

CHAPTER 7

RESULTS

Table 4 to 9 give the results of suspended solids at 30°C and 35°C at various starting total solid loadings. The results are also presented in graphical forms in figs. 8 to 13.

Tables 10 to 15 give the results of centrifuged supernatant BOD and COD values, also pH, settleable solids in 30 minutes and predominate microorganisms.

Figs. 16 and 17 show the pH values and settleable solids in 30 minutes respectively.

Figs. 18 and 19 show the reduction of solids at 30°C and 35°C respectively.

The characteristics of sludge are given in Appendix table 19.

TABLE 4 SUSPENDED SOLIDS OF SLUDGE AT 30°C

1.04 % STARTING TOTAL SOLIDS

Aeration (days)	VS (mg)	FS (mg)	VS/FS (mg/mg)	Average VS/FS
0	153.7	62.7	2.45	2.395
	245.2	103.9	2.36	
	98.7	42.4	2.33	
	52.3	21.4	2.44	
3	168.2	73.1	2.30*	2.093
	232.4	109.6	2.12	
	108.5	52.4	2.07	
	42.3	20.2	2.09	
6	222.4	124.9	1.78	1.746
	154.2	69.7	2.21*	
	95.6	54.3	1.76	
	56.7	33.3	1.70	
9	100.5	60.9	1.65	1.662
	170.7	100.4	1.70	
	240.2	147.4	1.63	
	56.1	33.6	1.67	
12	222.3	144.4	1.54	1.560
	140.1	87.6	1.60	
	98.3	63.8	1.54	
	50.2	38.0	1.32*	
15	235.6	149.1	1.58	1.542
	146.7	95.9	1.53	
	75.6	49.7	1.52	
	49.8	32.3	1.54	

* Omitted Values

TABLE 5 SUSPENDED SOLIDS OF SLUDGE AT 30°C

2.02 % STARTING SOLIDS

Aeration (days)	VS (mg)	FS (mg)	VS/FS (mg/mg)	Average VS/FS
0	127.2	49.3	2.58	2.495
	65.8	27.4	2.40	
	175.2	69.0	2.54	
	230.7	93.8	2.46	
3	246.2	106.1	2.32	2.293
	108.5	48.0	2.26	
	78.3	33.3	2.35	
6	170.1	75.9	2.24	2.058
	195.6	100.3	1.95	
	112.7	53.2	2.12	
	85.5	40.7	2.10	
9	40.1	19.5	2.06	1.993
	218.7	108.8	2.01	
	80.2	42.7	1.88	
	132.5	63.1	2.10	
12	48.7	24.6	1.98	1.933
	184.6	93.2	1.98	
	110.1	58.3	1.89	
	52.1	27.0	1.93	
15	260.2	121.0	2.15*	1.882
	76.5	41.3	1.85	
	190.6	98.7	1.93	
	122.3	64.4	1.90	
	56.4	30.5	1.85	

* Omitted Values

TABLE 6 SUSPENDED SOLIDS OF SLUDGE AT 30°C
3.1 % STARTING SOLIDS

Aeration (days)	VS (mg)	FS (mg)	VS/FS (mg/mg)	Average VS/FS
0	56.7	22.1	2.56	2.515
	292.6	117.5	2.49	
	176.2	69.6	2.53	
	101.1	40.8	2.48	
3	278.6	116.1	2.40	2.335
	212.5	91.2	2.33	
	135.0	59.0	2.29	
	50.1	21.6	2.32	
6	150.3	68.0	2.21	2.170
	247.6	114.6	2.16	
	96.5	45.1	2.14	
	42.3	19.5	2.17	
9	266.5	127.5	2.09	2.135
	180.4	83.9	2.15	
	109.2	50.3	2.17	
	56.4	26.5	2.13	
12	270.3	128.1	2.11	2.073
	54.5	27.0	2.02	
	175.2	76.5	2.29*	
	120.6	57.7	2.09	
15	139.8	74.4	1.88*	2.056
	248.2	121.1	2.05	
	92.6	44.7	2.07	
	49.9	24.3	2.05	

* Omitted Values

TABLE 7 SUSPENDED SOLIDS OF SLUDGE AT 35°C
1.1 % STARTING TOTAL SOLIDS

Aeration (days)	VS (mg)	FS (mg)	VS/FS (mg/mg)	Average VS/FS
0	145.7	58.0	2.51	2.473
	232.5	94.5	2.46	
	97.3	39.9	2.44	
	57.5	23.2	2.48	
3	243.3	115.3	2.11	2.075
	165.6	81.6	2.03	
	112.7	54.4	2.07	
	64.9	31.1	2.09	
6	140.7	74.4	1.89*	1.693
	85.6	49.2	1.74	
	53.2	32.2	1.65	
	227.8	134.7	1.69	
9	217.6	136.0	1.60	1.570
	132.3	80.7	1.64	
	95.5	62.0	1.54	
	49.4	32.9	1.50	
12	251.2	169.7	1.48	1.515
	176.3	123.3	1.43	
	123.4	78.6	1.57	
	55.3	35.0	1.58	
15	223.6	151.1	1.48	1.493
	165.4	107.4	1.54	
	108.0	74.0	1.46	
	44.1	29.6	1.49	

