CHAPTER VI

EXPERIMENTAL RESULTS

The experimental results of controlled cycling liquid-liquid extraction are as followed.

6.1 Effect of Combined Volumetric Flow Rate

Total cycle time 18 seconds was used. Volumetric flow ratio of H_2O to MIBK was kept almost constant. Controlled cyclic period was constant at MIBK flow period 1 second, H_2O flow period 1 second, MIBK coalescence 7.5 seconds, and H_2O coalescence 8.5 seconds. The results were shown in tables 6.1 to 6.4. To investigate effect clearly, Number of Transfer Unit (N.T.U) and $\frac{Yin-Yout}{Yin} \times 100$ were plotted versus combined flow rate as shown in Figures 6.1 to 6.6.

Table 6.1 Total Cycle Time 18 seconds

Volume flow ratio 0.693-0.714

Run No.	Volume flow rate (lit/hr)	Volume Flow ratio	$\frac{Yin-Yout}{Yin} \times 100$	Ideal Stage	NTU	HTU (inches)
1	28.8	0.714	85.27	4.5154	4.9195	7.93
2	37.4	0.700	84.28	4.2157	4.4226	8.92
3	44.1	0.696	82.23	4.2750	4.3378	8.99
4	40.9	0.704	82.23	4.1620	4.1566	9.38
5	47.2	0.71	82.23	4.6424	4.1745	9.34
6	50.8	0.693	84.28	4.3500	4.1565	9.36

M.I.B.K flow = 1 second

H_2O flow = 1 "

MIBK Coalescence 7.5 seconds

H_2O Coalescence 8.5 "

Table 6.2 Total Cycle Time 18 seconds

Volume flow ratio 0.85-0.859

Run No.	Volume flow rate (lit/hr)	Volume Flow ratio	$\frac{Yin-Yout}{Yin} \times 100$	Ideal Stage	NTU	HTU (inches)
1	39.6	0.850	86.13	3.4738	3.8977	10.00
2	40.8	0.854	85.14	3.7376	3.6705	10.62
3	42.6	0.852	86.13	3.6862	3.8878	10.03
4	44.8	0.851	87.12	3.8152	4.1185	9.47
5	47.6	0.859	88.11	3.8805	4.3182	9.03
6	49.4	0.857	87.12	3.8152	4.0852	9.55

M.I.B.K. flow = 1 second

H_2O flow = 1 "

MIBK Coalescence = 7.5 seconds

H_2O Coalescence = 8.5 "

Table 6.3 Total Cycle Time 18 seconds

Volume flow ratio 0.98-1.02

Run No.	Volume flow rate ($lit_{/hr}$)	Volume flow ratio	$\frac{Yin-Yout}{Yin} \times 100$	Ideal Stage	NTU	HTU (inches)
1	40.0	1.00	87.46	3.4098	3.578	10.89
2	41.6	0.98	89.38	3.4146	4.049	9.63
3	44.0	1.00	87.46	3.4098	3.578	10.89
4	46.0	1.02	87.46	3.1681	3.5281	11.05
5	46.8	1.02	88.42	3.0854	3.6834	10.58
6	48.0	1.00	87.46	3.4098	3.5780	10.89

MIBK flow = 1 second

H_2O flow = 1 second

MIBK coalescence = 7.5 seconds

H_2O coalescence = 8.5 seconds

Table 6.4 Total Cycle Time 18 seconds

Volume flow ratio 1.25-1.34

Run No.	Volume flow rate (lit/hr)	Volume flow ratio	$\frac{Yin-Yout}{Yin}\times 100$	Ideal stage	NTU	HTU (inches)
1	38.4	1.34	89.00	2.6747	3.1802	12.26
2	41.2	1.264	89.00	2.6286	3.2761	11.90
3	43.2	1.250	89.00	2.7217	3.2949	11.83
4	46.0	1.255	90.00	2.9466	3.4651	11.25
5	49.6	1.254	90.00	3.0579	3.4659	11.25
6	53.4	1.263	92.00	3.1148	3.8715	10.07

