Chapter VI

EXPERIMENTAL RESULTS

6.1 Over all Heat Transfer Coefficients

In order to find whether the efficiency of the double pipe heat exchanger was improved by cyclic operation, over all heat transfer coefficients of the exchanger were experimentally determined. These values were calculated using equation

The effects of operating variables; cycle time, Reynolds number, fraction open and fluid temperatures on over all heat transfer coefficients were found to be as below.

6.2 Effect of Cycle Time Upon Over All Heat Transfer Coefficients

Three values of cycle time; 6.1, 10.0 and 13.0 seconds were used. The inlet hot water temperature and fraction open were kept constant. The results are shown in Table 6-1. To investigate the effect clearly, over all heat transfer coefficients were plotted versus cycle time as shown in Figures 6.1 and 6.2.

Table 6-1 Effect of Cycle Time Upon Over all

Heat Transfer Coefficients

Inlet hot water temperture $^{\circ}C$	cycle time (seconds)	Over all heat transfer coefficient U_o, Btu/hr $ft^2\ ^{\circ}F$			
		Fraction open, f			
		0.5	0.6	0.7	1.0
82	6.1	263.6	262.6	297.1	155.7
	10.0	313.9	371.6	401.9	155.7
	13.0	170.7	184.2	254.9	155.7
72	6.1	233.3	282.7	392.4	149.1
	10.0	265.2	354.8	395.3	149.1
	13.0	123.8	268.5	294.2	149.1

Table 6-2 Effect of Reynolds Number Upon Over all

Heat Transfer Coefficients

a) fraction open = 0.5

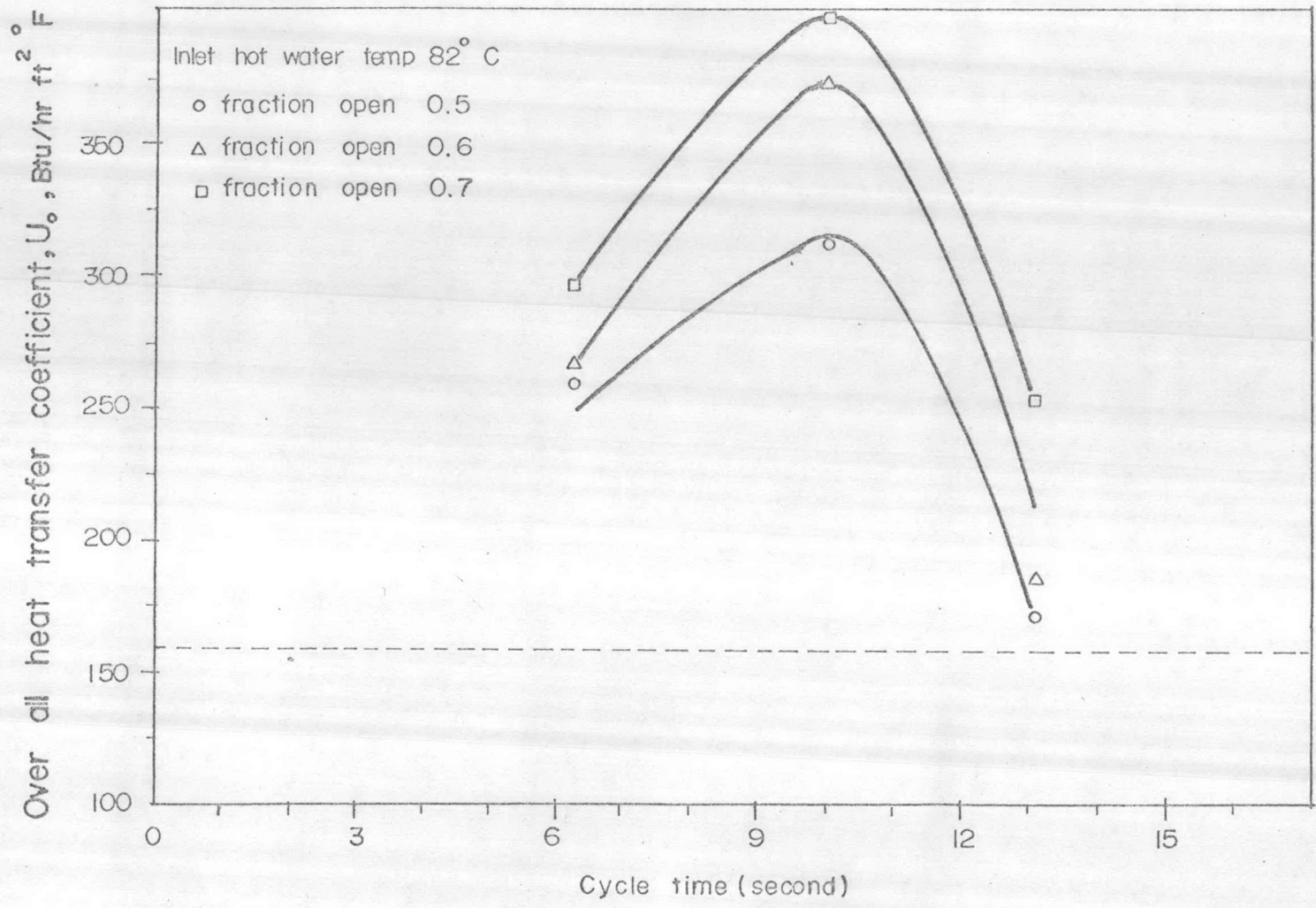| Cycle time (seconds)	Cold water Reynolds No.	Over all heat transfer coefficient U_o, Btu/hr ft^2 ^{o}F			
		hot water Reynold number			
		3789	3620	3344	2896
6.1	922	250.6	418.5	268.9	255.6
	1041	237.3	263.6	223.9	205.7
	1173	233.9	242.7	209.5	220.7
10.0	922	277.8	387.2	261.9	305.0
	1041	262.7	313.4	273.4	255.0
	1173	255.4	306.8	264.7	228.9
13.0	922	176.8	283.0	202.3	258.9
	1041	146.8	240.9	142.9	170.0
	1173	136.9	170.7	102.4	144.4