* Omitted Values

TABLE 8 SUSPENDED SOLIDS OF SLUDGE AT 35°C
2.05 % S TARTING TOTAL SOLIDS

Aeration (days)	VS (mg)	FS (mg)	VS/FS (mg/mg)	Average VS/FS
0	215.9	85.7	2.52	2.491
	122.6	49.8	2.46	
	49.5	18.4	2.69*	
	164.7	66.1	2.49	
3	220.1	99.6	2.21	2.183
	157.3	72.2	2.18	
	106.5	49.8	2.14	
	51.4	23.4	2.20	
6	60.7	28.9	2.10	2.040
	198.9	98.5	2.02	
	124.5	62.3	2.00	
	90.1	44.2	2.04	
9	229.3	121.9	1.88	1.910
	146.7	79.7	1.84	
	101.4	52.3	1.94	
	47.5	23.9	1.98	
12	115.6	55.0	2.10*	1.853
	154.6	81.4	1.90	
	209.3	115.0	1.82	
	56.7	30.8	1.84	
15	227.1	122.1	1.86	1.818
	165.4	90.4	1.83	
	123.5	70.2	1.76	
	60.3	33.1	1.82	

* Omitted Values

TABLE 9 SUSPENDED SOLIDS OF SLUDGE AT 35°C
3.02 % STARTING SLUDGE

aeration (days)	VS (mg)	FS (mg)	VS/FS (mg/mg)	Average VS/FS
0	249.5	104.8	2.38	2.438
	175.6	72.6	2.42	
	102.3	41.6	2.46	
	54.2	21.8	2.49	
3	190.9	86.4	2.21	2.255
	258.7	112.0	2.31	
	123.1	55.0	2.24	
	62.3	27.6	2.26	
6	223.0	104.7	2.13	2.105
	150.8	73.2	2.06	
	98.3	47.5	2.07	
	50.1	23.2	2.16	
9	238.7	115.3	2.07	2.055
	165.4	80.7	2.05	
	113.3	55.8	2.03	
	53.2	25.7	2.07	
12	218.7	111.0	1.97	1.983
	155.3	76.5	2.03	
	108.9	48.4	2.25*	
	51.2	26.3	1.95	
15	230.1	121.1	1.90	1.937
	167.4	84.9	1.97	
	121.7	62.7	1.94	
	60.6	31.2	1.94	

* Omitted Value

TABLE 10 BOD, COD, pH, SETTLEABLE IN 30 MINUTES AND
 PREDOMINATE MICROORGANISMS OF SLUDGE AT 30°C
 1.04 % STARTING SOLIDS

Aeration (days)	BOD* (mg/l)	COD* (mg/l)	pH	Settleable in 30 min. (%)	Predominate Microorganisms
0	212	251	7.5	10	<u>Sphaerotilus</u> <u>natans</u>
1			8.1		"
2			8.3		"
3	198	240	8.2	11	"
4			8.1		"
5			8.1		"
6	151	179	8.0	10	"
7			8.2		"
8			8.1		"
9	123	141	8.3	12	"
10			8.2		"
11			8.1		"
12	86	104	8.1	9	"
13			8.0		"
14			8.2		"
15	54	65	8.2	12	"

* Centrifuged Supernatant

TABLE 11 BOD, COD, pH, SETTLEABLE IN 30 MINUTES AND
 PREDOMINATE MICROORGANISMS OF SLUDGE AT 30°C
 2.02 % STARTING TOTAL SOLIDS



Aeration (days)	BOD* (mg/l)	COD* (mg/l)	pH	Settleability in 30 min.(%)	Predominate Microorganisms
0	224	254	7.3	12	<u>Sphaerotilus</u>
1			8.1		<u>natans</u> "
2			8.0		"
3	198	234	8.2	13	"
4			7.9		"
5			8.0		"
6	186	221	8.2	10	"
7			8.2		"
8			8.1		"
9	132	162	8.0	11	"
10			8.1		"
11			8.2		"
12	114	135	8.2	12	"
13			8.1		"
14			8.3		"
15	76	92	8.2	11	"

*Centrifuged Supernatant

TABLE 12 BOD, COD, pH, SETTLEABLE IN 30 MINUTES AND
 PREDOMINATE MICROORGANISMS OF SLUDGE AT 30°C
 3.1 % STARTING TOTAL SOLIDS

Aeration (days)	BOD* (mg/l)	COD* (mg/l)	pH	Settleable in 30 min.(%)	Predominate Microorganisms
0	242	280	7.2	12	<u>Sphaerotilus</u> <u>natans</u>
1			8.0		"
2			8.2		"
3	230	263	8.1	8	"
4			8.3		"
5			8.0		"
6	212	247	8.2	7	"
7			8.3		"
8			8.1		"
9	184	225	8.4	9	"
10			8.2		"
11			8.1		"
12	172	204	8.0	9	"
13			8.3		"
14			8.1		"
15	143	172	8.1	10	"

*Centrifuged Supernatant

TABLE 13 BOD, COD, pH, SETTLEABLE IN 30 MINUTES AND
 PREDOMINATE MICROORGANISMS OF SLUDGE AT 35°C
 1.1 % STARTING TOTAL SOLIDS

Aeration (days)	BOD* (mg/l)	COD* (mg/l)	pH	Settleable in 30 min.(%)	Predominate Microorganisms
0	228	262	7.0	12	<u>Sphaerotilus</u> <u>natans</u>
1			8.0		"
2			8.1		"
3	176	211	8.0	12	"
4			8.2		"
5			8.2		"
6	142	166	8.3	11	"
7			8.1		"
8			8.2		"
9	109	125	8.2	13	"
10			8.1		"
11			8.3		"
12	75	91	8.0	10	"
13			8.2		"
14			8.1		"
15	42	52	8.1	14	"

