# Chapter IV

## EXPERIMENTAL RESULTS

All data obtained from the study are :-

Table 3 Shows the characteristics of hospital sewage in many sources of the hospital

Table 4 Shows waste water flow of the pilot plant, 250 beds complex Tak General Hospital.

Table 5 Shows effluent quality of December 1974 samples

Table 6 Shows effluent quality of January 1975, samples

Table 7 Shows effluent quality of Febuary 1975, samples

Table 8 Shows treatment efficiency of the pilot plant

Table 9 Shows flow velocity in the oxidation ditch varying with immersion depth.

Figure 6 Shows relationship between BOD and COD of hospital combined sewage characteristics.

Figure 7 Shows typical diurnal pattern for hospital sewageflow.

Figure 8 Shows effluent BOD and influent BOD various time.

Figure 9 Shows flow velocity varying with immersion depth.

Table 3

SHOWING THE CHARACTERISTICS OF HOSPITAL WASTE

| HOSPITAL @ | pH | BOD* | COD* | SS* | $NH_4$-N** | $NO_3$* | $PO_4$* | TIME | RESOURSES |
|---|---|---|---|---|---|---|---|---|---|
| SIRIRAJ | 6.7 | 143.5 | 237 | 117 | 1.2 | 10.5 | 0.2 | 8.00 | Combine |
| CHULA | 5.9 | 445 | 741 | 138 | 0.6 | 6.6 | 1.0 | 7.30 | Laundry house |
| RAMA | 6.1 | 124 | 184 | 90 | 1.6 | 1.2 | 5.4 | 8.50 | O.P.D |
| WOMAN | 6.5 | 90.5 | 243 | 73 | 8.1 | 3.2 | 4.1 | 10.10 | O.P.D |
| SOMDEJ | 6.7 | 72 | 131.6 | 84 | 3.6 | 2.2 | 5.3 | 7.00 | Combine |
| LERTSIN | 6.3 | 61.5 | 106.5 | 66 | 11.0 | 3.4 | 3.5 | 9.00 | Combine |
| LAMPANG | 6.3 | 151 | 278.5 | 123 | 5.6 | 7.7 | 6.1 | 9.30 | Combine |
| TAK | 6.5 | 41.5 | 142 | 74 | 4.1 | 3.0 | 2.2 | 10.10 | Pump sum man. |
| TAK | 6.6 | 125 | 178 | 61 | 7.7 | 3.4 | 2.5 | 7.00 | Fresh combine |
| NONTHABURI | 5.7 | 133 | 254.5 | 70 | 2.5 | 2.7 | 1.8 | 13.00 | O.P.D |
| NAKORNPATHOM | 6.3 | 291 | 590 | 83 | 3.1 | 1.5 | 0.7 | 11.00 | Laundry house |
| AVERAGE | 6.3 | 152.5 | 254.1 | 89 | 3.2 | 4.1 | 3.0 | | |

* given in mg/l

@ government hospitals

# FIGURE 6

SHOW RELATIONSHIP BETWEEN BOD AND COD VALUES.

(COMBINE HOSPITAL SEWAGE )