Fig. 6.1 Effect of cycle time upon over all heat transfer coefficient.
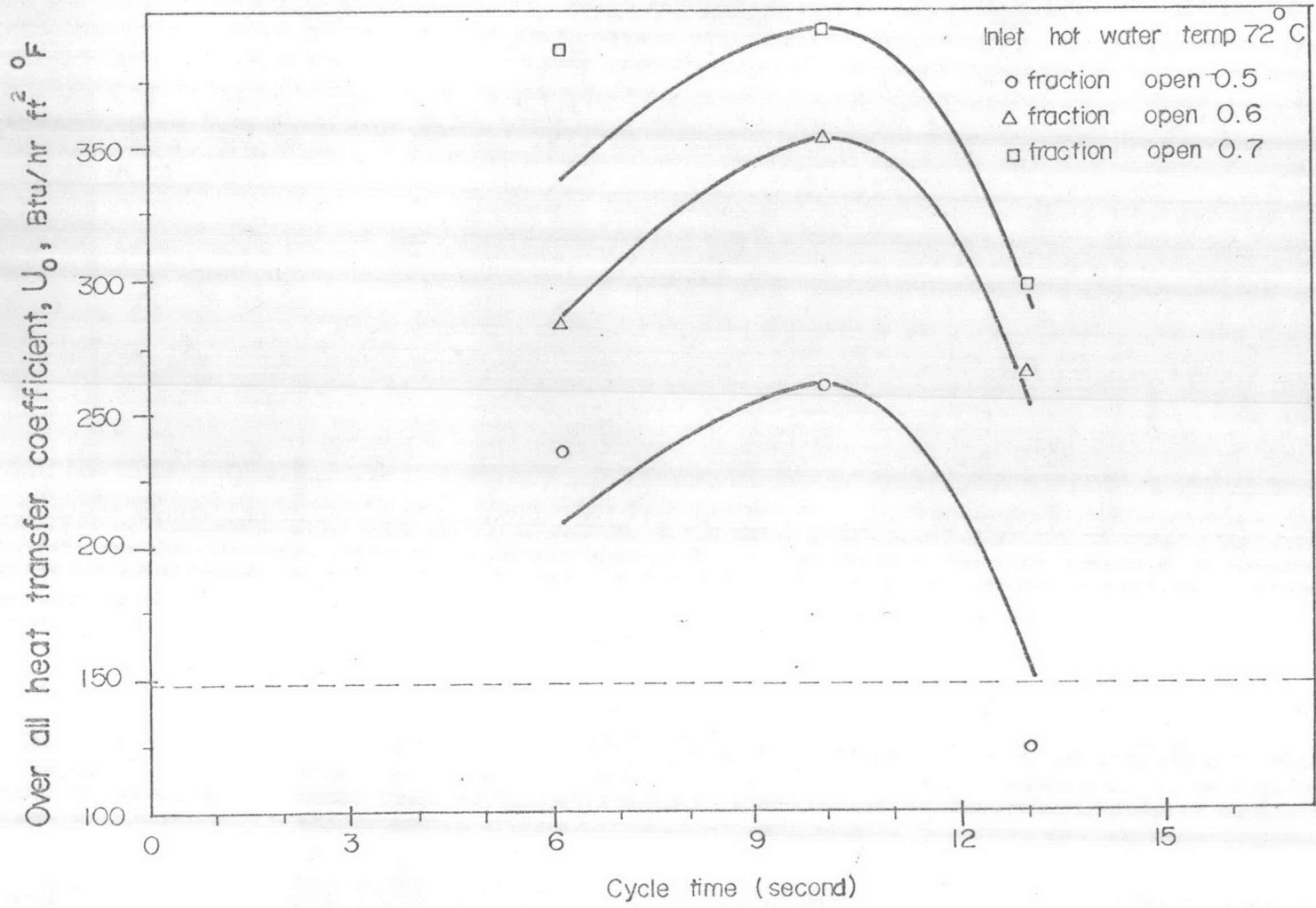
Fig. 6.2 Effect of cycle time upon over all heat transfer coefficient.

6.3   Effect of Reynolds Number Upon Over all Heat Transfer
      Coefficients

The dimensionless group which had significant effect
on the efficiency of the exchanger was Reynolds number.
Two kinds of Reynolds number; hot water and cold water
Reynolds number were used to interpret the results.   The
former was in the range of 2896-7149 and the latter was
1145-2346.   From these values, the flow of fluid covered
in both laminar zone and turbulent zone.   The results were
shown in table 6-2.   In order to show the effect, over all
heat transfer coefficients were plotted versus Reynolds
number at constant fraction open and cycle time as shown
in Figures 6-3 to 6-8.