* Centrifuged Supernatant

TABLE 14 BOD, COD, pH , SETTLEABLE IN 30 MINUTES AND
 PREDOMINATE MICROORGANISMS OF SLUDGE AT 35°C
 2.05 % STARTING TOTAL SOLIDS

Aeration (days)	BOD* (mg/l)	COD* (mg/l)	pH	Settable in 30 min.(%)	Predominate Microorganisms
0	221	264	7.2	11	<u>Sphaerotilus</u> <u>natans</u>
1			8.1		"
2			8.2		"
3	209	242	8.0	13	"
4			8.3		"
5			8.2		"
6	175	208	8.2	11	"
7			8.1		"
8			8.3		"
9	135	156	8.2	12	"
10			8.3		"
11			8.1		"
12	95	114	8.2	10	"
13			8.2		"
14			8.0		"
15	64	72	8.2	10	"

* Centrifuged Supernatant

TABLE 15 BOD, COD, pH, SETTLEABLE IN 30 MINUTES AND
 PREDOMINATE MICROORGANISMS OF SLUDGE AT 35° C
 3.02 % STARTING TOTAL SOLIDS

Aeration (days)	BOD* (mg/l)	COD* (mg/l)	pH	Settleable in 30 min.(%)	Predominate Microorganisms
0	245	270	7.2	11	<u>Sphaerotilus</u> <u>natans</u>
1			8.1		"
2			8.2		"
3	233	264	8.3	10	"
4			8.3		"
5			8.4		"
6	212	247	8.2	11	"
7			8.2		"
8			8.3		"
9	175	199	8.1	9	"
10			8.4		"
11			8.3		"
12	154	185	8.2	10	"
13			8.1		"
14			8.2		"
15	122	146	8.2	12	"