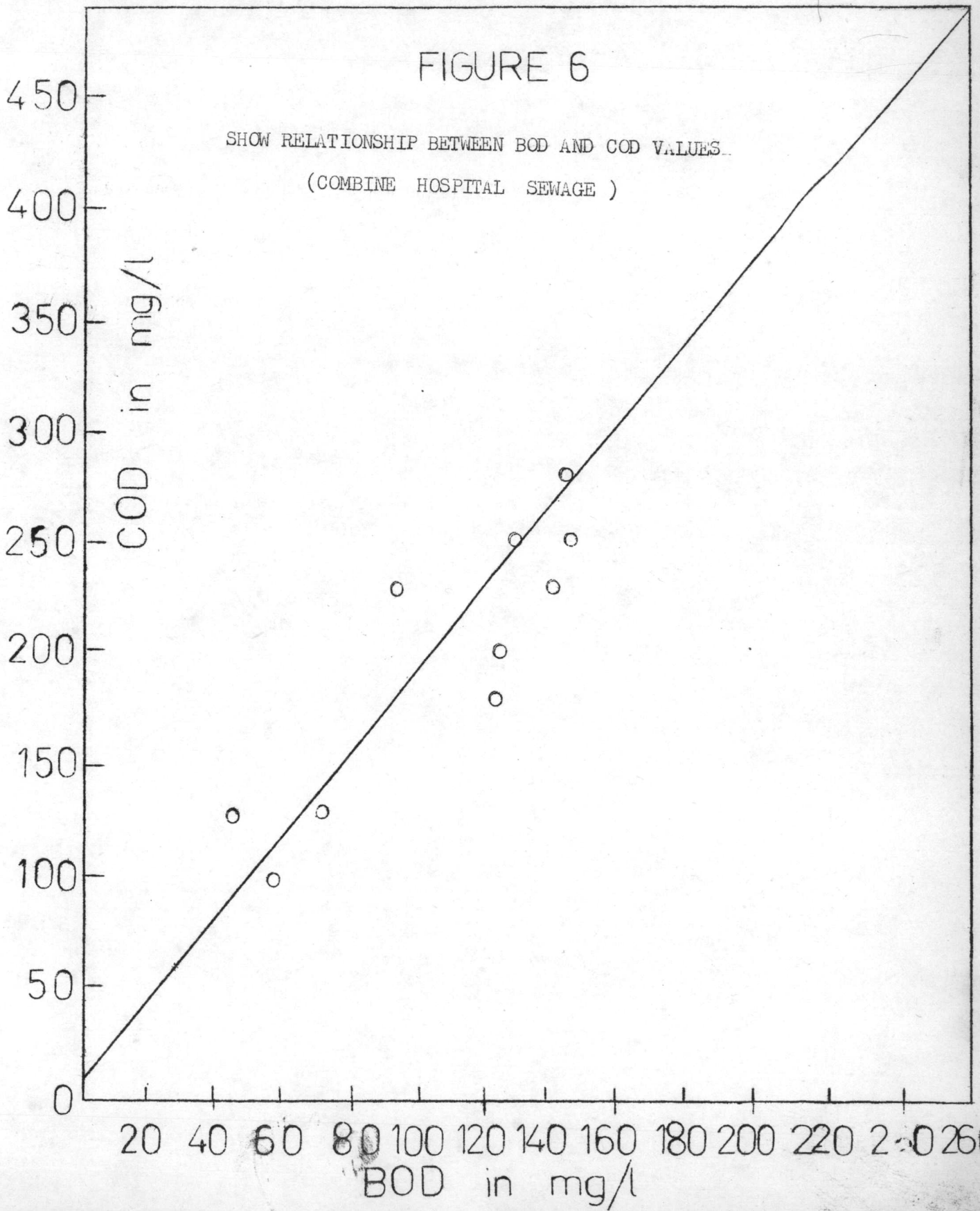


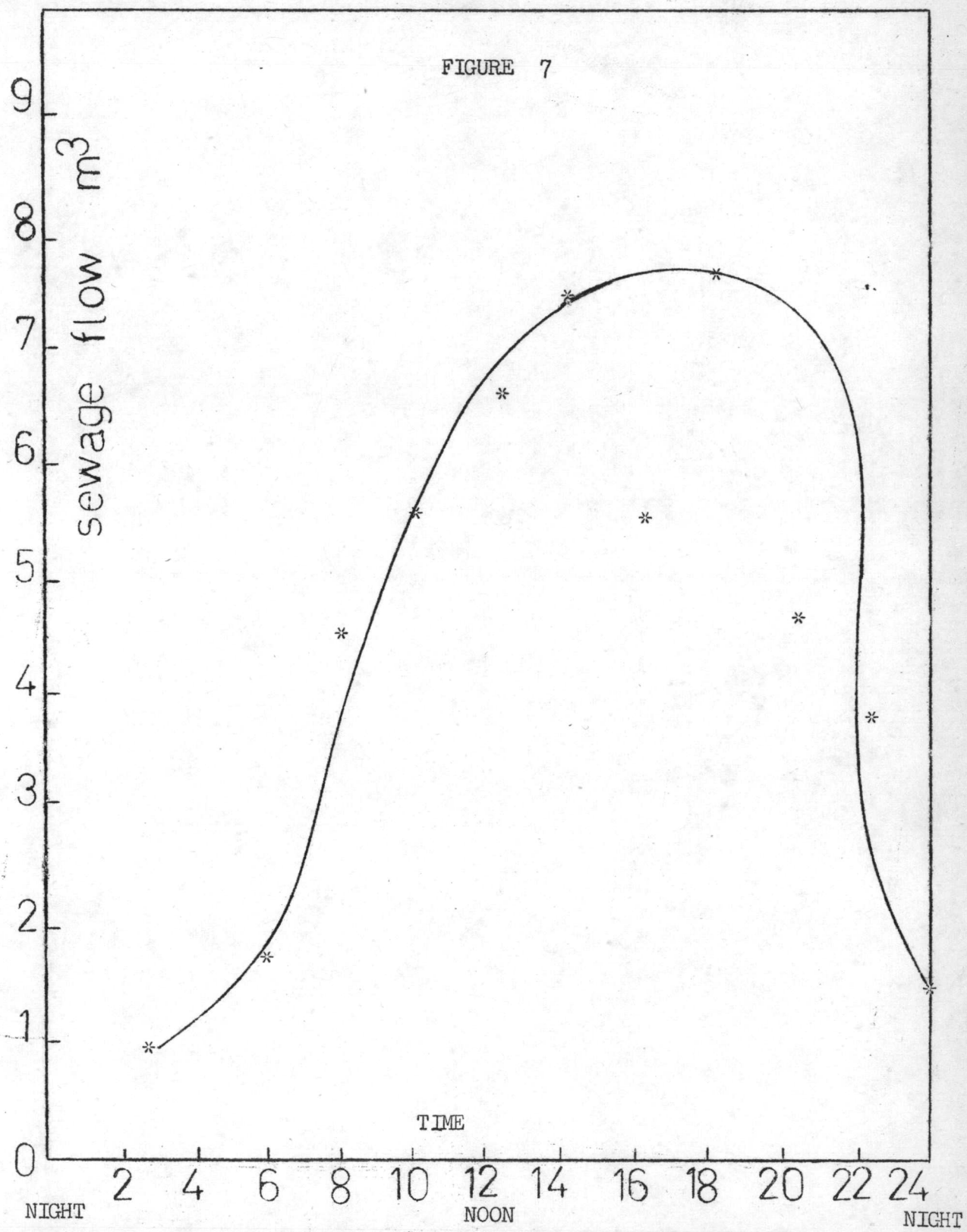
Table 4

SHOW WASTE FLOW OF 250 BEDS COMPLEX AT

TAK HOSPITAL

| TIME | Mon. | Tue. | Wed. | Thur. | Fri. | Sat. | Sun. | Average ($m^3$) | gpm. |
|---|---|---|---|---|---|---|---|---|---|
| 00-03 | 1.05 | 0.55 | 1.20 | 0.72 | 0.85 | 0.50 | 0.30 | 0.74 | 1.08 |
| 03-06 | 1.73 | 0.15 | 1.44 | 0.92 | 3.12 | 1.17 | 2.48 | 1,66 | 2.24 |
| 06-08 | 5.32 | 3.72 | 2.13 | 2.95 | 4.20 | 5.34 | 7.15 | 4.41 | 9.72 |
| 08-10 | 5.15 | 4.53 | 5.85 | 3.53 | 5.65 | 5.56 | 7.70 | 5.44 | 11.92 |
| 10-12 | 7.67 | 6.10 | 6.67 | 5.97 | 5.70 | 6.10 | 8.13 | 6.62 | 14.56 |
| 12-14 | 8.55 | 6.50 | 7.32 | 5.15 | 6.33 | 8.13 | 6.69 | 7.38 | 16.24 |
| 14-16 | 5.12 | 5.72 | 5.87 | 6.54 | 4.12 | 6.20 | 3.42 | 5.41 | 11.90 |
| 16-18 | 7.38 | 8.34 | 5.53 | 8.32 | 5.80 | 10.15 | 8.17 | 7.68 | 16.90 |
| 18-20 | 3.52 | 4.90 | 4.21 | 4.15 | 6.42 | 5.44 | 6.88 | 4.60 | 11.18 |
| 20-22 | 2.18 | 2.24 | 5.82 | 3.17 | 3.24 | 4.93 | 4.60 | 3.61 | 7.94 |
| 22-24 | 0.80 | 1.12 | 1.30 | 1.72 | 1.54 | 2.45 | 1.12 | 1.42 | 3.12 |
| Total flow | 48.47 | 39.59 | 47.34 | 43.14 | 45.53 | 55.99 | 60.53 | 49.45 | |