Table 6-2 Effect of Reynolds Number Upon Over all

Heat Transfer Coefficient

b) fraction open = 0.7

| Cycle time (seconds)	Cold water Reynolds No.	Over all heat transfer coefficient, U_o, Btu/hr ft^2 ^{o}F			
		Hot water Reynolds number			
		5133	4904	4531	3924
6.1	1457	543.4	526.9	888.5	694.2
	1535	538.6	519.1	823.5	451.9
	1642	507.4	449.9	820.2	497.6
10.0	1457	400.3	440.6	465.3	433.2
	1535	377.6	410.7	446.0	378.2
	1642	294.1	349.6	431.5	333.3
13.0	1457	271.9	238.7	289.8	258.9
	1535	247.0	223.3	266.5	159.5
	1642	215.3	248.9	254.3	149.7
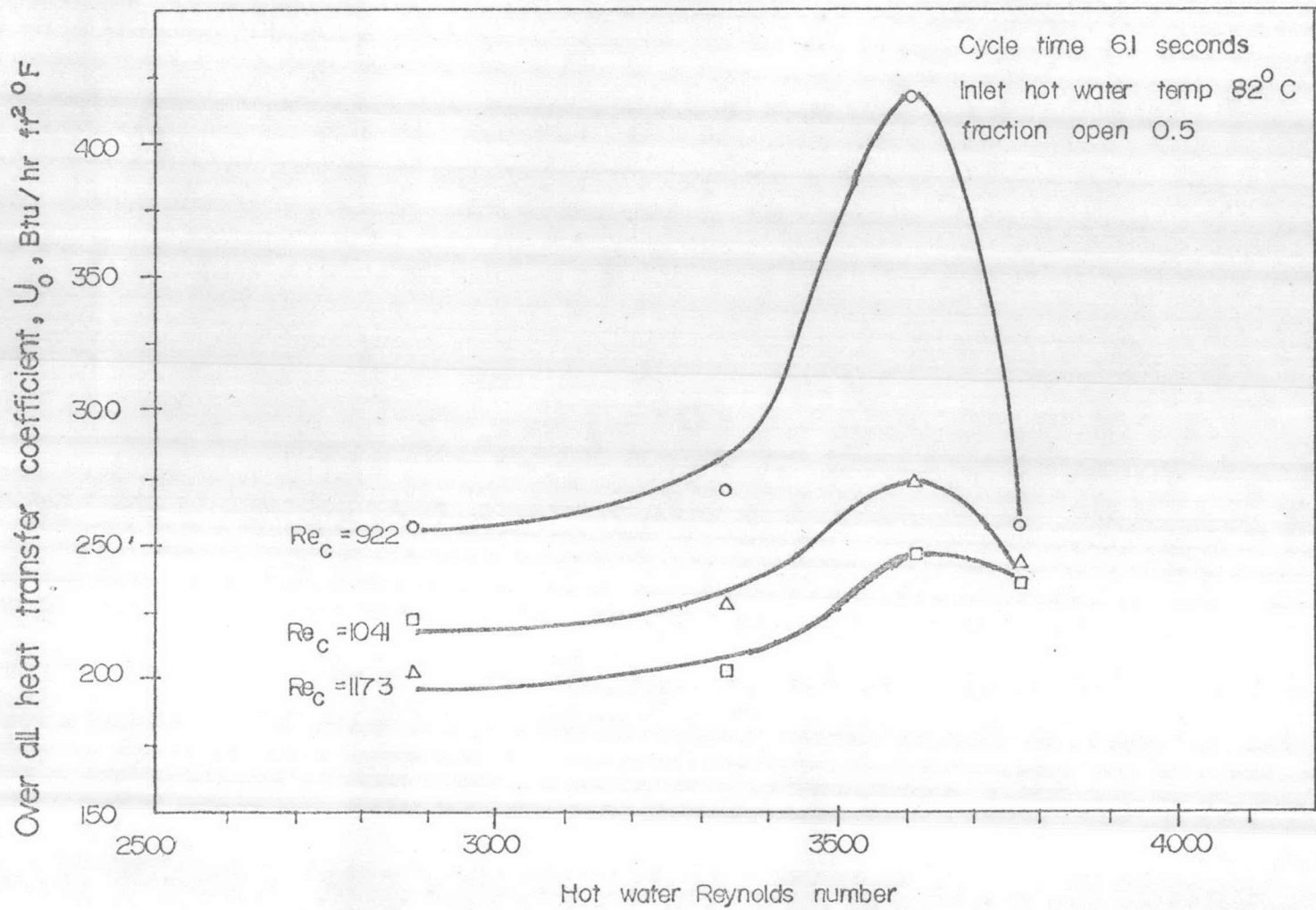
Fig. 6.3 Effect of Reynolds number upon over all heat transfer coefficient
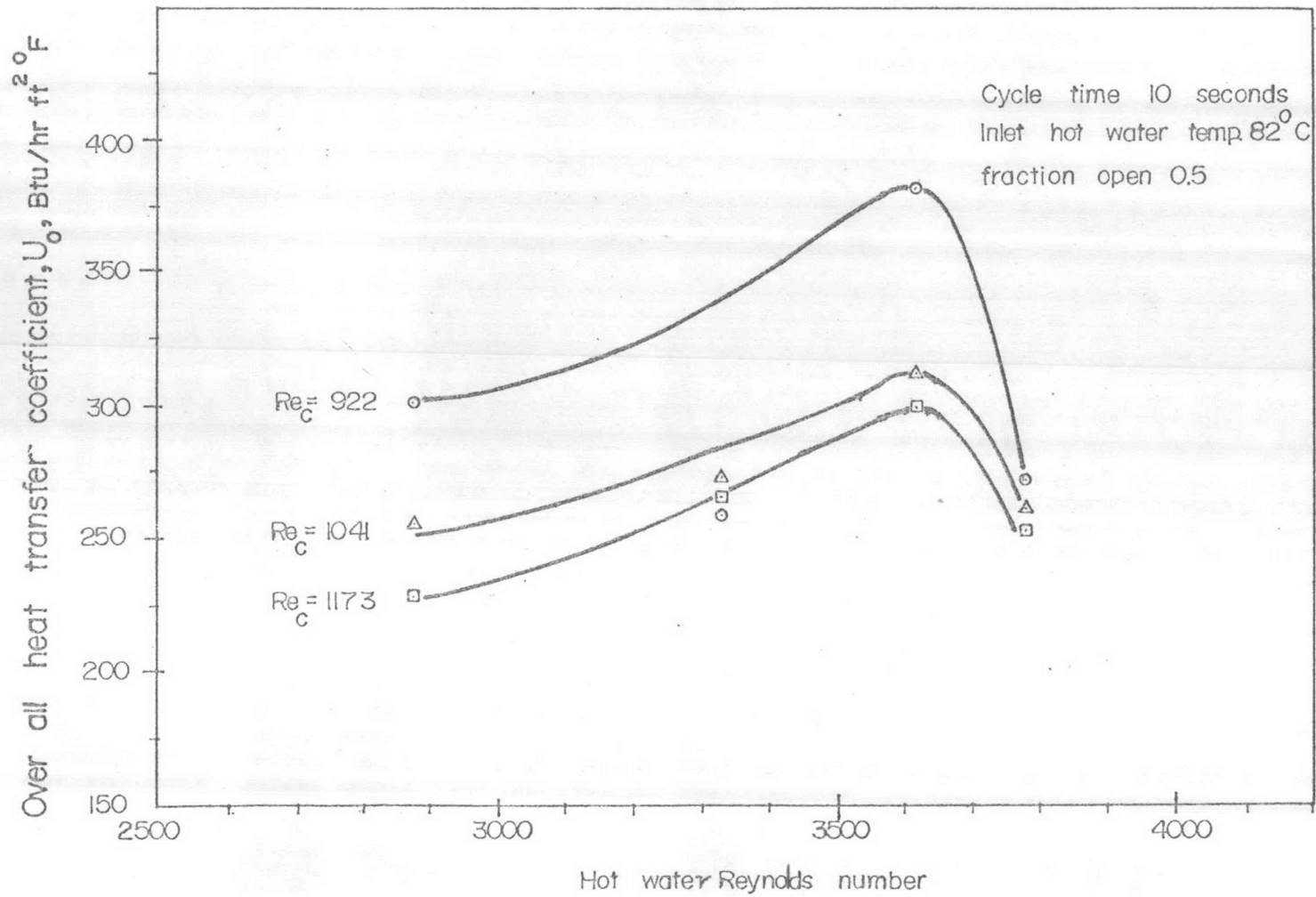
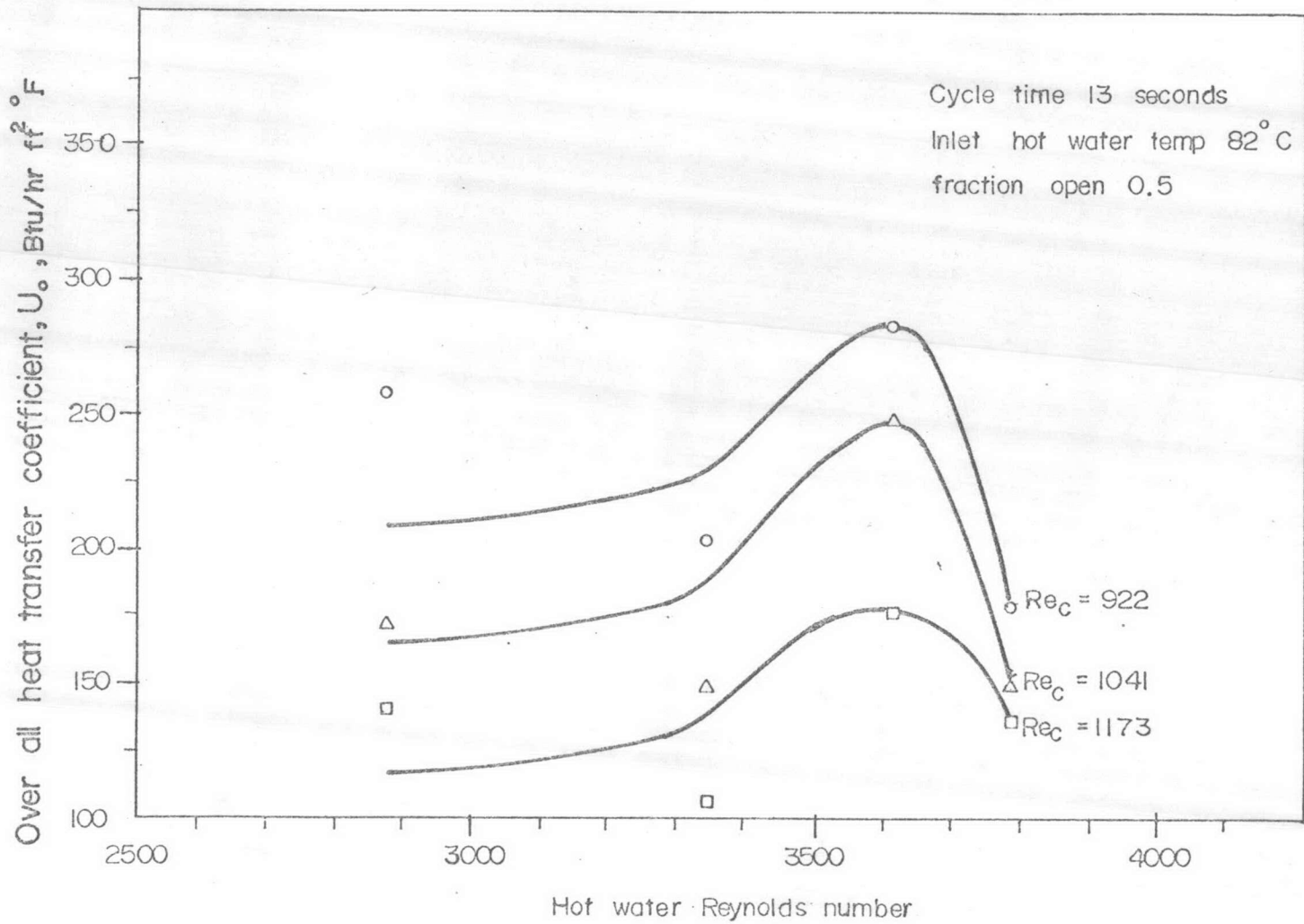Fig. 6.4 Effect of Reynolds number upon over all heat transfer coefficient.

