REFERENCES

American Public Health Association, American Waterworks Association and Water Pollution Control Federation, (1971), Standard Methods for the Examination of Water and Wastewater, 13^{th} ed., Am. Publ . Hlth Ass. Inc., N.Y.

Arceivala, S.J, (1973), Simple Waste Treatment Methods : Aerated Lagoon, Oxidation Ditches, Stabilization Ponds in Warm and Temperate Climates, Middle East Technical University, Ankara.

Barth, E.F. and Ettinger, M.B., (1967), Mineral Controlled Phosphorus Removal in the Activated Sludge Process, J. Wat. Pollut. Control Fed., 39, 8, 1362-1368

Eckenfelder, W.W.,Jr. and O'Connor, D.J., (1961), Biological Waste Treatment, Pergamon Press, N.Y.

Eckenfelder, W.W.,Jr. (1966), Industrial Water Pollution Control, McGraw-Hill Book Co. Inc., N.Y.

Fair, G.M., Geyer, J.C., and Morris, J.C.,(1954), Water Supply and Waste Water Disposal, John Wiley and Son Inc., N.Y.

Ford, D.L., and Eckenfelder, W.W.,Jr., (1967), Effect of Process Variables on Sludge Floc Formation and Settling Characteristics, J. Wat. Pollut. Control Fed., 39, 11,1850 - 1859

Goodman, B.L., and Englande, A.J.,Jr, (1974), A Unified Model of the Activated Sludge Process, J.Wat. Pollut. Control Fed., 46, 2, 312-332

Hardenbergh, W.A., (1939), Operation of Sewage - Treatment Plant, Part 1-3, International Text Book Co., P.A.

Imhoff, K., Muller, W.J., and Thistlethwayte, D.K.B., (1956), Disposal of Sewage and Other Water-Borne Wastes, Butterworths Scientific Publication, N.Y.

Jesuitas, E.P., (1966), An Investigation of Tapioca Wastes, Master of Engineering Thesis, Seato Graduate School of Engineering, Bangkok, Thailand.

Mancini, J.L., and Barnhart, E.L., (1967), Design of Aerated Systems for Industrial Waste Treatment, J. Wat. Pollut. Control Fed., 39, 6, 978-986.

Markly, K.S., (ed, 1950), Soybeans and Soybean Products, vol. 1, Interscience Publishers Inc., N.Y.

McKinney, R.E., and Gram, A., (1956), Protozoa and Aactivated Sludge, J.Sewage and Industrial Wastes, 28, 1219-1231.

Metcalf and Eddy, Inc., (1972), Wastewater Engineering : Collection, Treatment, Disposal, McGraw-Hill Book Co. Inc., N.Y.

Rickard, M.D., and Gaudy, A.F., Jr., (1968). Effect of Mixing Energy on Sludge Yield and Cell Composition, J. Wat. Pollut. Control Fed., 40, 5 part 2

Steel, E.W., (1960), Water Supply and Sewerage, McGraw-Hill Book Co. Inc., N.Y.

Symons, J.M., McKinney, R.E. and Hassis, H.H., (1960), A Procedure for Determination of the Biological Treatability of Industrial Wastes, J. Wat. Pollut. Control Fed., 32, 8, 841-851

Symons, J.M., (1963), Simple, Continuous-Flow, Low and Variable Rate Pump, J.Wat. Pollut. Control Fed., 35, 11,1480-1485

Taimmanenate, K., (1974), Waste Water Treatment Evaluation for Dairy Industry, Master of Science Thesis, Asian Institute of Technology, Bangkok, Thailand.

Thijayung, C., (1974), Studies on Design Parameters of the Completely Mixed Activated Sludge Process, Master of Science Thesis., Asian Institute of Technology, Bangkok, Thailand.