FIGURE 7




TYPICAL PATTERN FOR DAILY HOSPITAL SEWAGE FLOW

Table 5

SHOWS EFFLUENT QUALITY OF THE OXIDATION DITCH

AT TAK HOSPITAL WASTE TREATMENT PLANT

| DATE | pH | D.O * | BOD * | COD * | SS * | $NO_3$ * | $PO_4$ * | TEMP ** |
|---|---|---|---|---|---|---|---|---|
| 14 Dec 74 | 7.0 | 3.8 | - | 53.3 | 43 | 6.5 | 2.4 | 24 |
| 15 Dec 74 | 6.8 | 3.3 | - | 70.6 | 32 | 4.3 | 2.2 | 26 |
| 16 Dec 74 | 7.2 | 3.1 | 10.2 | 45.2 | 37 | 4.4 | 3.15 | 24 |
| 22 Dec 74 | 7.0 | 3.7 | - | 40.1 | 35 | 5.6 | 2.4 | 25 |
| 23 Dec 74 | 7.1 | 4.0 | 6.5 | 61.0 | 30 | 4.0 | 1.8 | 27 |
| 29 Dec 74 | 7.2 | 3.1 | - | 24.2 | 22 | 3.5 | 2.1 | 25 |
| 30 Dec 74 | 7.0 | 3.3 | 8.0 | 25.4 | 20 | 3.0 | 1.9 | 26 |

* Given in mg/l

** Temp in $^{o}C$

O The immersion depth 12 cm and cage rotor with 75 rpm

Table 6

SHOWS EFFLUENT QUALITY OF THE OXIDATION DITCH

AT TAK HOSPITAL WASTE TREATMENT PLANT

| DATE | pH | D.O * | BOD * | COD * | SS * | $NO_3$ * | $PO_4$ * | TEMP ** |
|---|---|---|---|---|---|---|---|---|
| 2 Jan 75 | 7.3 | 2.7 | - | 35.0 | 15 | 4.0 | 1.0 | 22 |
| 3 Jan 75 | 7.3 | 2.5 | - | 42.7 | 22 | 4.1 | 1.4 | 23 |
| 4 Jan 75 | 7.0 | 2.5 | 5.0 | 31.0 | 30 | 2.3 | 1.7 | 25 |
| 14 Jan 75 | 7.1 | 3.4 | - | 20.5 | 28 | 1.3 | 1.1 | 26 |
| 15 Jan 75 | 7.1 | 3.3 | 3.0 | 29.5 | 32 | 2.1 | 1.6 | 28 |
| 28 Jan 75 | 6.7 | 2.8 | - | 31.5 | 33 | 6.7 | 2.1 | 25 |
| 29 Jan 75 | 6.8 | 2.6 | 7.5 | 37.6 | 39 | 3.8 | 1.9 | 27 |

* Given in mg/l

** Temp in $^{o}C$

O The immersion depth 12 cm and cage rotor with 75 rpm.