Fig. 6.5 Effect of Reynold number upon over all heat transfer coefficient.
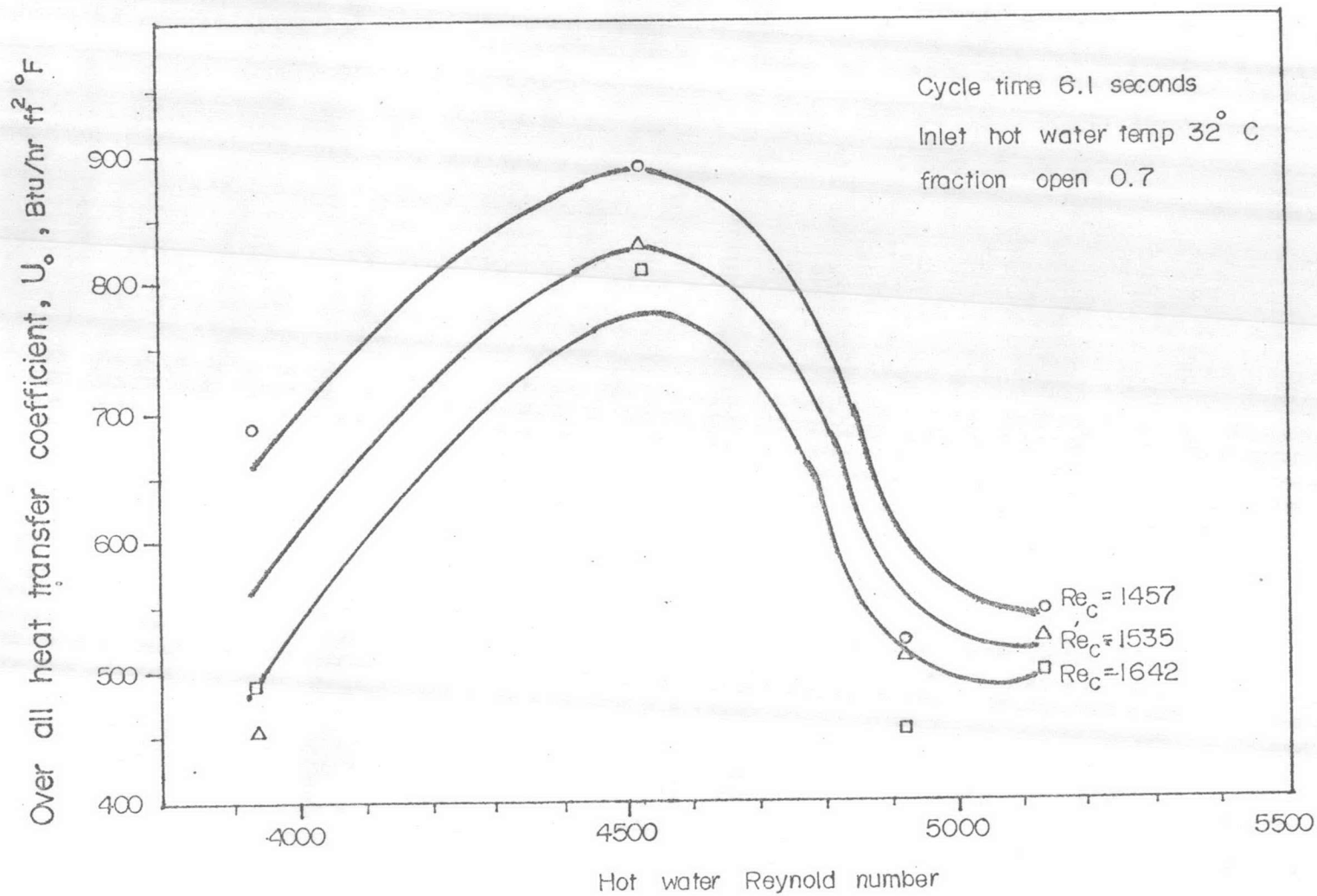
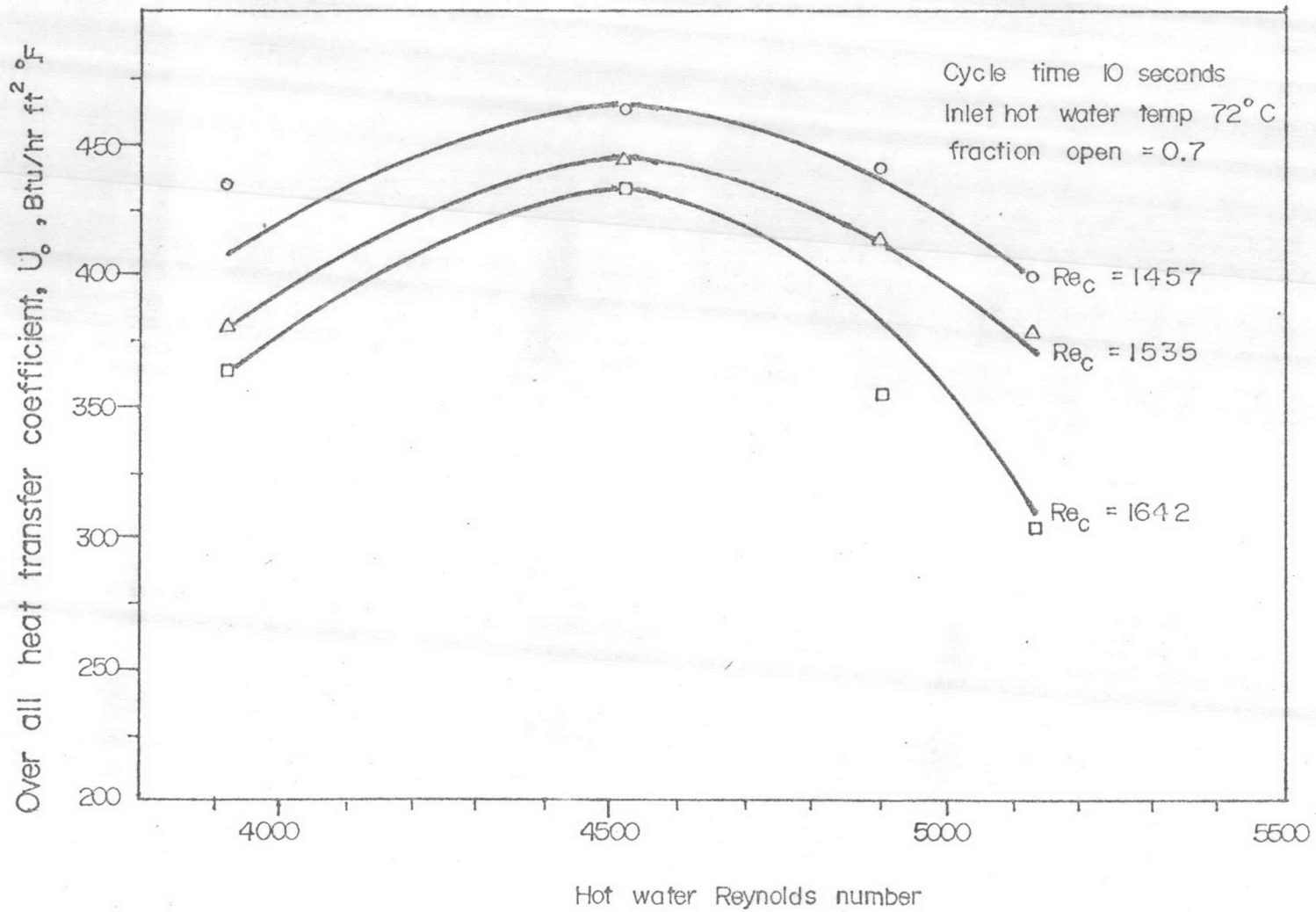Fig. 6.6 Effect of Reynolds number upon over all heat transfer coefficient.