MIBK flow = 1 second

H_2O flow = 1 second

MIBK coalescence = 7.5 seconds

H_2O coalescence = 8.5 seconds

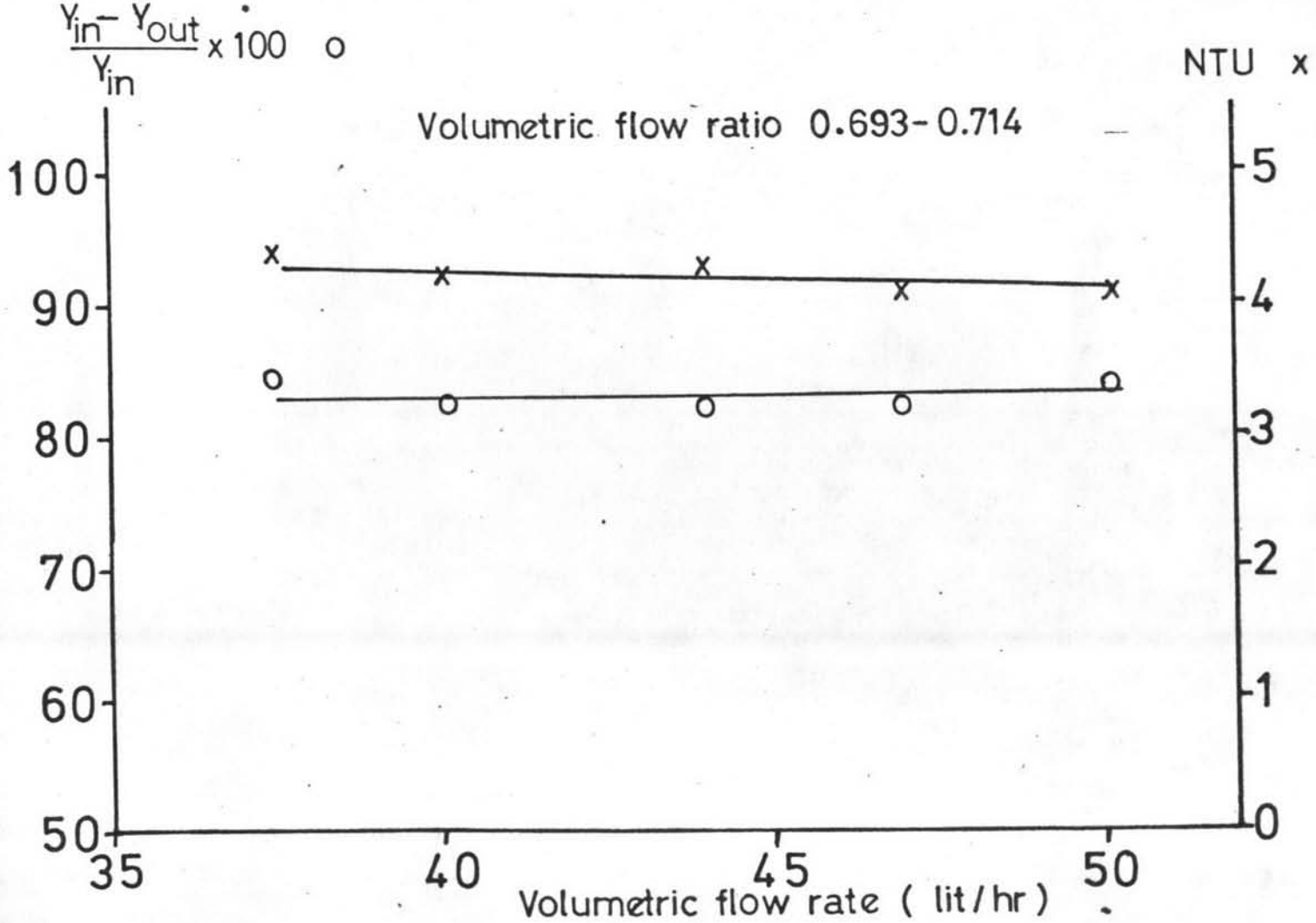

Figure 6.1 Effect of combined flow rate

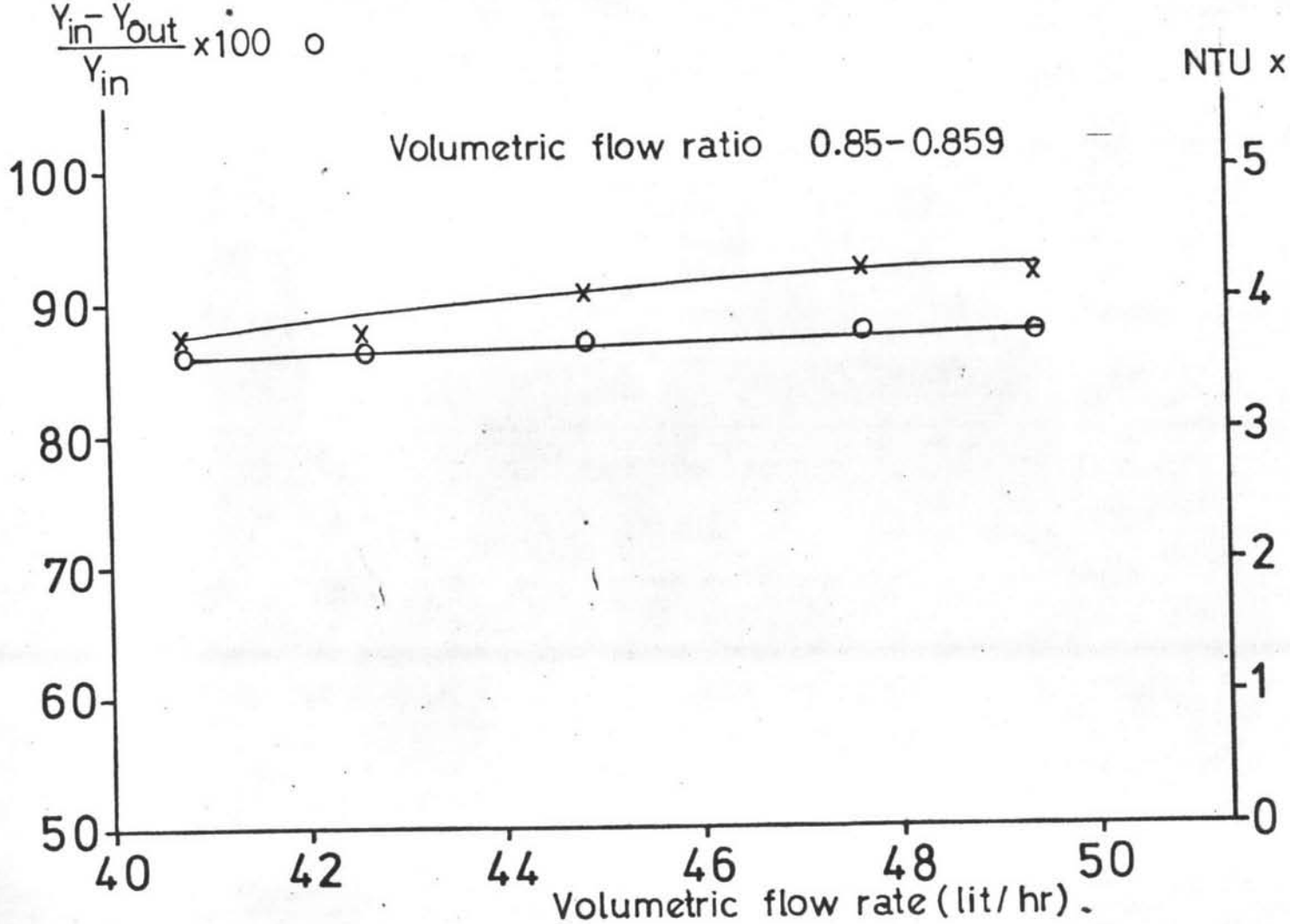

Figure 6.2 Effect of combined flow rate

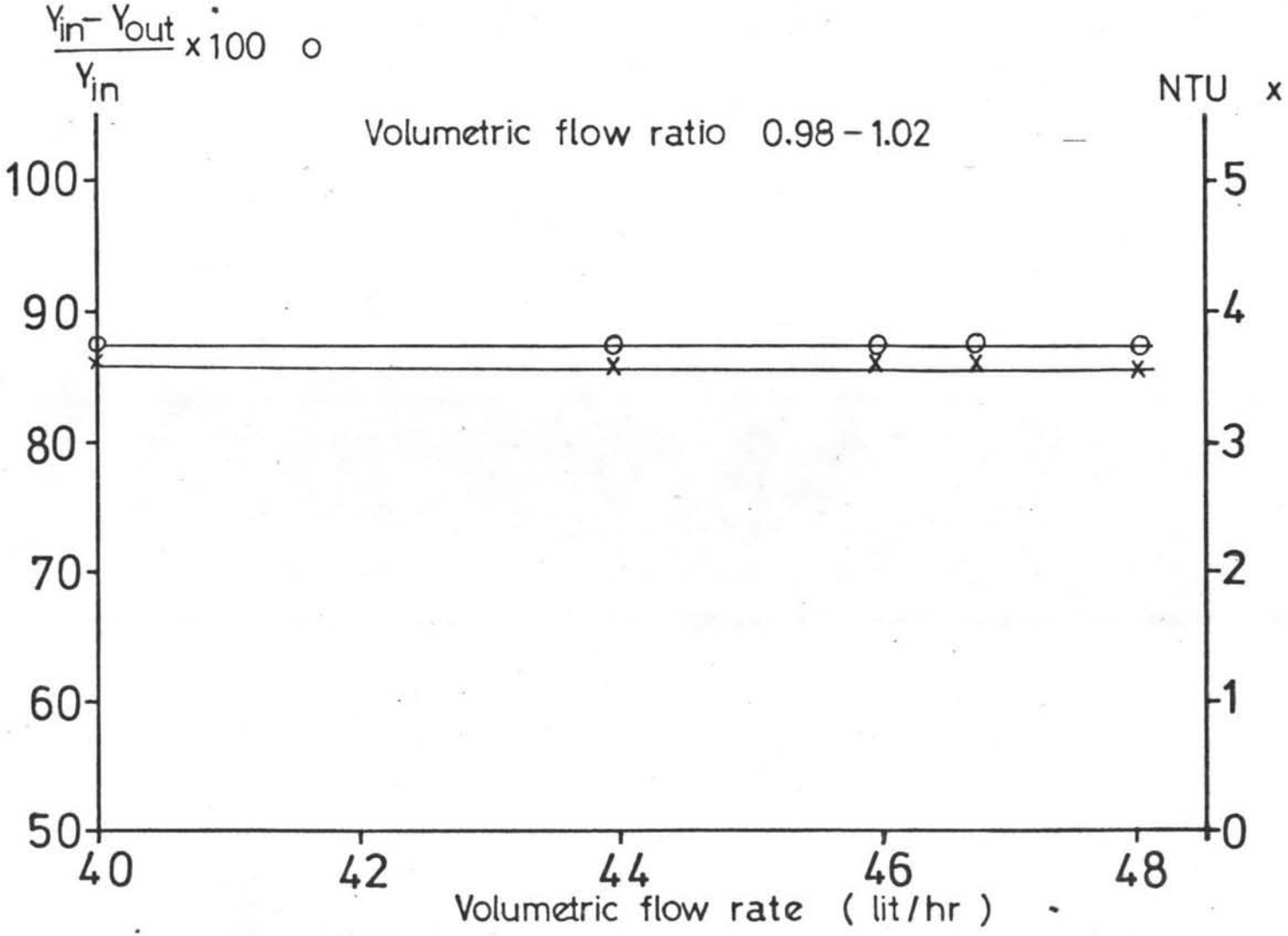

Figure 6.3 Effect of conbined flow rate

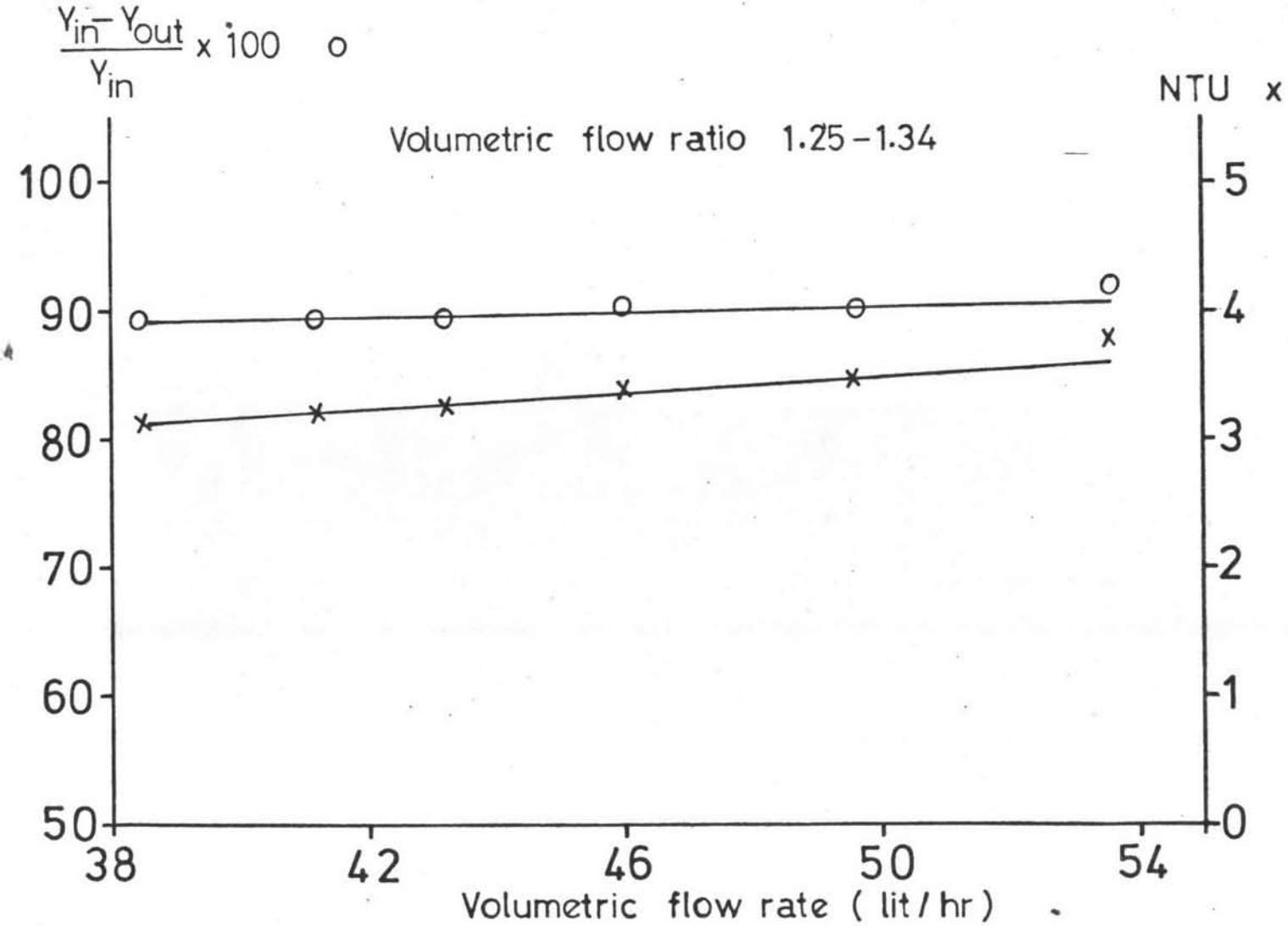

Figure 6.4 Effect of combined flow rate

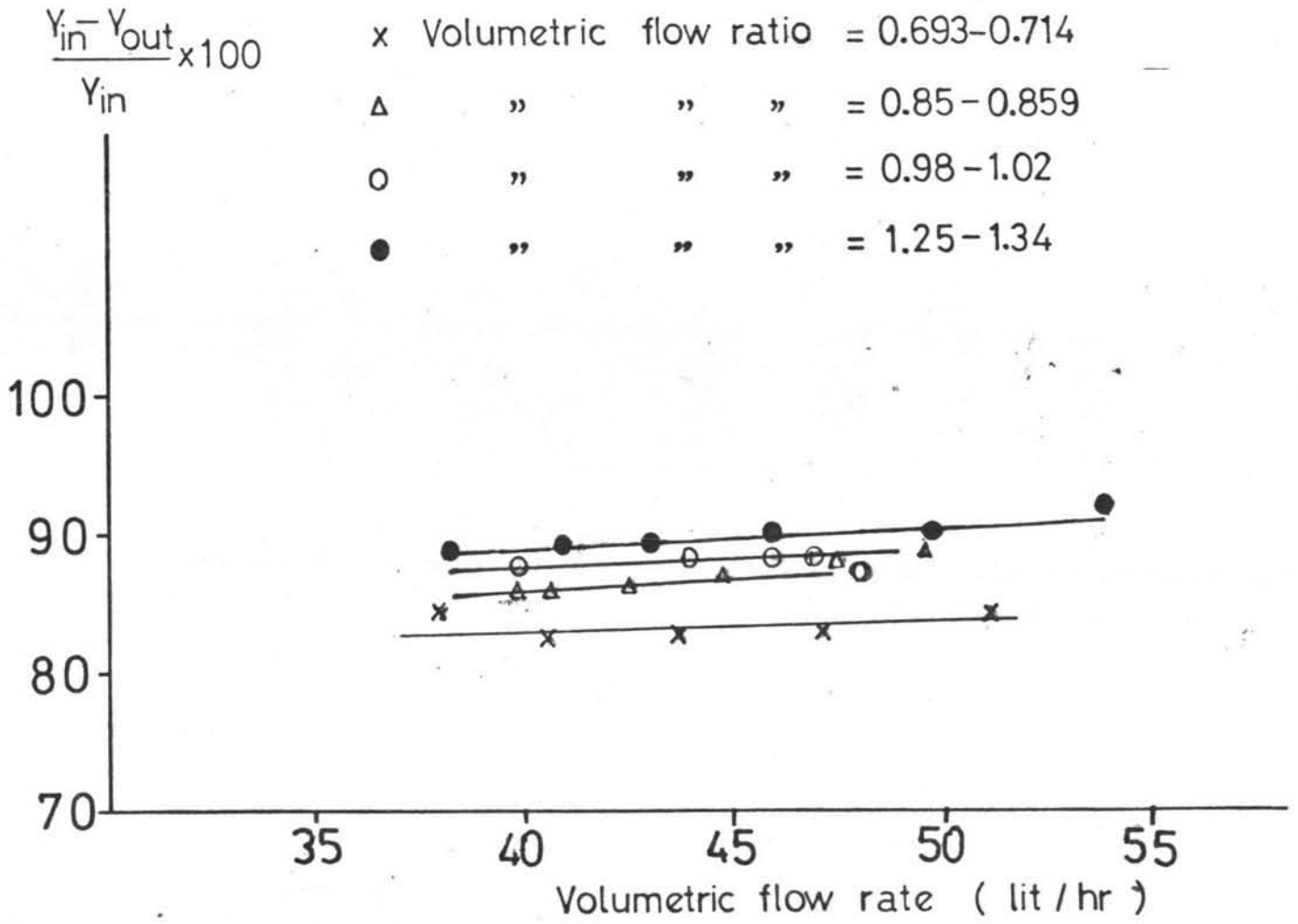

Figure 6.5 Effect of combined flow rate

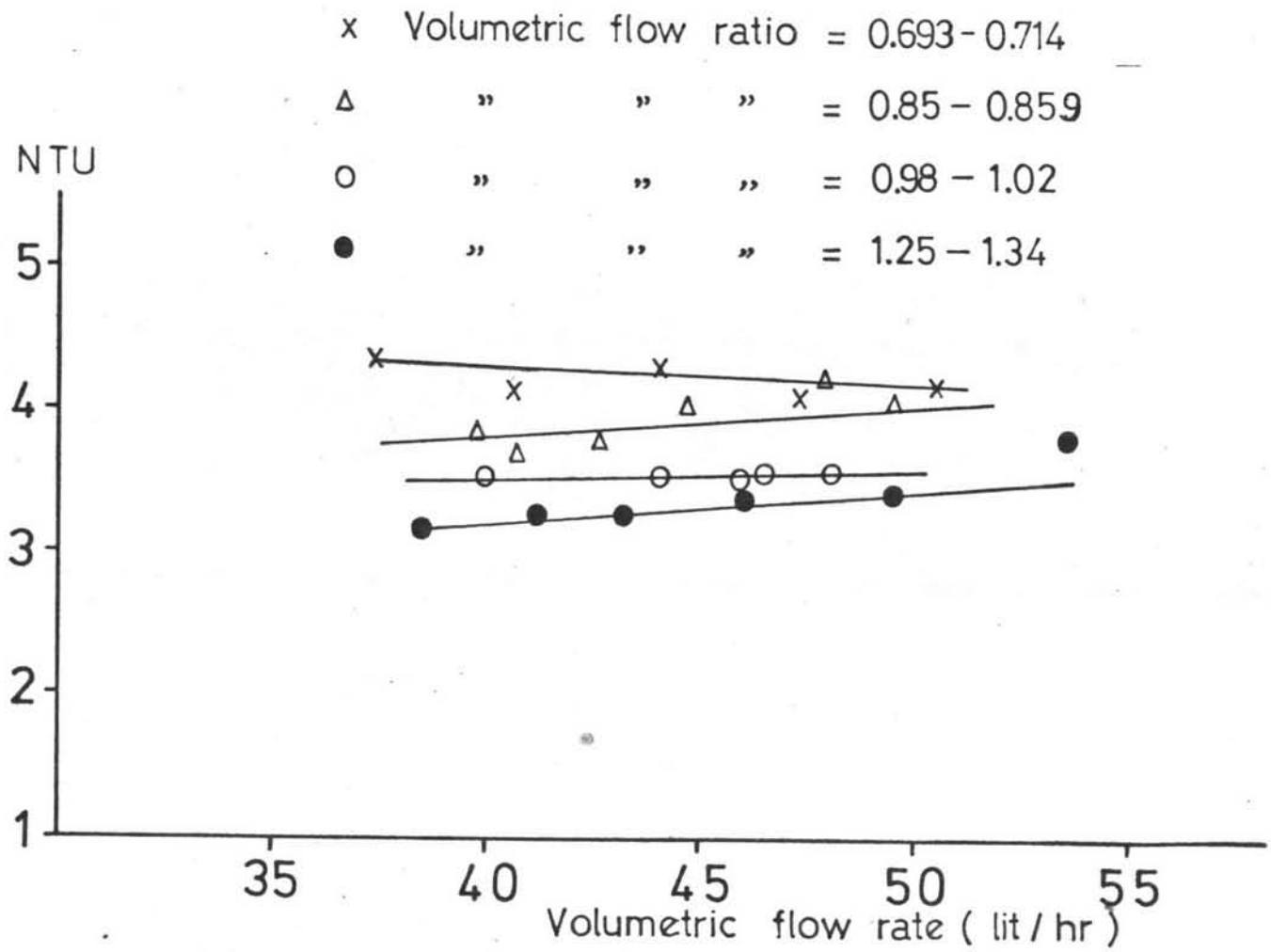