APPENDIX

Table A_1. Calculation of (So-Se)/Xv.t

Date 30^{th} Nov. 74

Time, t hr	Eff COD (Se)^s mg/l	So-Se	MLVSS, Xv mg/l	$\frac{So-Se}{Xv.t}$
0	460.00	186.42	1136.0	—
0.5	408.88	237.54	1084.0	0.4383
1	327.10	319.32	—	-
2	218.85	427.57	1193.3	0.1792
3	105.14	541.28	1227.3	0.1470
4	85.67	560.75	1260.0	0.1113
6	66.20	580.22	966.63	0.1000
8	46.73	599.69	1000.0	0.0750
10	56.22	590.20	753.3	0.0783
23	64.25	582.17	626.7	0.0404

Initial COD, So = 646.42 mg/l

Plot $\frac{So-Se}{Xv.t}$ VS. S_e, the graph is shown in Fig A_1

Table A_2. Calculation of (So-Se)/Xv.t

Date : 5^{th} Dec. 74

Time, t hr	Eff COD$_s$ (S_e) mg/l	$S_o - S_e$	MLVSS, Xv mg/l	$\frac{S_o - S_e}{X_v . t}$
0	695.65	300.40	1706.67	–
0.5	505.97	490.08	1820.0	0.5380
1	320.16	675.89	1720.0	0.3927
2	142.29	853.76	1960.0	0.2180
3	98.81	897.24	1707.5	0.1750
4	75.10	920.95	1697.5	0.1355
6	63.24	932.81	1488.0	0.1045
8	52.96	943.09	1341.0	0.0880
10	60.31	935.74	1241.0	0.0753
23	44.75	951.30	924.0	0.0448

Initial COD, S_o= 996.05 mg/l

Plot $\frac{S_o - S_e}{X_v . t}$ VS. S_e , the graph is shown in Fig A_2 .

Table A_3 Calculation of $(S_o-S_e)/X_v.t$

Date : 7[th] Dec. 74

Time, t hr	Eff COD_s (S_e) mg/l	$S_o - S_e$	MLVSS, X_v mg/l	$\frac{S_o - S_e}{X_v . t}$
0	765.35	257.51	1560	—
0.5	519.68	503.18	1504	0.670
1	317.32	705.54	1596	0.442
2	165.35	857.51	1571	0.273
3	82.68	940.18	1534	0.204
4	52.76	970.10	1402	0.173
6	44.88	977.98	—	—
8	32.94	989.92	1379	0.0897
10	42.35	980.51	—	—
23	40.00	982.86	1029	0.0415

Initial COD, So = 1022.86 mg/l

Plot $\frac{S_o - S_e}{X_v .\ t}$ VS. S_e , the graph is shown in Fig A_3.

Table A_4 Calculation of $(S_o-S_e)/X_v.t$

Date: 10^{th} Dec. 74

Time, t hr	Eff COD_s (S_e) mg/l	S_o-S_e	MLVSS, X_v mg/l	$\frac{S_o-S_e}{X_v.t}$
0	690.6	301.4	1584	—
0.5	432.0	560.0	1496	0.7487
1	316.8	675.2	1948	0.3466
2	130.4	361.6	1836	0.2346
3	88.0	904.0	1756	0.1716
4	60.0	932.0	1724	0.1352
6	40.0	952.0	1656	0.0956
8	32.0	960.0	1612	0.0744
10	29.8	966.2	—	—
23	33.7	958.3	981	0.0425

Initial COD, S_o = 992.0 mg/l

Plot $\frac{S_o-S_e}{X_v.t}$ VS. S_e , the graph is shown in Fig A_4 .

Table B_1. Fitting substrate removal curve through the origin.

Date : 30th Nov. 74

S_e as x	$\frac{S_o - S_e}{Xv.t}$ as y	x^2	xy
408.88	0.4383	167182.0	179.212
327.10	—	—	—
218.85	0.1792	47895.3	39.218
105.14	0.1470	11054.4	15.456
85.67	0.1113	7339.34	9.535
66.20	0.1000	4382.44	6.620
46.73	0.0750	2183.69	3.505
56.22	0.0783	3160.68	4.402
64.25	0.0404	4128.06	2.596
	Total	247325.91	260.544

$$\text{Slope} = \frac{\Sigma xy}{\Sigma x^2}$$

$$= \frac{260.544}{247325.91}$$

$$k = 0.00105 \quad hr^{-1}$$

$$= 0.0252 \quad day^{-1}$$

Table B_2 Fitting substrate romoval curve through the origin.