* Centrifuged Supernatant

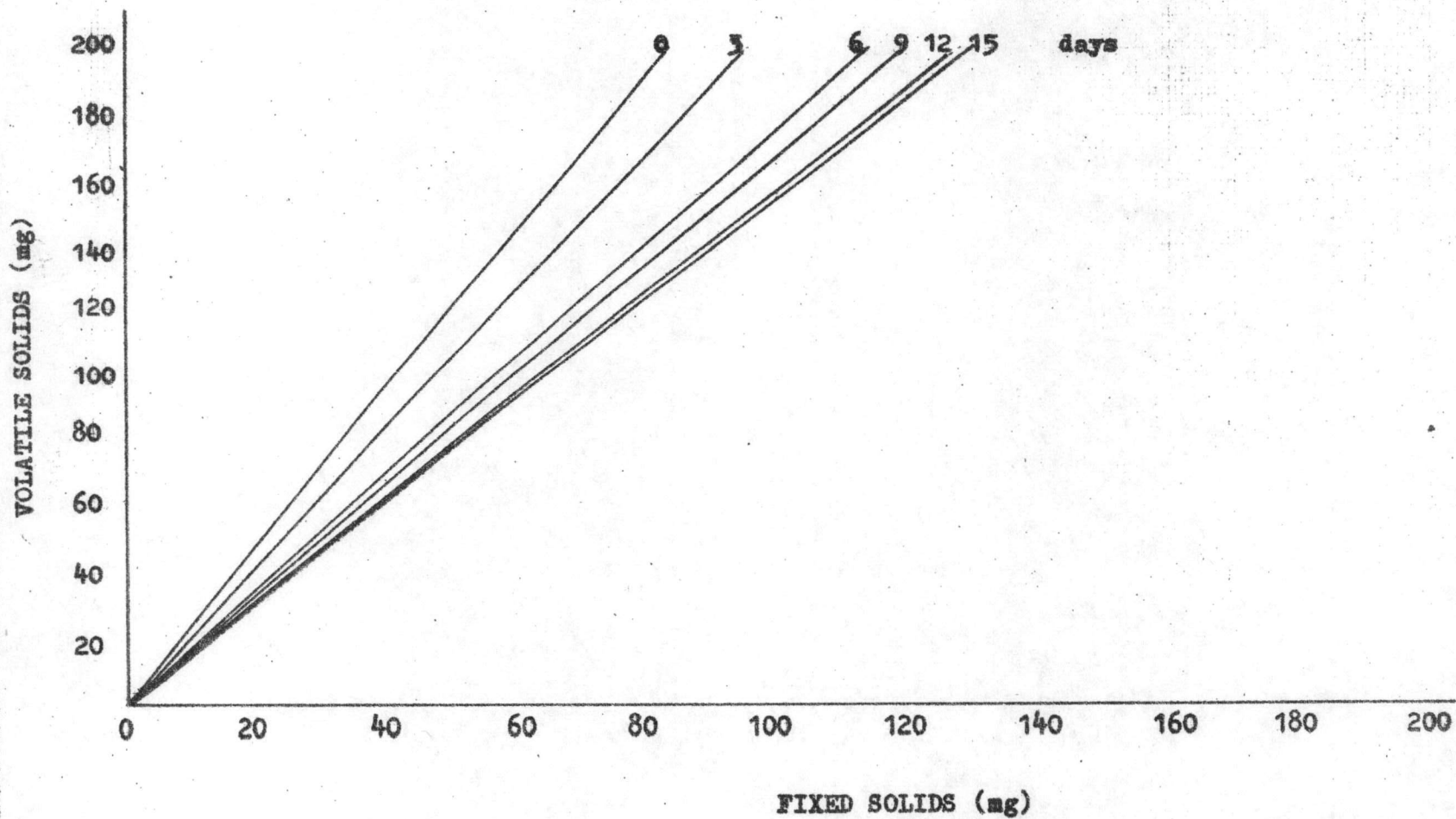


FIG. 8 SUSPENDED SOLIDS OF 1.04 % TS AT 30°C

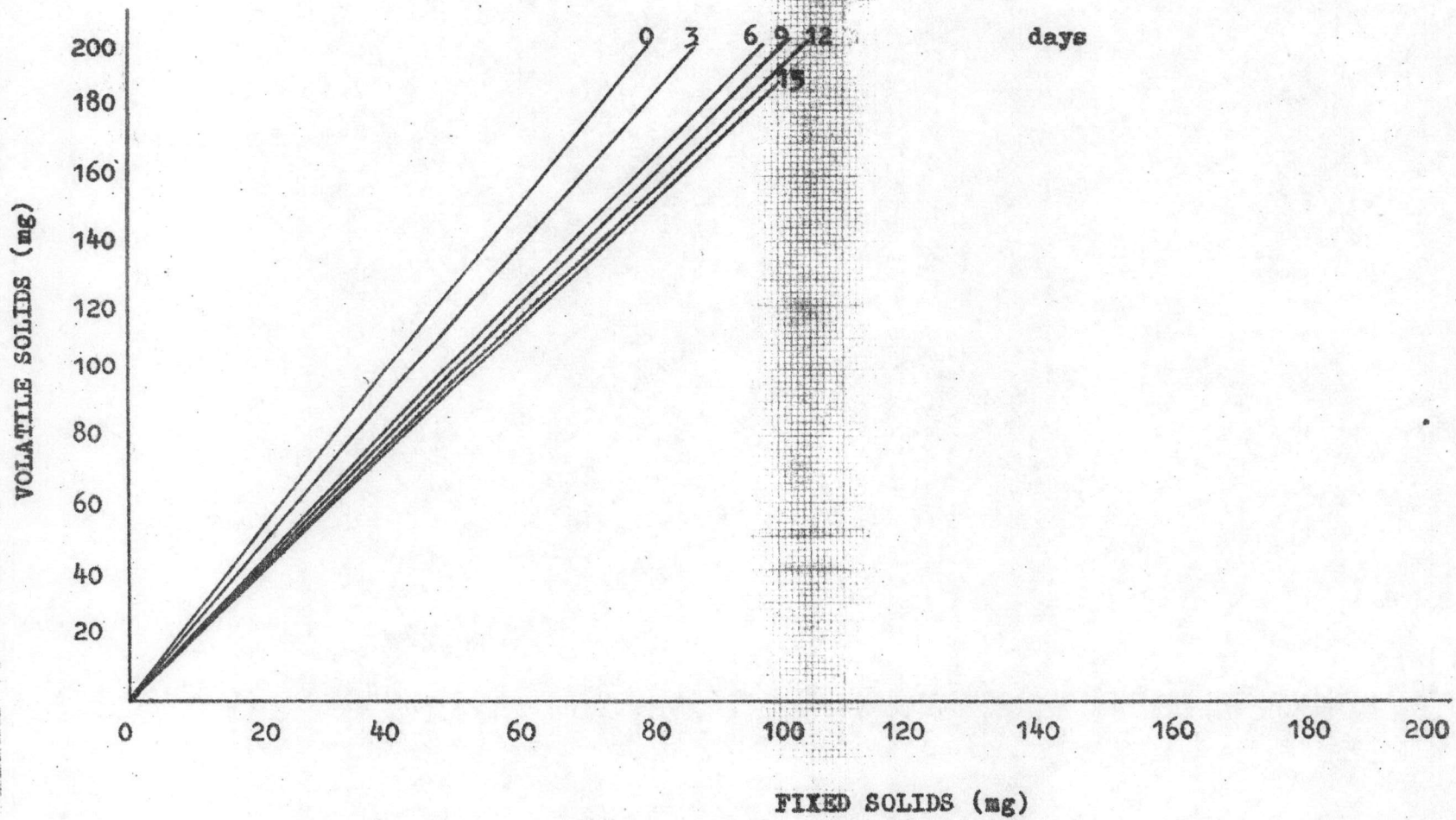