Table 7

SHOWS EFFLUENT QUALITY OF THE OXIDATION DITCH

AT TAK HOSPITAL WASTE TREATMENT PLANT

| DATE | pH | D.O * | BOD * | COD * | SS * | $NO_3$ * | $PO_4$ * | TEMP ** |
|---|---|---|---|---|---|---|---|---|
| 9 Feb 75 | 7.1 | 3.3 | - | 45.1 | 19 | 3.4 | 1.8 | 28 |
| 10 Feb 75 | 6.9 | 2.9 | 7.3 | 49.7 | 23 | 2.3 | 1.3 | 29 |
| 16 Feb 75 | 7.2 | 3,2 | - | 32.3 | 28 | 3.4 | 1.7 | 31 |
| 17 Feb 75 | 7.2 | 3.4 | 5.5 | 37.4 | 33 | 4.1 | 1.0 | 27 |
| 23 Feb 75 | 6.8 | 2.5 | - | 44.8 | 36 | 5.6 | 1.2 | 25 |
| 24 Feb 75 | 6.7 | 2.7 | 4.0 | 43.0 | 32 | 4.3 | 1.5 | 29 |

* Given in mg/l

** temp in $^{o}C$

○ The immersion depth 12 cm and cage rotor with 75 rpm.

Table 8

TREATMENT EFFICIENCY OF THE OXIDATION DITCH SYSTEM

250 BEDS COMPLEX HOSPITAL ,TAK,THAILAND

| DATE | Raw waste characteristic* | | | Effluent quality* | | | | |
|---|---|---|---|---|---|---|---|---|
| | °C Temp | BOD | COD | COD | BOD | % BOD Removal | % COD Removal | Disolved Oxygen |
| 16 Dec 74 | 24 | 101.5 | 242.4 | 45.2 | 10.2 | 90 | 81 | 3.1 |
| 23 Dec 74 | 27 | 83.3 | 275.3 | 61.0 | 6.5 | 91 | 78 | 4.0 |
| 30 Dec 74 | 26 | 62.0 | 183.7 | 25.0 | 8.0 | 87 | 86 | 3.3 |
| 4 Jan 75 | 25 | 54.6 | 173.0 | 31.0 | 6.0 | 91 | 82 | 2.4 |
| 15 Jan 75 | 28 | 46.7 | 194.2 | 29.7 | 3.0 | 93 | 87 | 3.3 |
| 29 Jan 75 | 27 | 58.4 | 214.1 | 37.6 | 7.5 | 84 | 82 | 2.6 |
| 10 Fed 75 | 29 | 93.8 | 225.5 | 49.7 | 7.3 | 90 | 78 | 2.9 |
| 17 Feb 75 | 27 | 86,6 | 195.6 | 37.4 | 5.5 | 95 | 79 | 3.4 |
| 24 Feb 75 | 29 | 86 | 243.8 | 43.1 | 4.0 | 95 | 83 | 2.7 |