Cycle time 6.1 seconds
Inlet hot water temp 32° C
fraction open 0.7

$Re_C = 1457$
$Re_C = 1535$
$Re_C = 1642$

Over all heat transfer coefficient, U_o, Btu/hr ft^2 °F

Hot water Reynold number

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Fig. 6.7 Effect of Reynolds number upon over all heat transfer coefficient
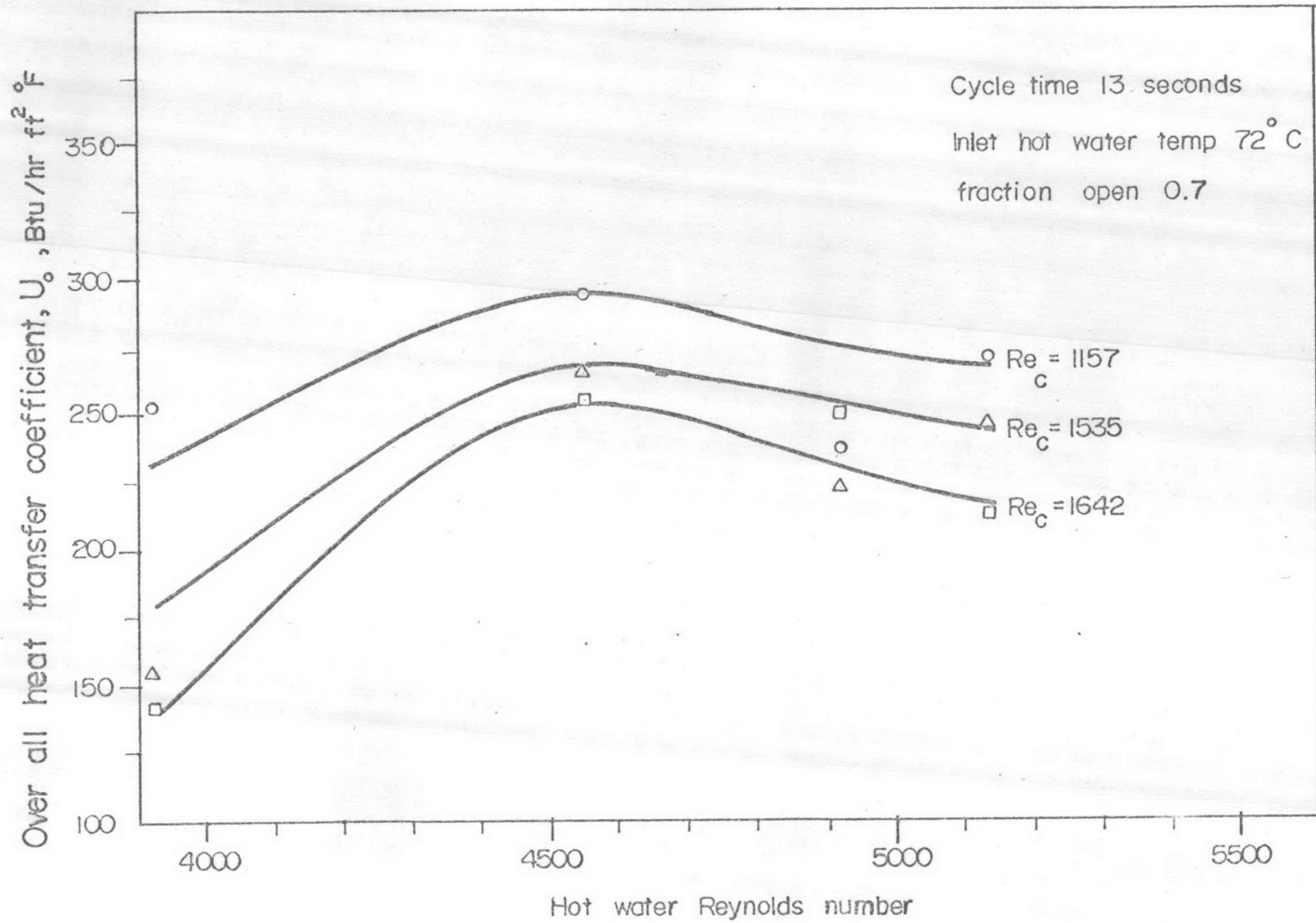
Fig. 6.8 Effect of Reynold number upon over all heat transfer coefficient.

6.4 Effect of Fraction Open Upon Over all Heat Transfer
       Coefficients

      The fraction open used in the experiments were 0.5,
0.6, 0.7 and 1.0. The interpretations of these results
were shown in Figures 6-9 to 6-12, by plotting the over all
heat transfer coefficients versus fraction open.

Table 6-3 Effect of Fraction Open Upon Over all

Heat Transfer Coefficients

a) Inlet hot water temperature $82^{\circ}C$

Cycle time (seconds)	Hot water Reynolds No.	Over all heat transfer Coefficient U_o, Btu/hr ft^2 $^\circ$F		
		fraction open		
		0.5	0.7	1.0
6.1	7149	209.9	264.8	156.2
	6830	222.6	278.4	150.2
	6310	143.9	596.0	141.5
	5464	198.3	207.1	135.5
10.0	7149	279.6	472.6	156.2
	6830	302.0	490.2	150.3
	6310	277.6	*823.9	141.5
	5464	276.8	695.4	135.5

Table 6-3 Effect of Fraction Open Upon Over all

Heat Transfer Coefficient

b) Inlet hot water temperature 72°C

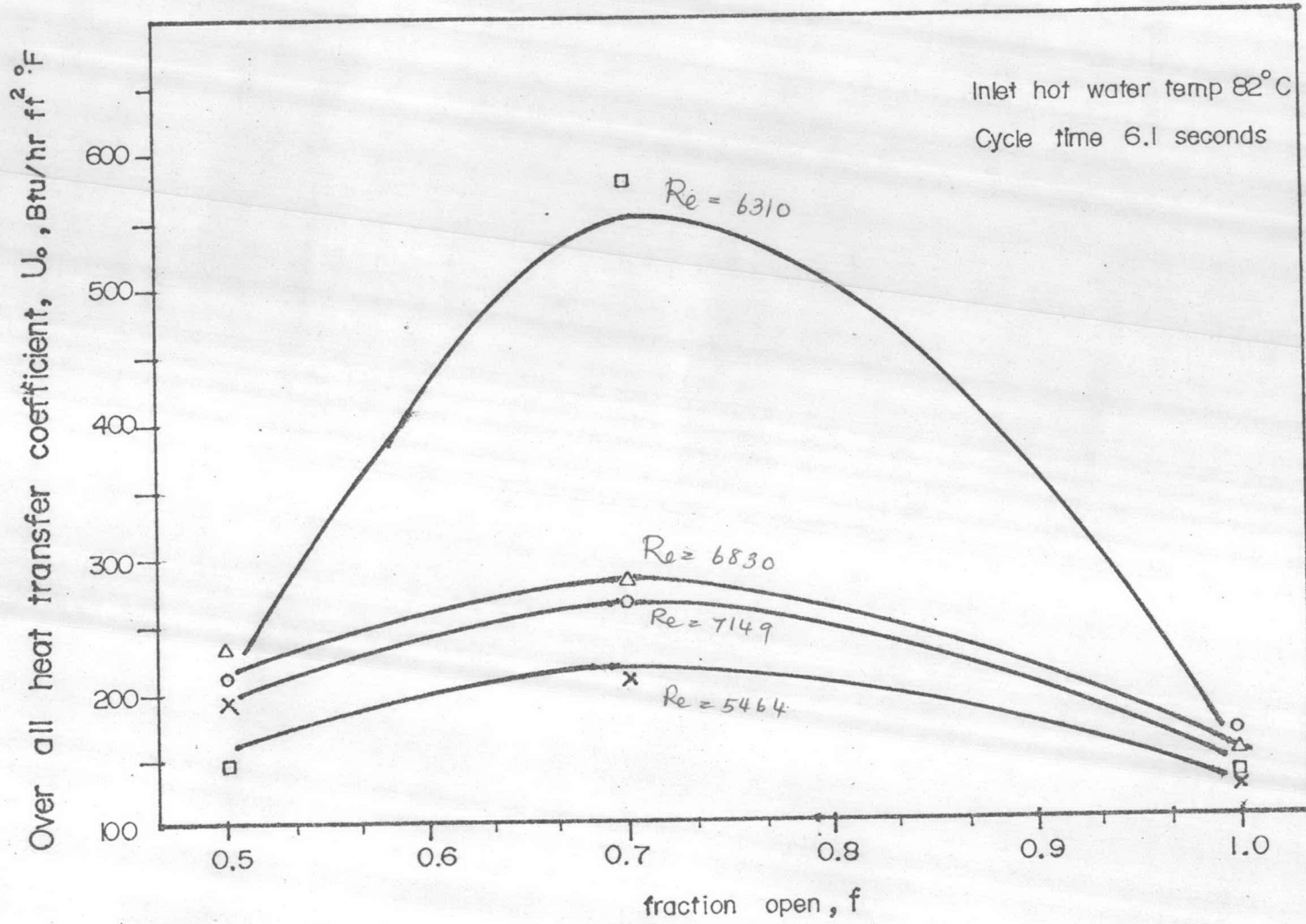| Cycle time	Hot water Reynolds No.	Over all heat transfer coefficient U_o, Btu/hr ft^2 °F		
		fraction open		
		0.5	0.7	1.0
10.0	7149	233.3	490.1	149.0
	6830	360.9	560.6	143.2
	6310	238.4	792.1	141.2
	5464	259.8	684.5	123.9
13.0	7149	213.7	400.3	149.0
	6830	220.7	367.5	143.8
	6310	183.1	465.3	141.2
	5464	196.5	433.2	123.9