Date : 5^{th} Dec. 74

S_e as x	$\frac{S_o - S_e}{X_v . t}$ as y	x^2	xy
505.97	0.5380	256005.0	272.211
320.16	0.3927	102502.0	125.726
142.29	0.2180	20246.4	31.019
98.81	0.1750	9763.41	17.292
75.10	0.1355	5640.01	10.176
63.24	0.1045	3999.29	6.609
52.96	0.0880	2804.76	4.660
60.31	0.0753	3637.29	4.541
44.75	0.0448	2002.56	2.005
	Total	406600.72	474.239

$$\text{Slope} = \frac{\Sigma xy}{\Sigma x^2}$$

$$= \frac{474.239}{406600.72}$$

$$k = 0.00116 \text{ hr}^{-1}$$

$$= 0.0278 \text{ day}^{-1}$$

Table B_3. Fitting substrate removal curve through the origin.

Date : 7^{th} Dec. 74

S_e as x	$\frac{S_o - S_e}{Xv.t}$ as y	x^2	xy
519.68	0.670	270067.0	348.185
317.32	0.442	100691.0	140.255
165.35	0.273	27340.6	45.141
82.68	0.204	6835.98	16.867
52.76	0.173	2783.61	9.127
44.88	–	–	–
32.94	0.0897	1085.04	2.955
42.35	–	–	–
40.00	0.0415	1600.00	1.660
	Total	410403.23	564.190

$$\text{Slope} = \frac{\Sigma xy}{\Sigma x^2}$$

$$= \frac{564.190}{410403.23}$$

$$k = 0.00137 \quad hr^{-1}$$

$$= 0.0329 \quad day^{-1}$$

Table B_4 Fitting substrate removal curve through the origin

Date : 10^{th} Dec. 74

S_e as x	$\frac{S_o - S_e}{X_v . t}$ as y	x^2	xy
432.0	0.7487	186624.0	323.438
316.8	0.3466	100362.0	109.802
130.4	0.2346	17004.1	30.592
88.0	0.1716	7744.0	15.101
60.0	0.1352	3600.0	8.112
40.0	0.0956	1600.0	3.824
32.0	0.0744	1024.0	2.381
29.76	–	–	–
33.73	0.0425	1137.71	1.434
	Total	319095.81	494.684