Figure 6.6 Effect of combined flow rate

6.2 Effect of Combined Volumetric Flow rate on Different Control Cyclic Periods

Total cycle time 18 seconds was used. Two sets of controlled cyclic period were used. Set 1. MIBK flow period 1.0 second, H_2O flow 1 second, MIBK coalescence 7.5 seconds H_2O coalescence 8.5 seconds, and volumetric flow ratio 0.85-0.859 were used. The results were shown in table 6.2. Set 2. MIBK flow period 1 second, H_2O flow 1.3 seconds MIBK coalescence 8.4 seconds, H_2O coalescence 7.3 seconds, and volumetric flow ratio 0.811-0.89. The results are shown in ta table 6.5. In order to show the effect NTU and $\frac{Yin-Yout}{Yin}$ were plotted versus volumetric flow rate on Figure 6.7 and 6.8 respectively.

Table 6.5 Total Cycle Time 18 seconds

Volume flow ratio 0.811-0.89

Run No.	Volume flow rate (lit/hr)	Volume flow ratio	$\frac{Yin-Yout}{Yin}\times 100$	Ideal stage	NTU	HTU (inches)
1	30.76	0.853	88.11	2.8303	4.3005	9.06
2	32.32	0.857	87.12	2.6305	3.9837	9.78
3	33.68	0.811	87.12	2.6805	4.3228	9.02
4	34.4	0.890	90.00	3.0073	4.5666	8.54
5	36.94	0.847	90.00	3.2706	4.9211	7.92
6	41.26	0.875	88.11	2.7814	4.1726	9.34