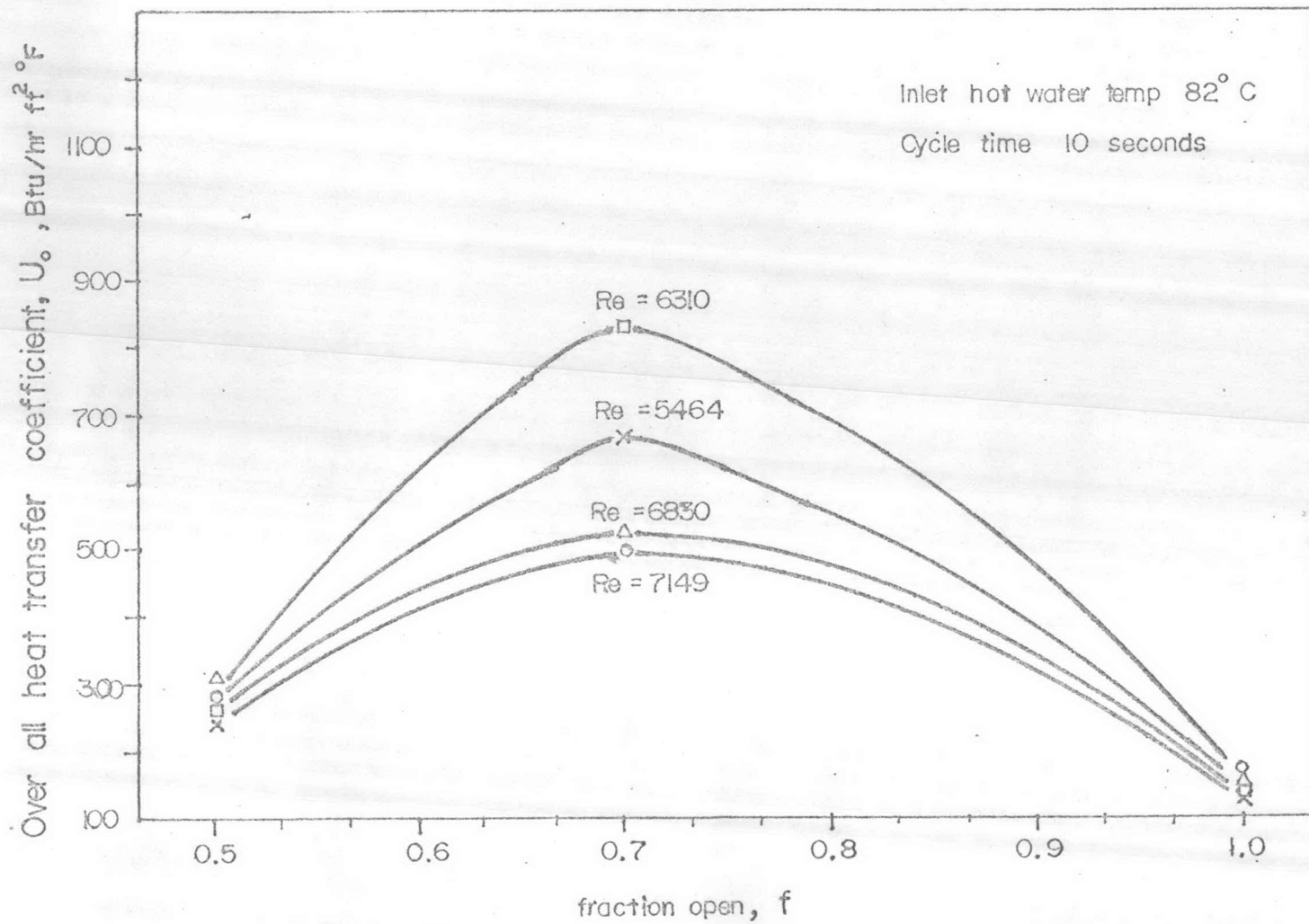Fig. 6.9 Effect of fraction open upon over all heat transfer coefficient.