$$\text{Slope} = \frac{\Sigma xy}{\Sigma x^2}$$

$$= \frac{494.684}{319095.81}$$

$$k = 0.00155 \quad hr^{-1}$$

$$= 0.0372 \quad day^{-1}$$

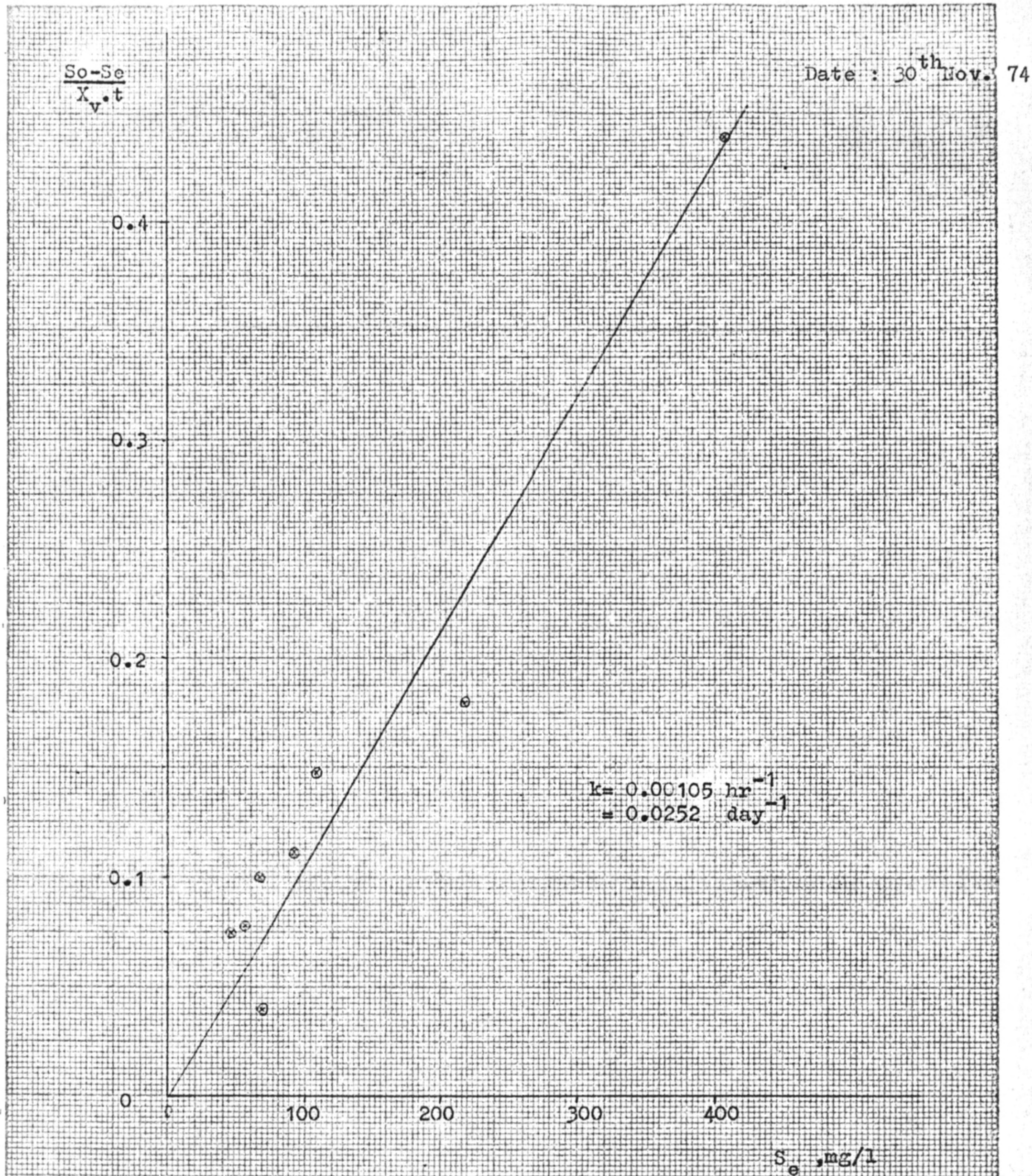

Fig. A_1 Determination Of k