MIBK flow = 1.0 second

H_2O flow = 1.3 second

MIBK coalescence = 8.4 seconds

H_2O coalescence = 7.3 seconds

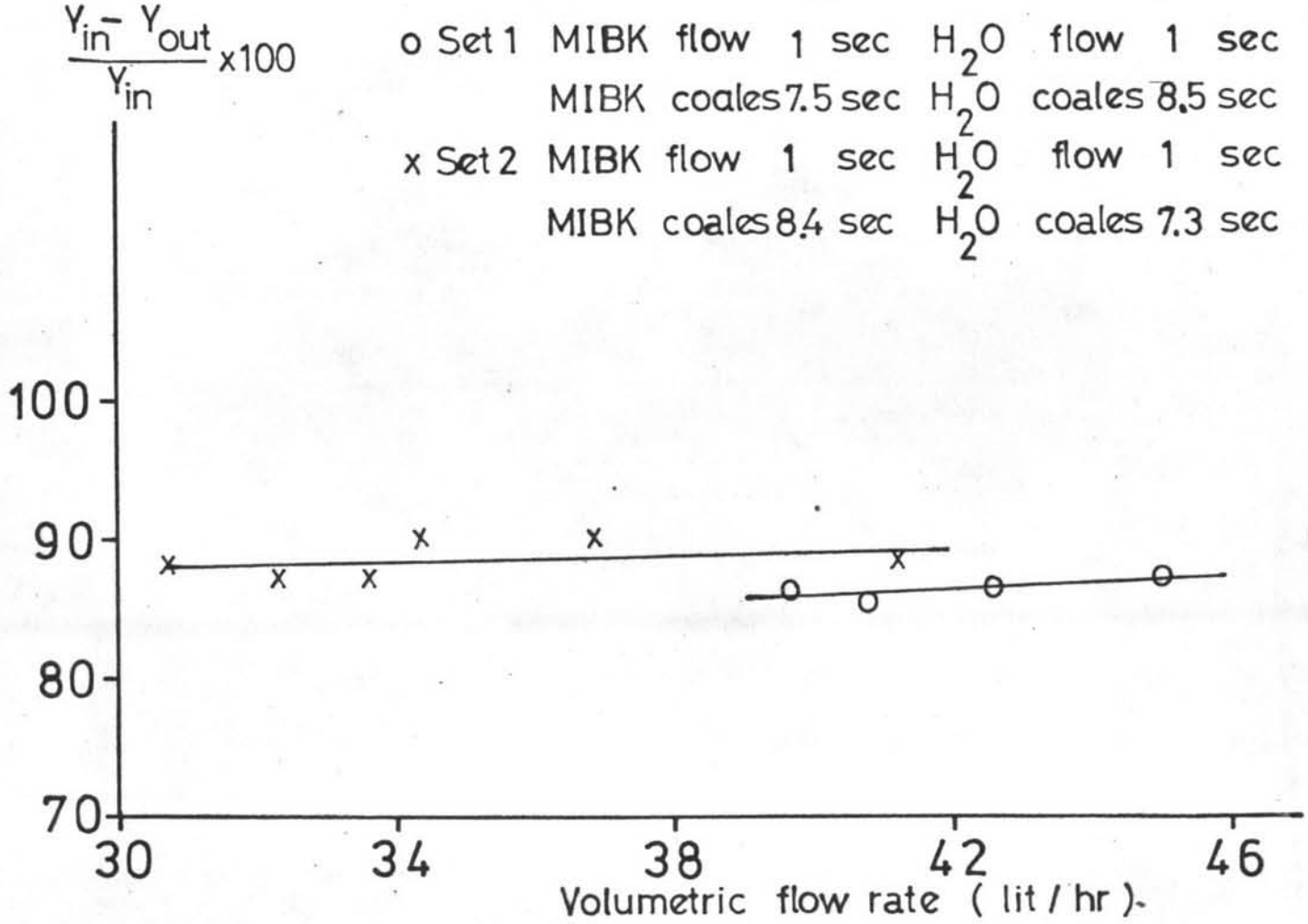

Figure 6.7 Effect of different control cyclic period

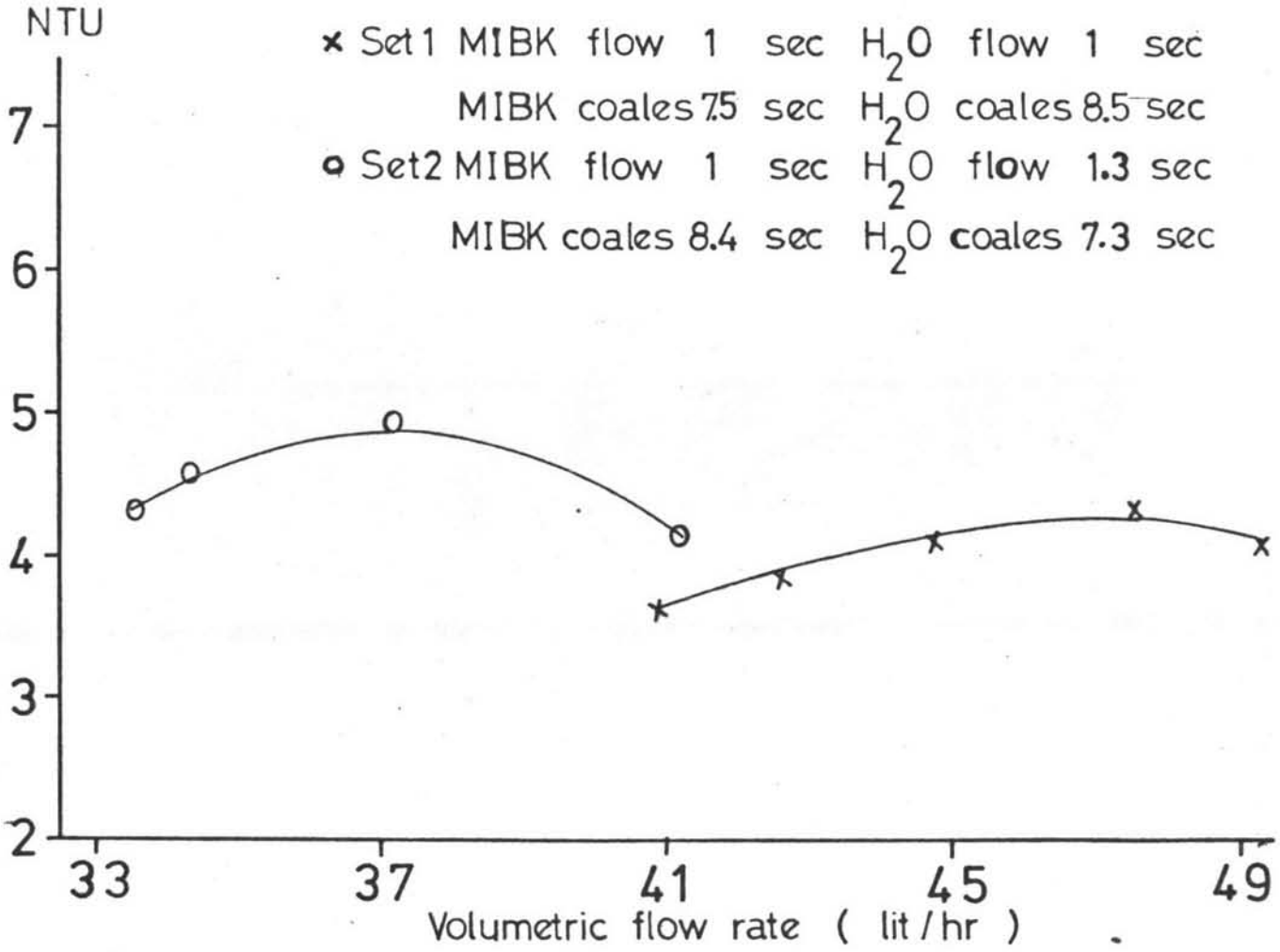

Figure 6.8 Effect of different control cyclic period

6.3 Effect of Volumetric Flow Ratio on Total Cycle Time 13.2 Seconds

Total cycle time 13.2 seconds was used. Volumetric flow rate was kept almost constant. Controlled cyclic period was used as: MIBK flow 0.9 second, H_2O flow 0.9 second MIBK coalescence 5.7 seconds, and H_2O coalescence 5.7 seconds. The results were shown in table 6.6. The interpretations of these results were shown in Figures 6.9 and 6.10

6.4 Effect of Volumetric Flow Ratio on Total Cycle Time 11.8 Seconds

Total cycle time 11.8 seconds was used. Volumetric flow rate was kept almost constant. Controlled cyclic period was used as: MIBK flow 0.8 second, H_2O flow 0.8 second MIBK coalescence 5.1, and H_2O coalescence 5.1 seconds. The results were shown in table 6.7. The interpretations of these results were shown in Figure 6.11 and 6.12.

Table 6.6 Total Cycle Time 13.2 seconds

Run No.	Volume flow rate (lit/hr)	Volume flow ratio	$\frac{Yin-Yout}{yin} \times 100$	Ideal stage	NTU	HTU (inches)
1	58.091	0.49	83.55	2.4097	1.5170	25.74
2	57.272	0.62	60.09	2.5080	1.5801	24.72
3	56.454	0.77	65.61	2.9284	1.7292	22.51
4	55.637	0.96	80.37	3.5983	2.6572	14.70
5	54.818	1.21	86.64	3.4749	3.024	12.89
6	54.000	1.54	91.78	3.5592	3.4849	11.19

MIBK flow = 0.9 seconds

H_2O flow = 0.9 seconds

MIBK Coalescence = 5.7 seconds

H_2O Coalescence = 5.7 seconds

Table 6.7 Total Cycle Time 11.8 seconds

Run No.	Volume flow rate (lit/hr)	Volume flow ratio	$\frac{Yin-Yout}{Yin}\times 100$	Ideal stage	NTU	HTU (inches)
1	57.966	0.46	52.43	3.0277	1.543	25.27
2	56.136	0.77	69.91	3.4110	2.046	19.06
3	55.221	0.99	84.58	2.9096	3.0991	12.58
4	53.39	1.19	88.69	3.2366	3.3584	11.61
5	54.39	1.28	82.43	3.3966	2.4475	15.93