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Fig. 6.10 Effect of fraction open upon over all heat transfer coefficient.
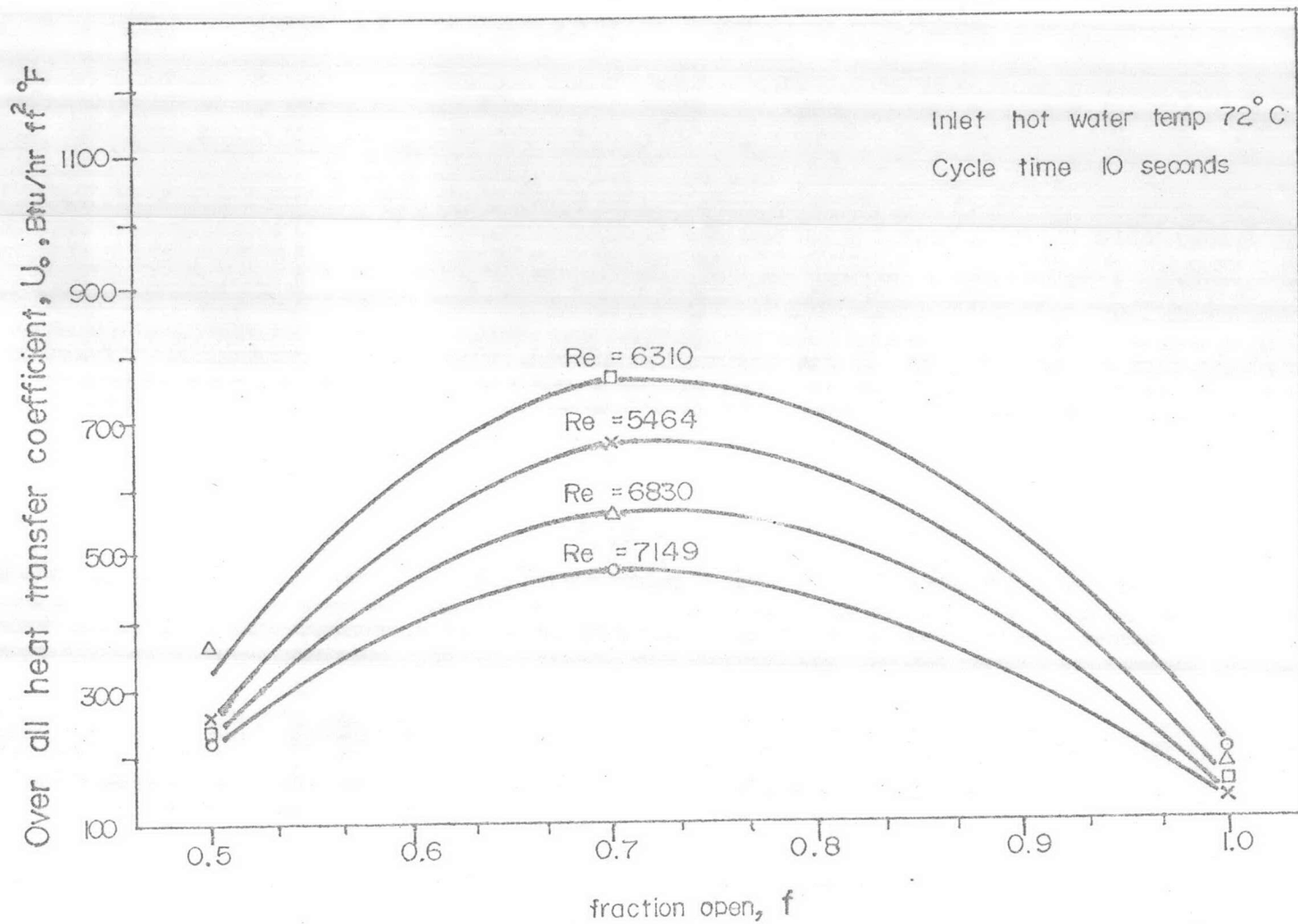
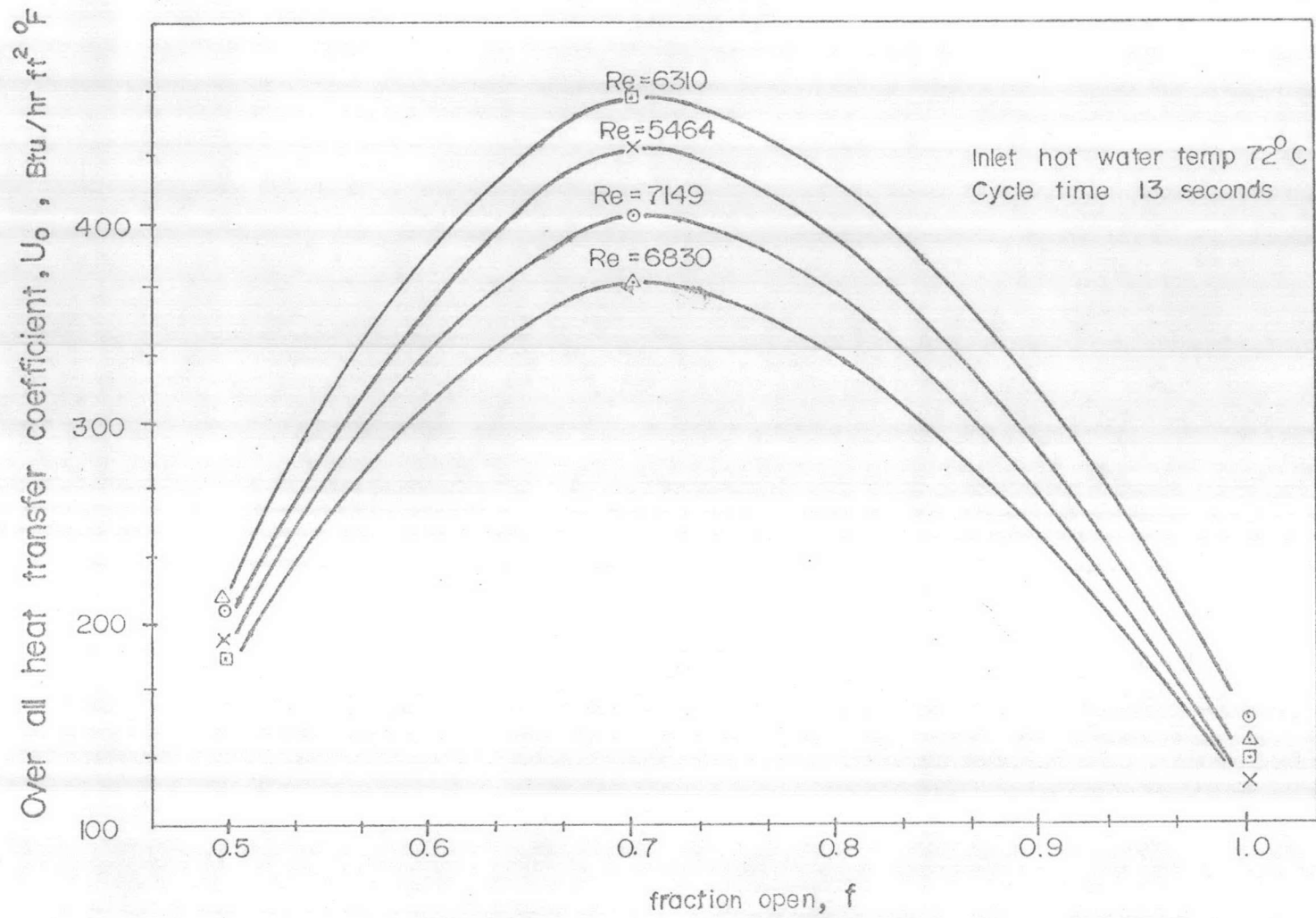Fig. 6.11 Effect of fraction open upon over all heat transfer coefficient.

Fig.6.12 Effect of fraction open upon over all heat transfer coefficient.