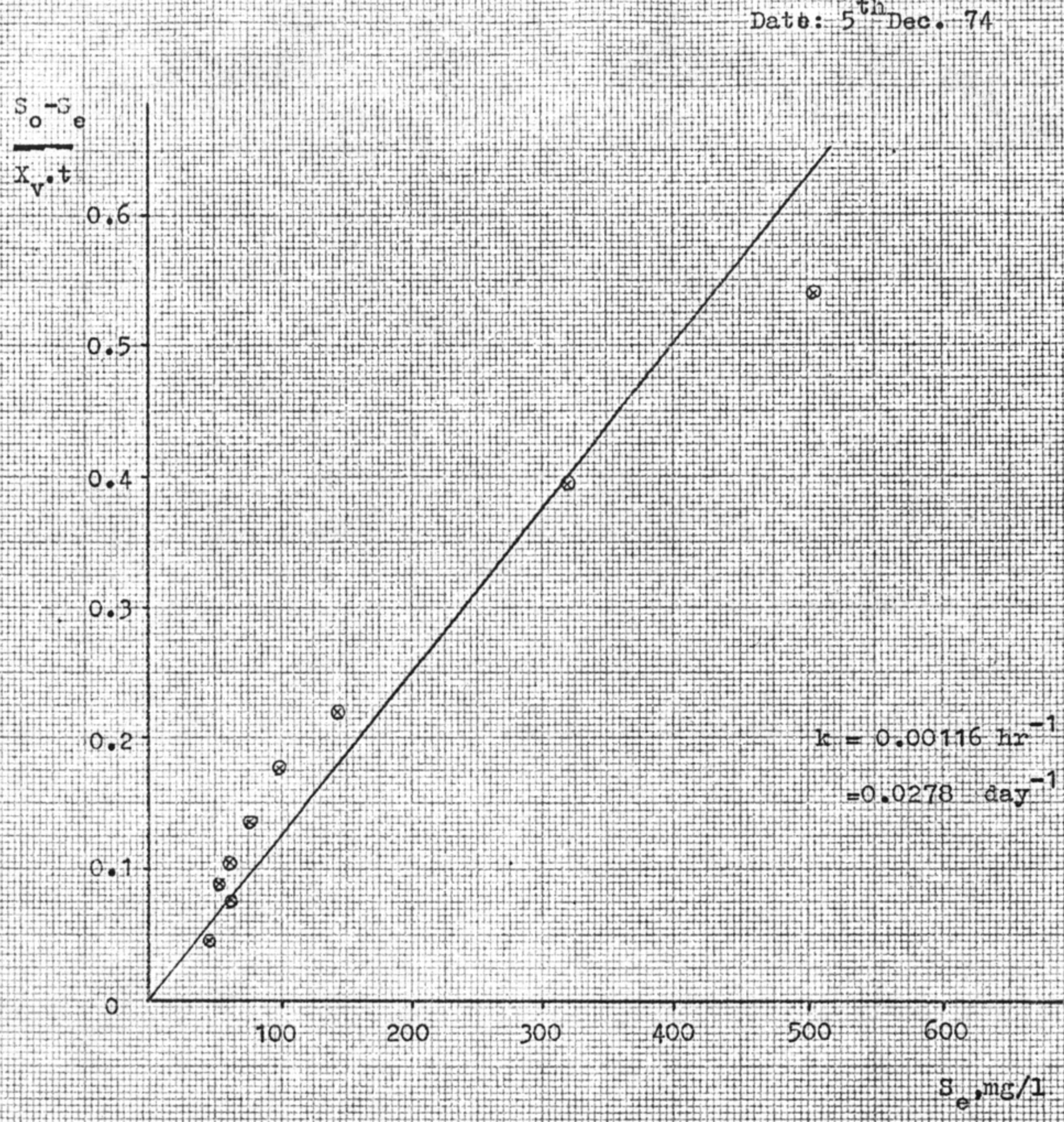

Fig. A_2 Determination of k

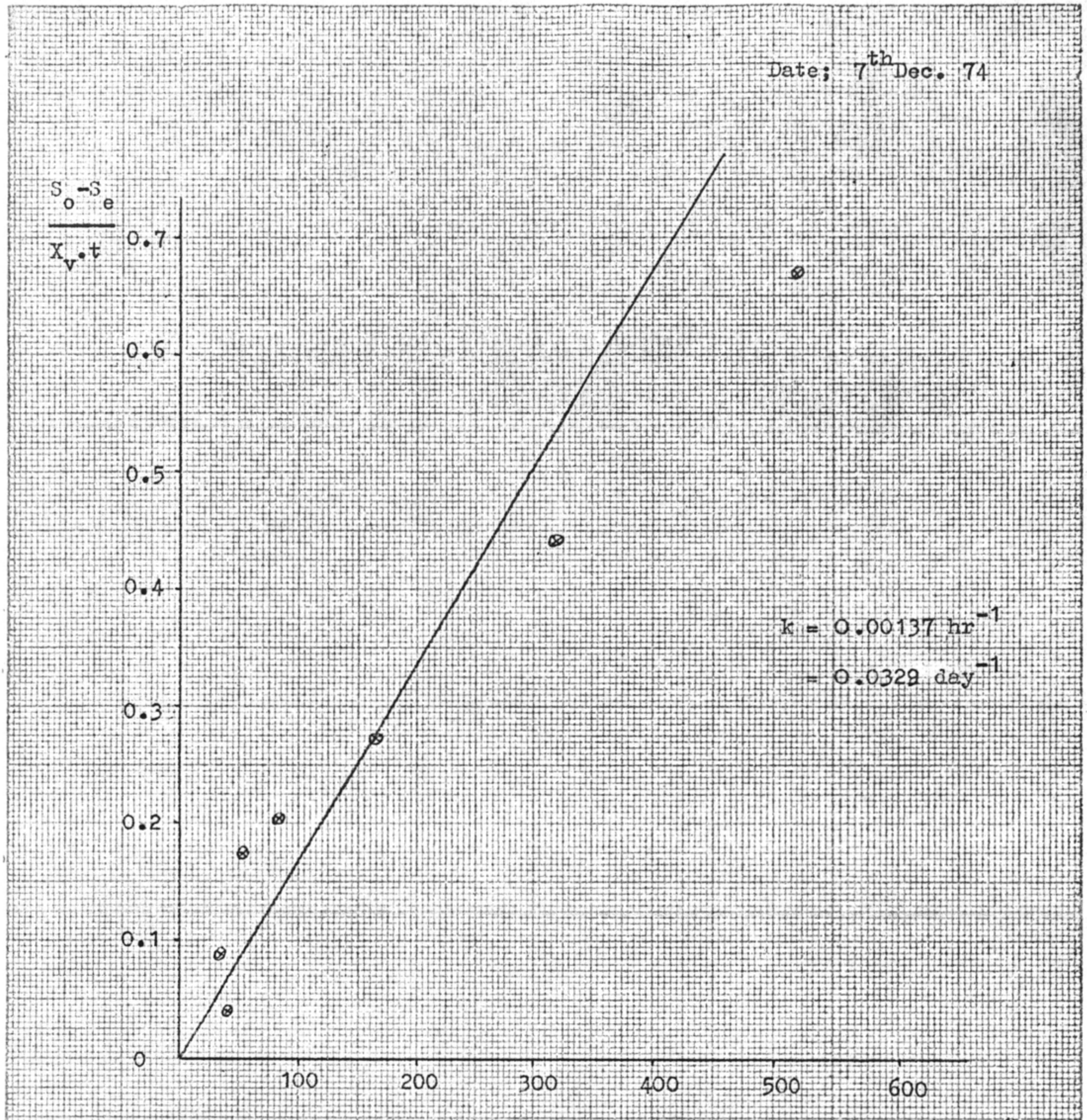

Fig. A_3 Determination of k

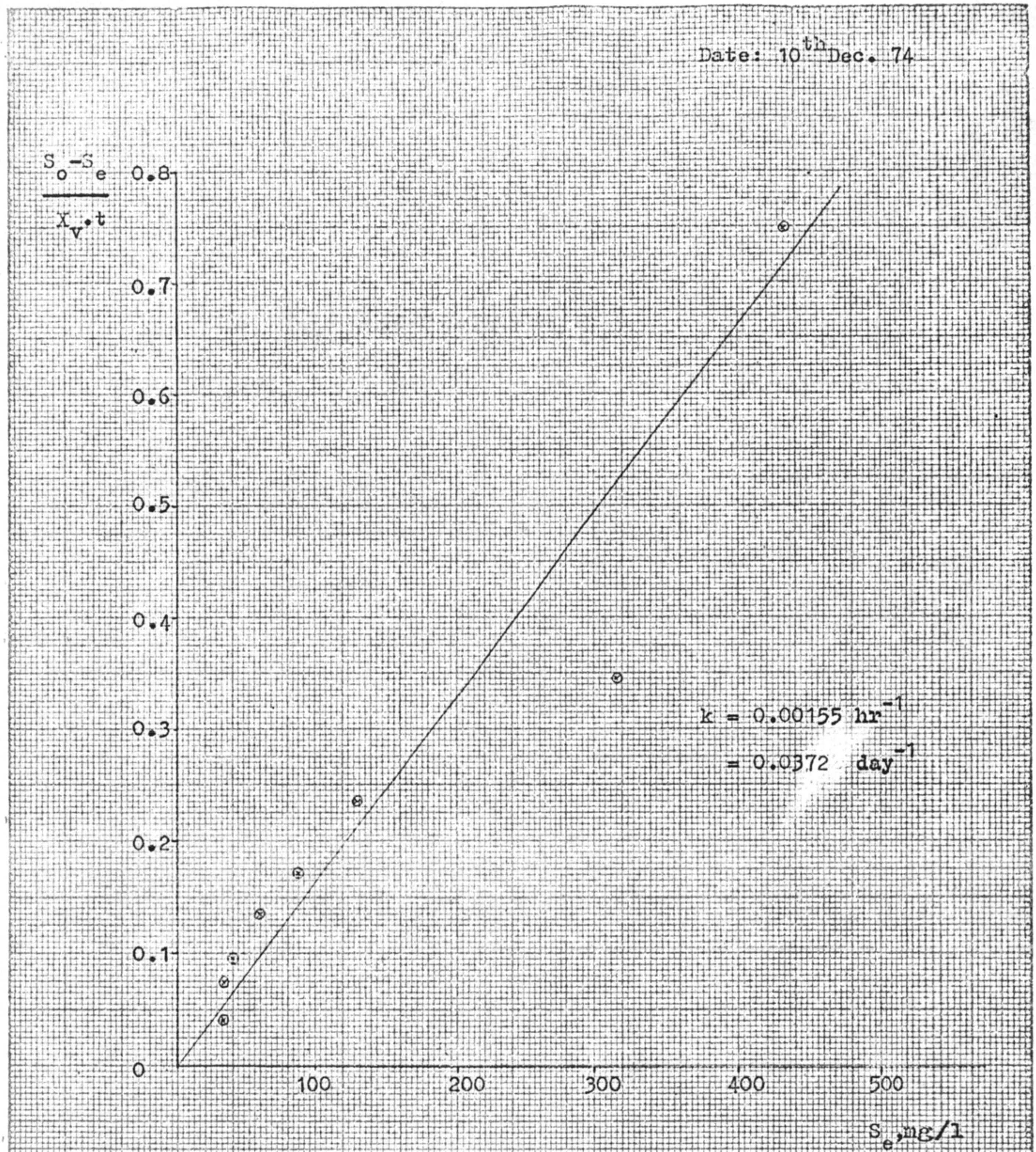

Fig. A_4 Determination of k

Table C_1. Calculation of a and b by Least Square Method

Date : 10^{th} Dec. 74

$\frac{S_o - S_e}{X_v . t}$ as x	$\frac{\Delta X_v}{X_v}$ as y	x^2	xy
0.3466	0.18690	0.1183	0.06476
0.2346	0.06860	0.0550	0.01609
0.1716	0.03265	0.0294	0.00560
0.1352	0.02030	0.0184	0.00274
$\Sigma x = 0.8880$	$\Sigma y = 0.30845$	$\Sigma x^2 = 0.2215$	$\Sigma xy = 0.08919$
$\bar{x} = 0.2220$	$\bar{y} = 0.07711$		