MIBK flow = 0.8 second

H_2O flow = 0.8 second

MIBK coalescence = 5.1 second

H_2O coalescence = 5.1 second

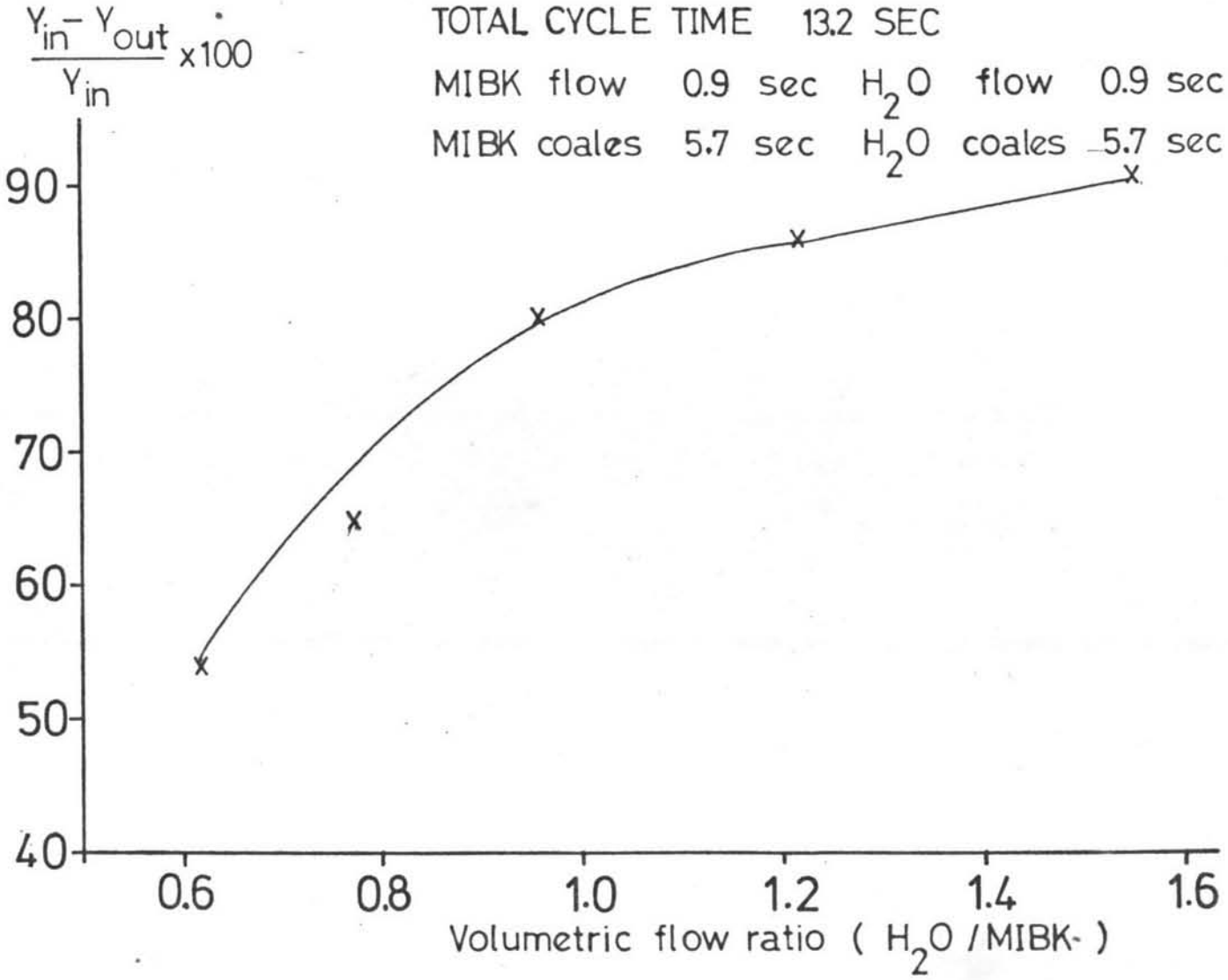

Figure 6.9 Effect of volumetric flow ratio

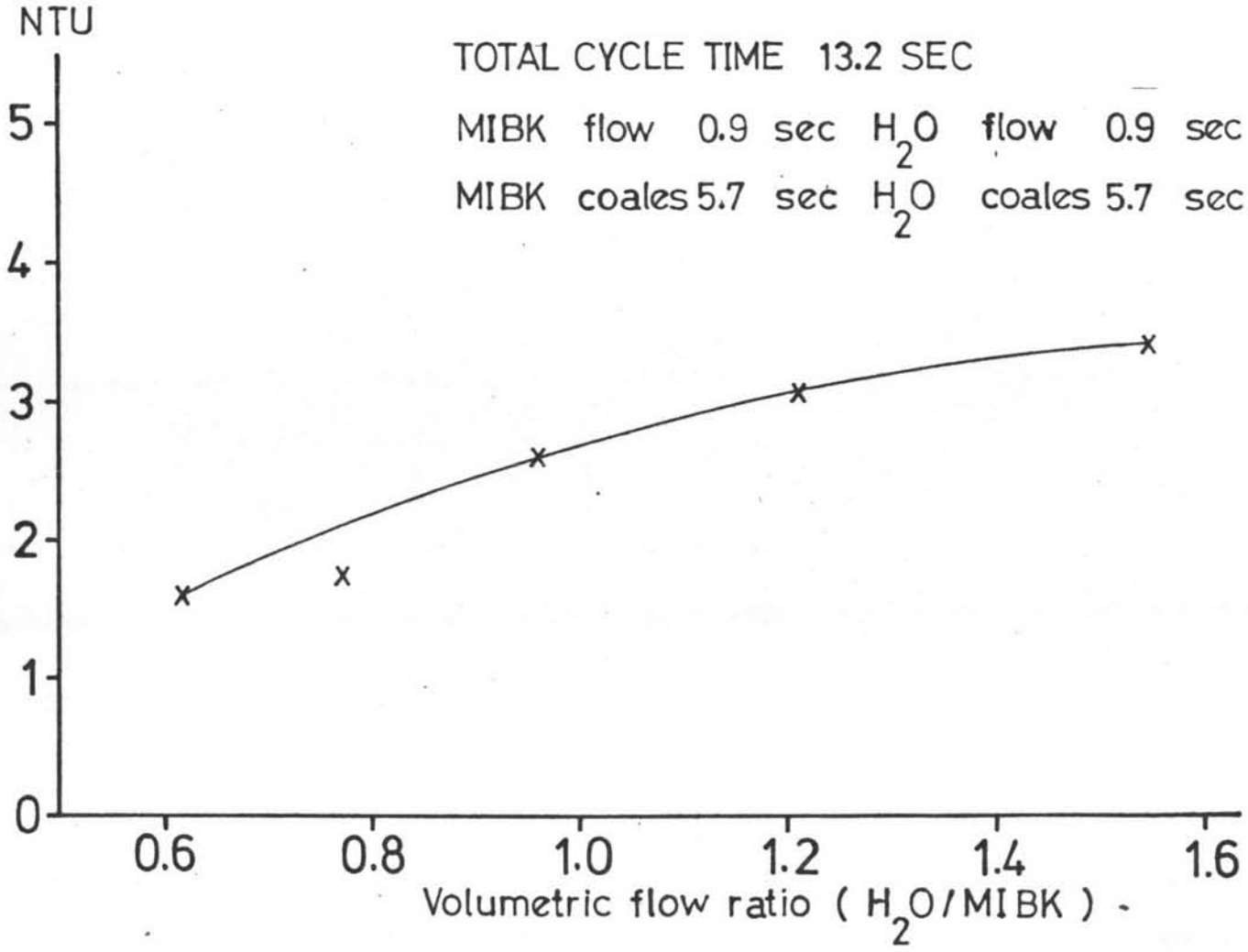

Figure 6.10 Effect of volumetric flow ratio

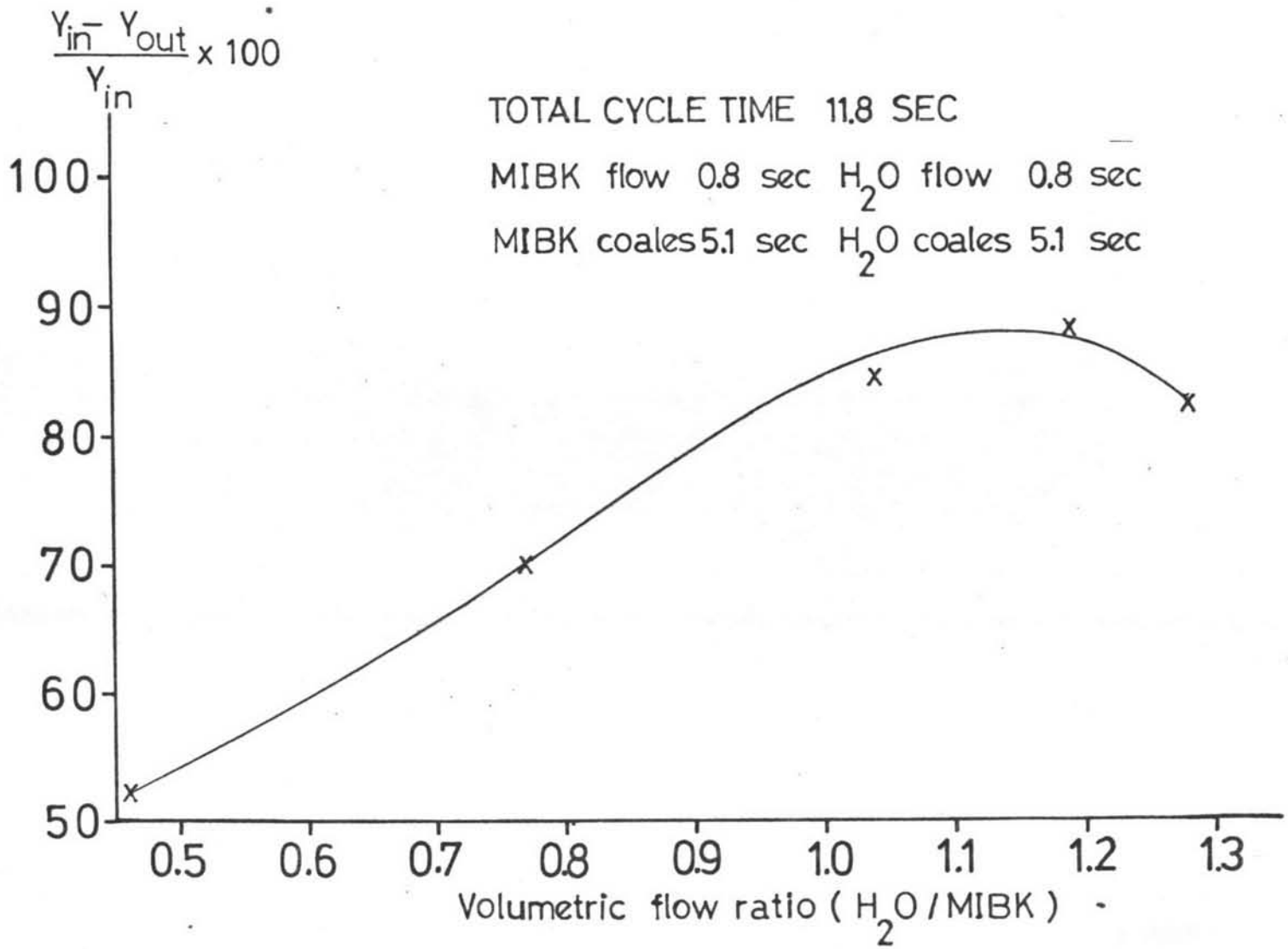

Figure 6.11 Effect of volumetric flow ratio

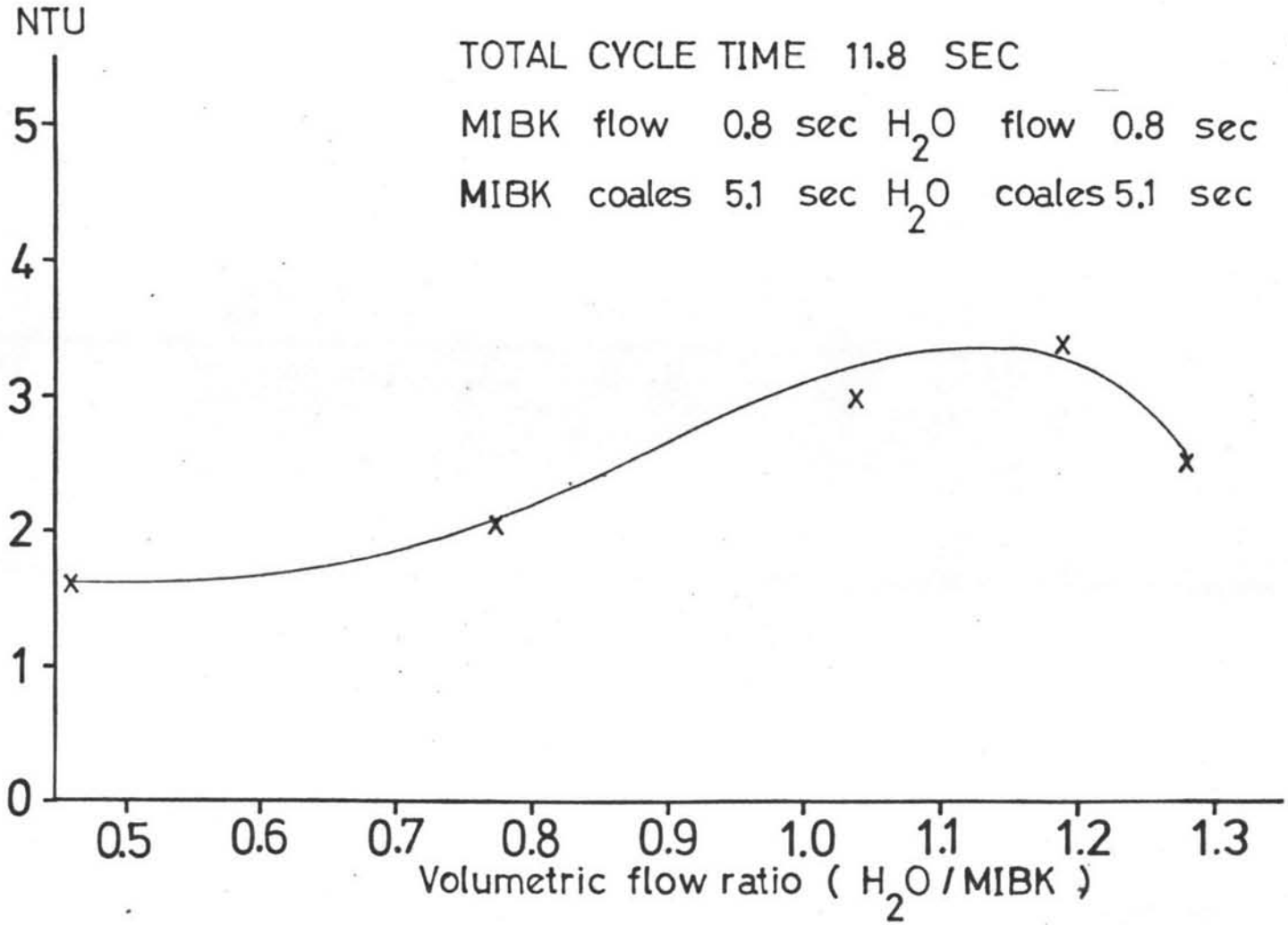

Figure 6.12 Effect of volumetric flow ratio

6.5 Effect of Fraction Open of H_2O to MIBK Flow

Total cycle time 18 seconds was used. Fraction open of H_2O to MIBK flow periods in this experiment were varied from 0.714 to 1.6, and kept coalescence period of H_2O and MIBK constant at 7.8 seconds. Volumetric flow rate, and volumetric flow ratio are kept constant as possible the interpretations of these results were shown in table 6.8 and in Figure 6.13 and 6.14 respectively.