FIG. 9 SUSPENDED SOLIDS OF 2.02 % TS AT 30°C

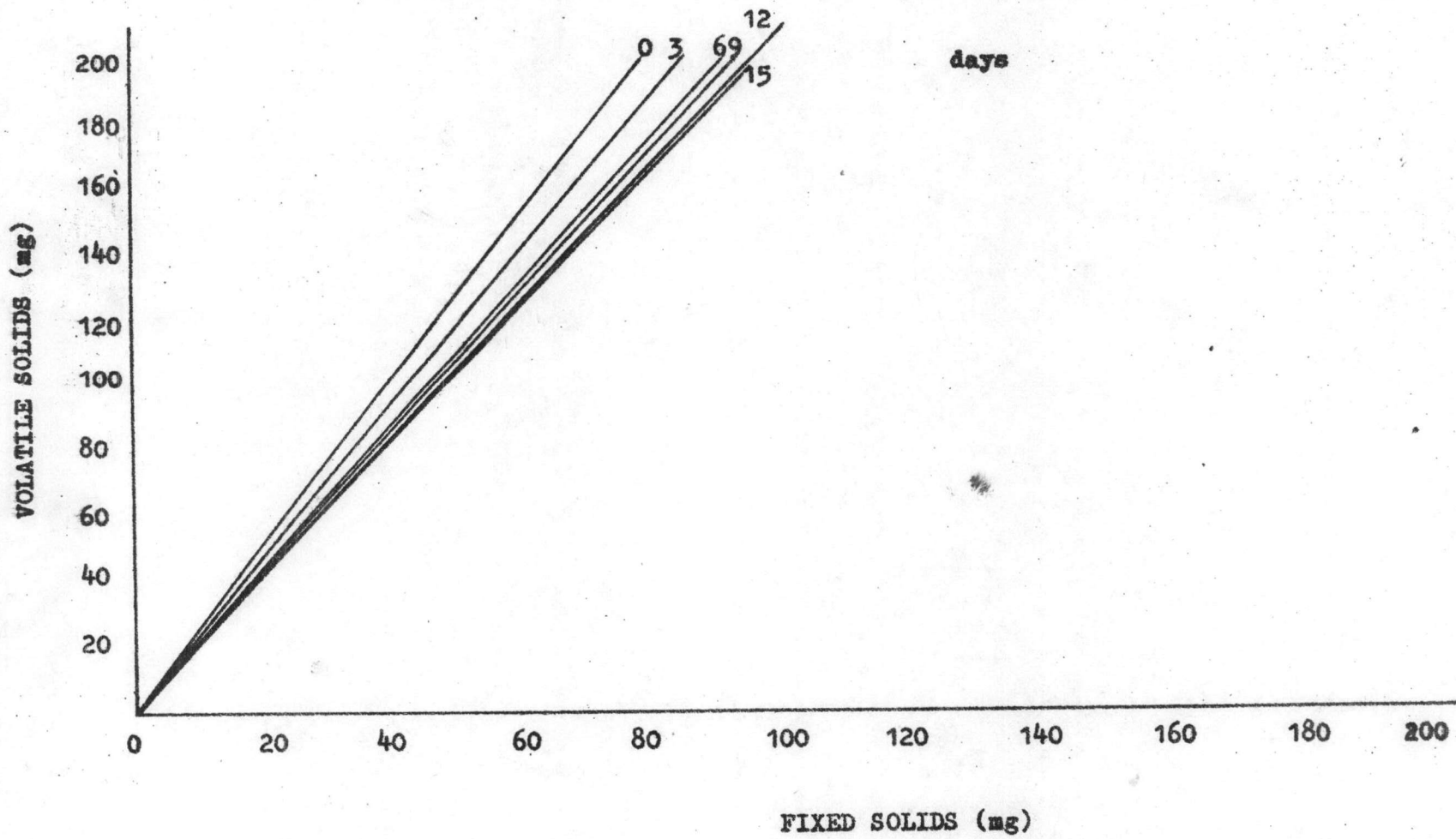


FIG. 10 SUSPENDED SOLID OF 3.1 % TS AT 30°C