* All fiure are given in mg/l

# The immersion Depth 12 cm and Cage Roter with 75 rpm.

# FIGURE 8

INFLUENT BOD AND EFFLUENT BOD vs TIME

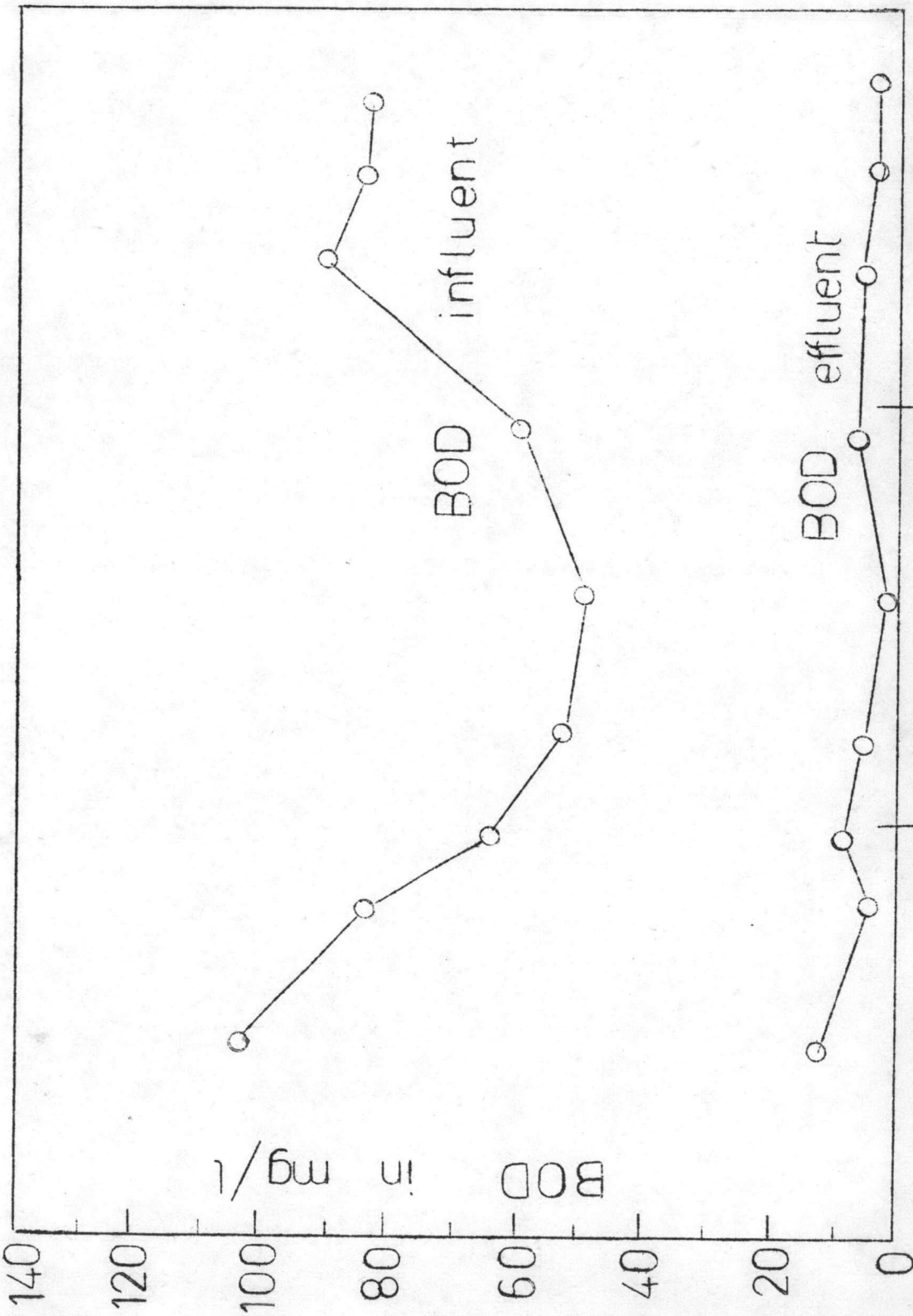


Table 9

SHOWS VELOCITY FLOW IN OXIDATION DITCH AT

TAK HOSPITAL WASTE TREATMENT

| IMMERSION DEPTH (cm) | ROTOR SPEED (RPM) | VELOCITY FLOW * | | | AVERAGE VELOCITY FLOW ** |
|---|---|---|---|---|---|
| | | 1.0 metr | 2.5 metrs | 4.5 metrs | |
| 6 | 75 | .742 | .815 | .729 | .762 |
| 7 | 75 | .729 | .851 | .729 | .770 |
| 8 | 75 | .815 | .960 | .797 | .857 |
| 9 | 75 | .887 | 1.032 | .887 | .935 |
| 10 | 75 | .905 | 1.249 | .924 | 1.026 |
| 11 | 75 | .924 | 1.285 | .924 | 1.044 |
| 12 | 75 | .960 | 1.321 | .987 | 1.086 |
| 13 | 74 | .960 | 1.358 | .996 | 1.105 |
| 14 | 74 | 1.032 | 1.430 | 1.014 | 1.159 |
| 15 | 74 | 1.050 | 1.460 | 1.032 | 1.177 |
| 16 | 74 | 1.068 | 1.538 | 1.032 | 1.213 |

* From side wall of ditch and average depth

** Flow velocity in fps

FIGURE 9

SHOWS VELOCITY FLOW VARIES WITH IMMERSION DEPTH