$$a = \frac{n(\Sigma xy) - (\Sigma x)(\Sigma y)}{n(\Sigma x^2) - (\Sigma x)^2}$$

$$= \frac{4\,(0.08919) - (0.888)(0.30845)}{4\,(0.2215) - (0.888)^2}$$

$$= 0.85$$

$$b = \bar{y} - a\bar{x}$$

$$= -\,0.07711 - 0.85 \neq 0.2220$$

$$= -\,0.1118 \quad hr^{-1}$$

$$= -\,2.6832 \quad day^{-1}$$

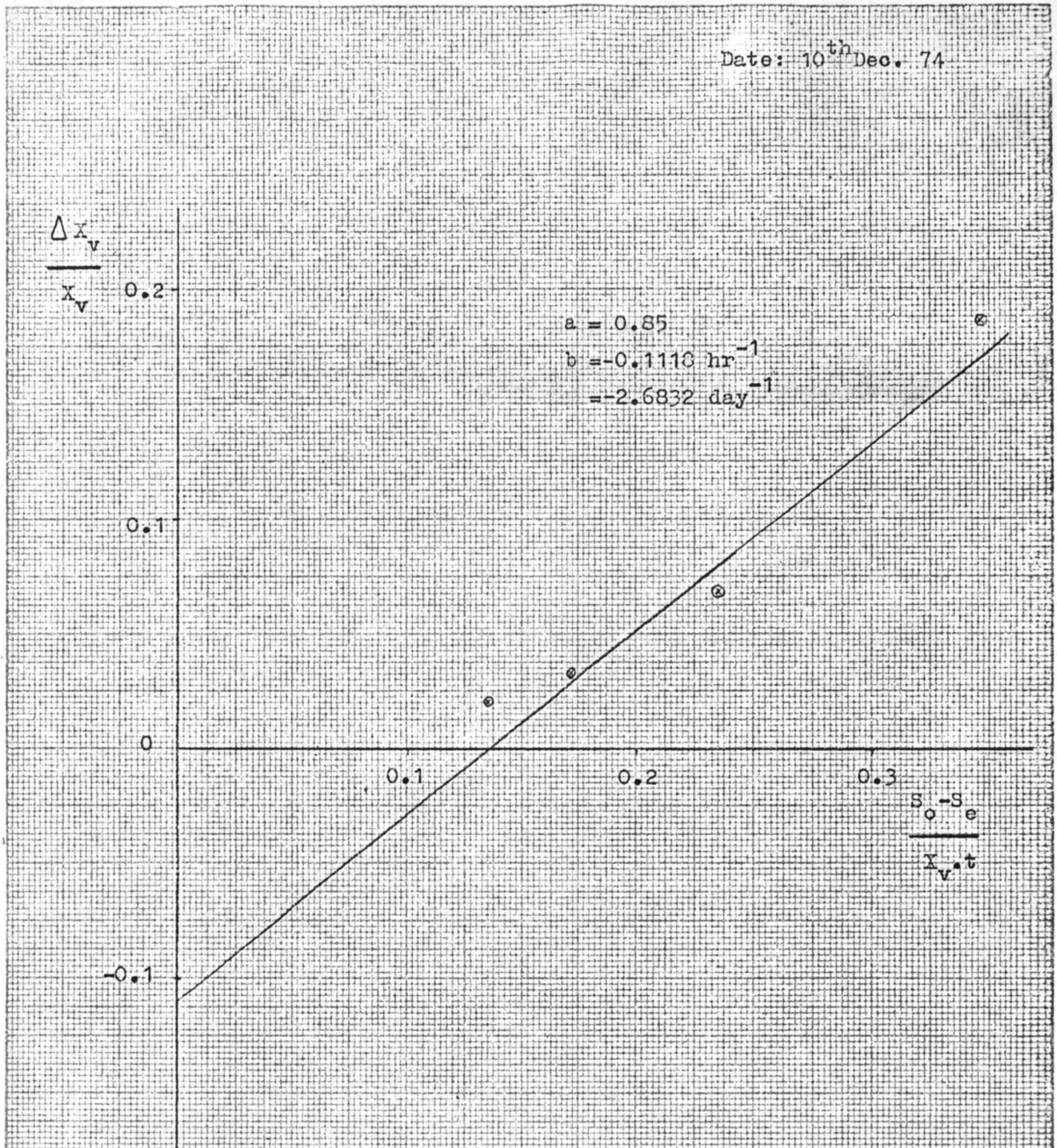

Fig.B_1 Determination of a and b

VITA

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LIST OF TABLES