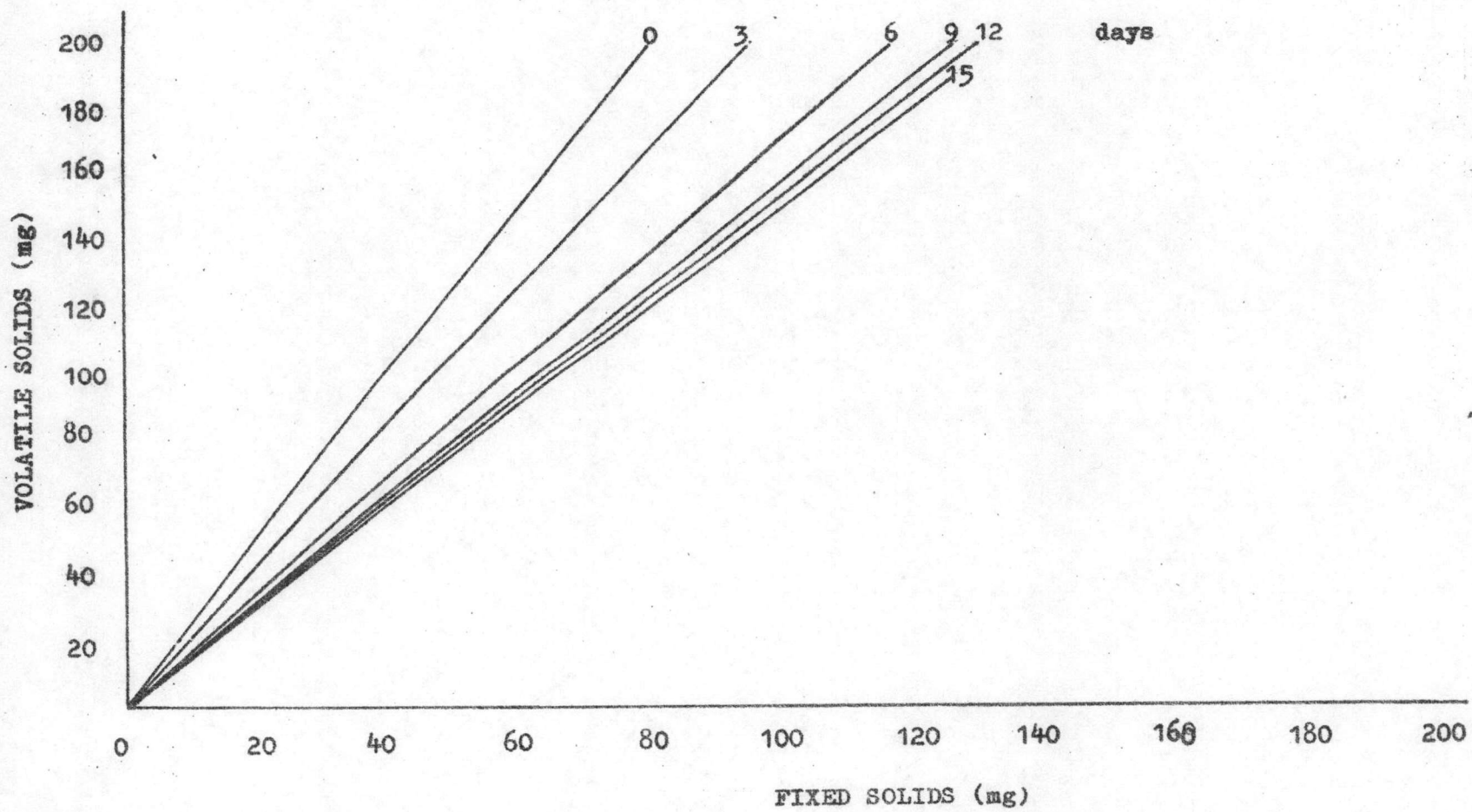


FIG.11 SUSPENDED SOLIDS OF 1.1 % TS AT 35°C

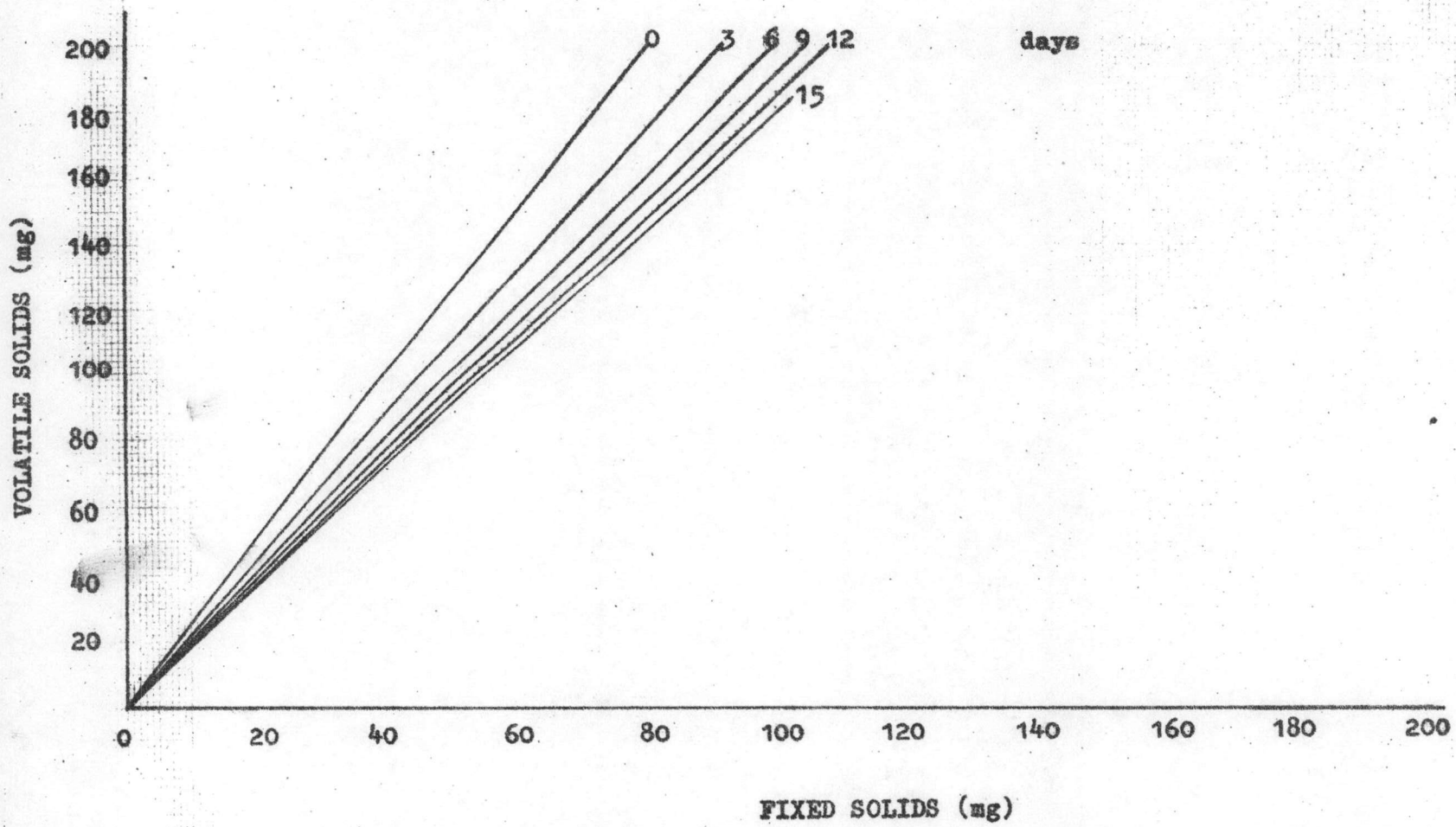


