHg
$d_{\text{HOAc}}$	1.049	g/ml			

表一

$V_{\text{toluene}}(\text{ml})$	$V_{\text{water}}(\text{ml})$	$V_{\text{HOAc}}(\text{ml})$	$W_{\text{toluene}}(\text{g})$	$W_{\text{water}}(\text{g})$	$W_{\text{HOAc}}(\text{g})$	$W_{\text{總重}}(\text{g})$	$W\%_{\text{toluene}}$	$W\%_{\text{water}}$	$W\%_{\text{HOAc}}$
15.00	1.00	12.60	13.01	0.998	13.217	27.22	47.78%	3.66%	48.56%
10.00	2.00	15.45	8.670	1.995	16.207	26.87	32.26%	7.42%	60.31%
10.00	3.00	20.55	8.670	2.993	21.557	33.22	26.10%	9.01%	64.89%
5.00	2.00	14.92	4.335	1.995	15.651	21.98	19.72%	9.08%	71.20%
5.00	3.00	16.98	4.335	2.993	17.812	25.14	17.24%	11.90%	70.85%
3.00	3.00	13.90	2.601	2.993	14.581	20.17	12.89%	14.83%	72.27%
3.00	6.00	20.46	2.601	5.985	21.463	30.05	8.66%	19.92%	71.43%
1.00	5.00	11.82	0.867	4.988	12.399	18.25	4.75%	27.32%	67.93%
1.00	15.00	20.48	0.867	14.963	21.484	37.31	2.32%	40.10%	57.58%
1.00	25.00	28.30	0.867	24.938	29.687	55.49	1.56%	44.94%	53.50%

表二

	Run1	Run2
Wt. of KHP (g)	2.022	2.002
$V_{\text{NaOH}}(\text{ml})$	9.78	9.56
$N(\text{NaOH})$	1.012	1.025
$N(\text{NaOH})$ (average)	1.019	

表三

V%	$V_{\text{甲苯}}(\text{ml})$	$V_{\text{冰醋酸}}(\text{ml})$	$V_{\text{水}}(\text{ml})$	Wt(g) of 5ml sol'n from lower layer	$V_{\text{NaOH}}(\text{ml})$	$W_{\text{冰醋酸}}(\text{g})$	Wt%冰醋酸
(40.20.40)	16	8	16	4.775	23.80	1.456	30.50%
(40.30.30)	16	12	12	4.583	34.60	2.117	46.19%
(40.40.20)	16	16	8	4.564	45.25	2.769	60.66%
(40.50.10)	16	20	4	4.482	50.60	3.096	69.07%

表四

V%	$V_{\text{甲苯}}(\text{ml})$	$V_{\text{冰醋酸}}(\text{ml})$	$V_{\text{水}}(\text{ml})$	$W_{\text{甲苯}}(\text{g})$	$W_{\text{冰醋酸}}(\text{g})$	$W_{\text{水}}(\text{g})$	$W_{\text{甲苯}}(\%)$	$W_{\text{冰醋酸}}(\%)$	$W_{\text{水}}(\%)$
(40.20.40)	16	8	16	13.872	8.392	15.96	36.29	21.95	41.75
(40.30.30)	16	12	12	13.872	12.588	11.97	36.10	32.76	31.15
(40.40.20)	16	16	8	13.872	16.784	7.98	35.90	43.44	20.65
(40.50.10)	16	20	4	13.872	20.98	3.99	35.71	54.01	10.27

## Calculation

Part A (以 run1 為例)

$$1. W_{\text{total}} = W_{\text{toluene}} + W_{\text{water}} + W_{\text{HOAc}}$$

$$= 15.00\text{ml} \times 0.867 \frac{\text{g}}{\text{ml}} + 1.00\text{ml} \times 0.9975 \frac{\text{g}}{\text{ml}} + 12.60\text{ml} \times 1.049 \frac{\text{g}}{\text{ml}}$$

$$= 27.22\text{ml}$$

$$W\%_{\text{toluene}} = \frac{W_{\text{toluene}}}{W_{\text{total}}} = \frac{15.00\text{ml} \times 0.867 \frac{\text{g}}{\text{ml}}}{27.22\text{ml}} = 47.78\%$$

$$W\%_{\text{water}} = \frac{W_{\text{water}}}{W_{\text{total}}} = \frac{1.00\text{ml} \times 0.9975 \frac{\text{g}}{\text{ml}}}{27.22\text{ml}} = 3.66\%$$

$$W\%_{HOAc} = \frac{W_{HOAc}}{W_{total}} = \frac{12.60ml \times 1.049 \frac{g}{ml}}{27.22ml} = 48.56\%$$

2. 標定 (以 run1 為例)

$$M_{NaOH} \times V_{NaOH} = \frac{W_{KHP}}{M_{KHP}}$$

$$M_{NaOH} = \frac{2.022g}{204.228 \frac{g}{mol}} \times \frac{1}{9.78 \times 10^{-3}L} = 1.012M$$

Part B(以 run 1 為例, 原始組成之計算方法與 Part 1 相同)

$$M_{NaOH} \times V_{NaOH} = n_{HOAc} = \frac{W_{HOAc}}{M_{HOAc}}$$

$$1.019 \frac{mol}{L} \times (23.80 \times 10^{-3}L) = \frac{W_{HOAc}}{60.05 \frac{g}{mol}}$$

$$W_{HOAc} = 1.456g W\%_{HOAc} = \frac{1.456}{4.775} = 30.50\%$$

利用所得知數據繪製三元相圖，並請嘗試找出臨界點

Step 1 點出 10 個原始組成的點

Step 2 繪製一條圓滑線

Step 3 對應 PartB(表四)之數據點出四個點(四個點應位於圓滑線中)

Step 4 將 Part B (表三)對應之組成與圓滑線相交的點點出來

Step 5 將 step 4 和 step 5 的點連線後找出中點

Step 6 將中點之趨勢連成一條線，此直線與圓滑線之相交點即為臨界點(critical point)