Table 6.8 Effect of Fraction Open of H_2O to MIBK flow

Total cycle time 18 seconds; volume flow ratio 0.76-0.78

Run No.	Volume flow rate (lit/hr)	Fraction open	$\frac{Yin-Yout}{Yin} \times 100$	Ideal stage	NTU	HTU
1	46.8	0.714	72.74	4.20	2.31	16.8
2	46.9	0.850	76.51	4.087	2.72	14.33
3	46.0	1.00	83.4	3.422	3.66	10.65
4	46.7	1.18	84.43	3.356	4.02	9.10
5	46.10	1.4	89.15	2.93	4.8	7.50
6	47.0	1.6	86.51	3.31	4.49	8.68

H_2O Coalescence 7.8 seconds

MIBK Coalescence 7.8 seconds

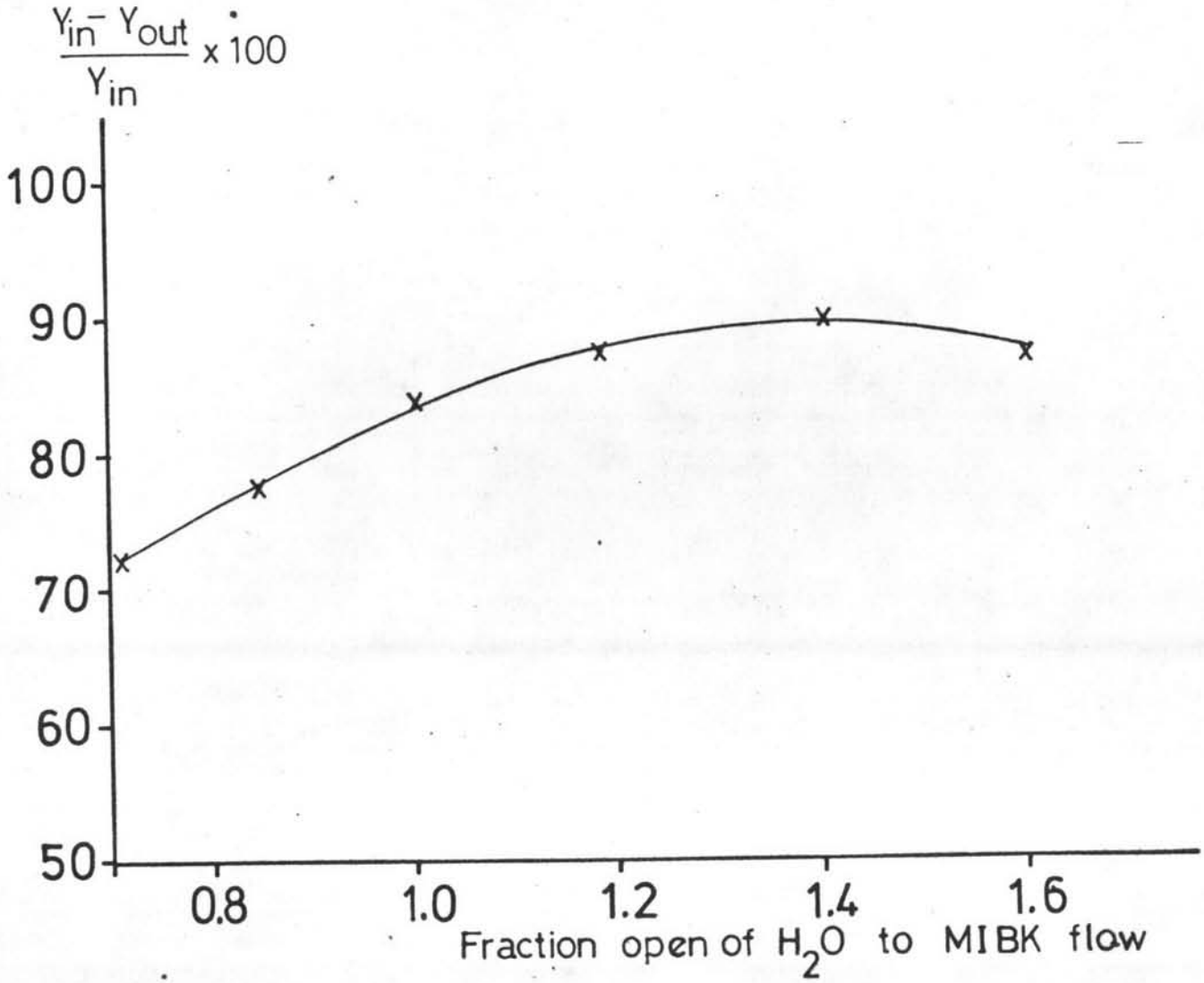

Figure 6.13 Effect of fraction open of H_2O to MIBK flow

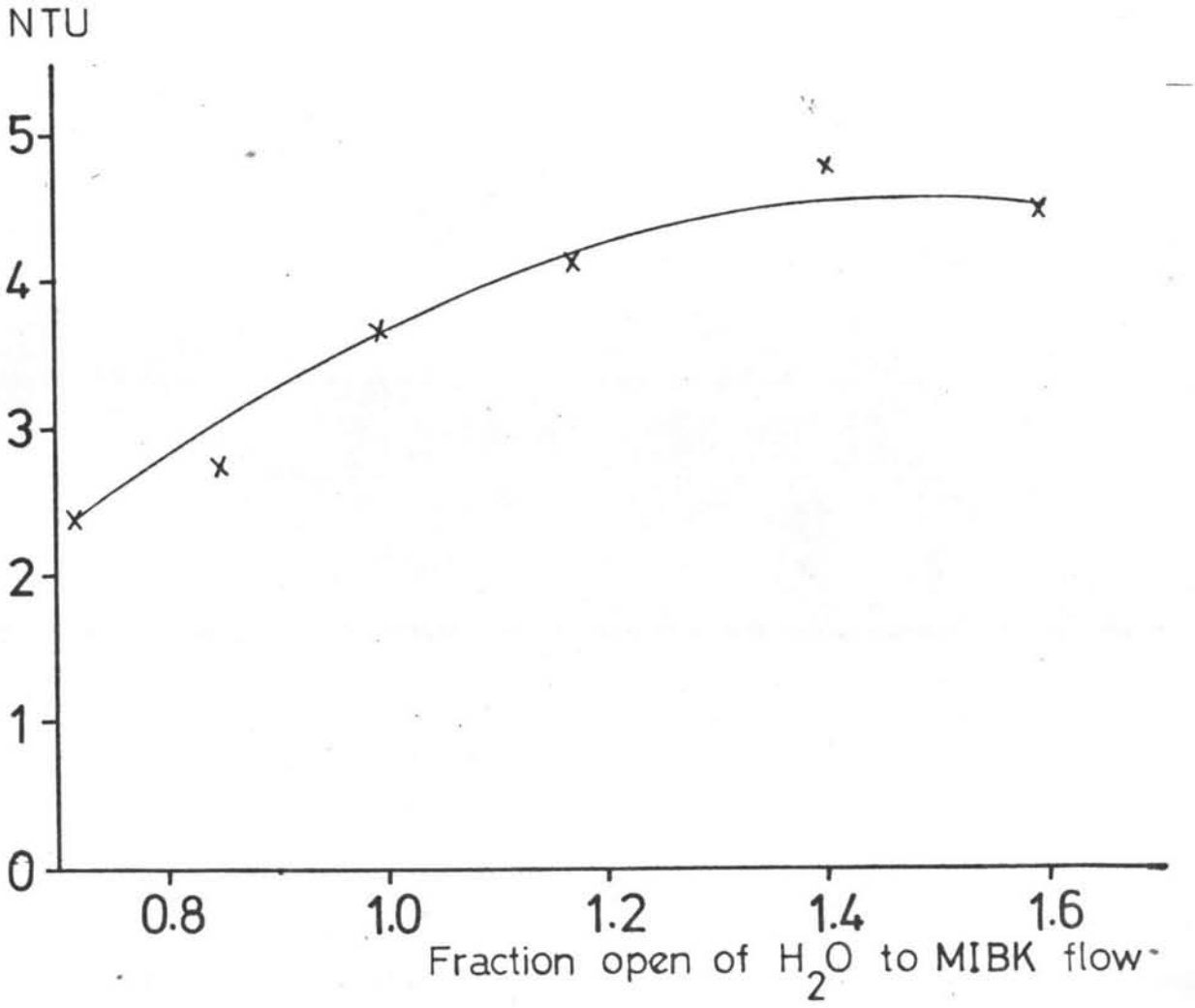

Figure 6.14 Effect of fraction open of H_2O to MIBK flow