FIG. 12 SUSPENDED SOLIDS OF 2.05 % TS AT 35°C

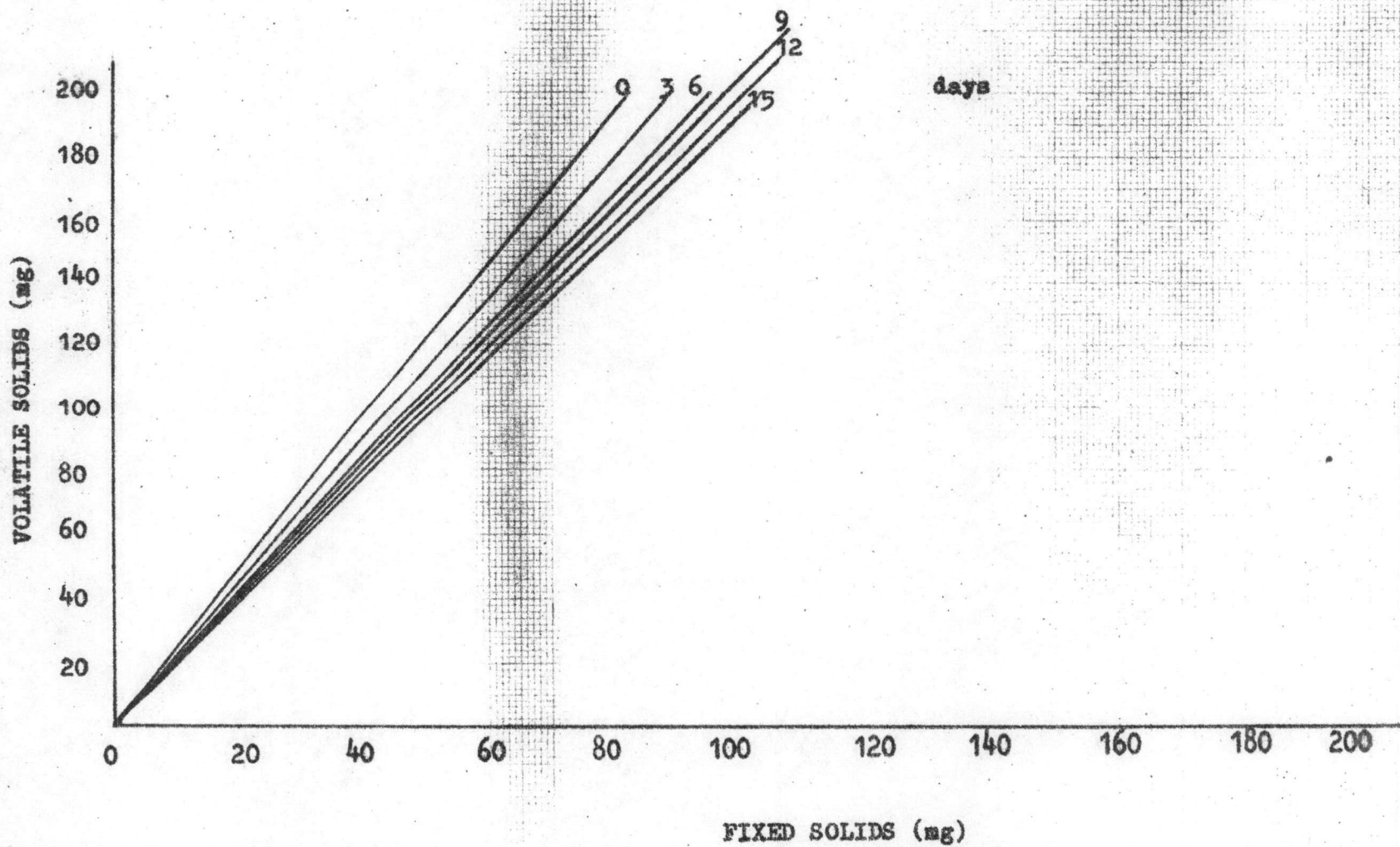


FIG. 13 SUSPENDED SOLIDS OF 3.02 % TS AT 35°C

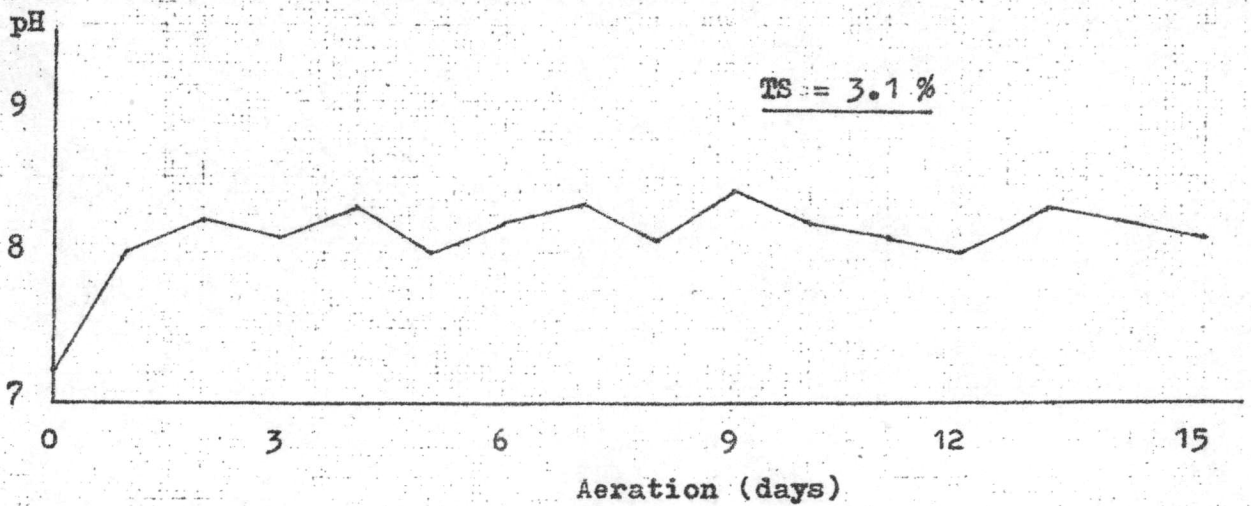
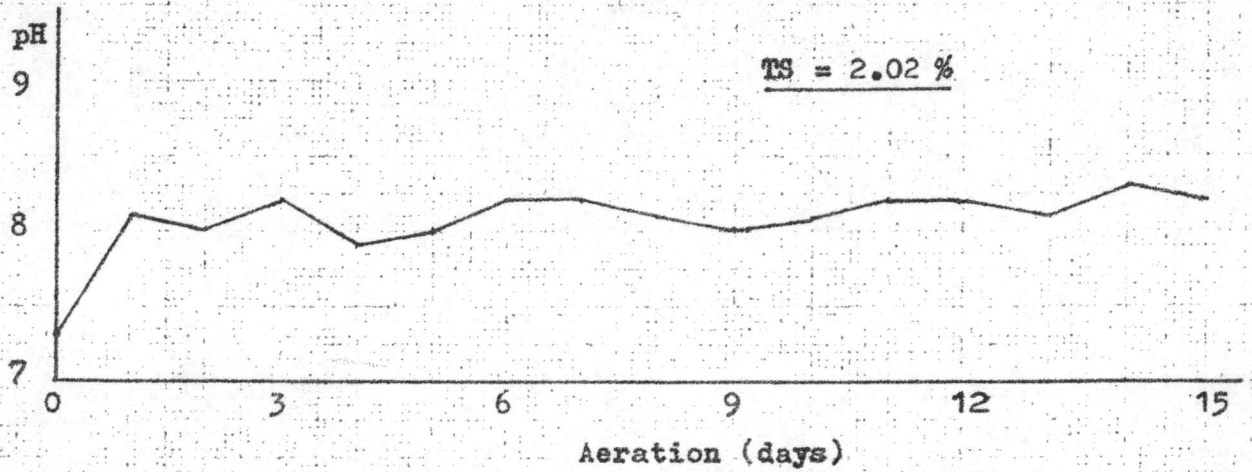
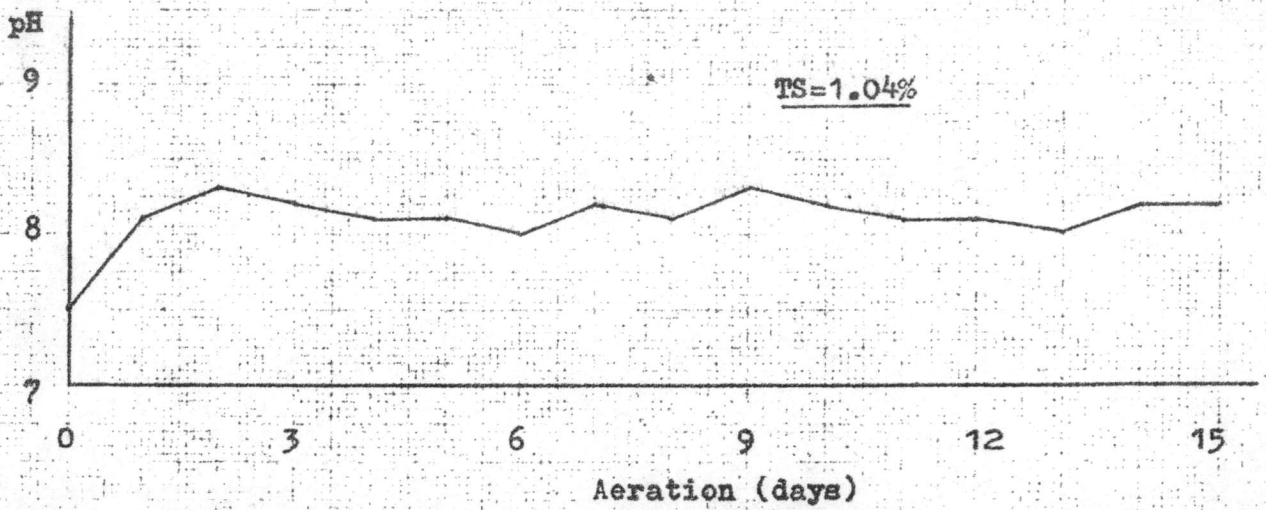


FIG. 14 pH OF AERATED SLUDGE AT 30° C

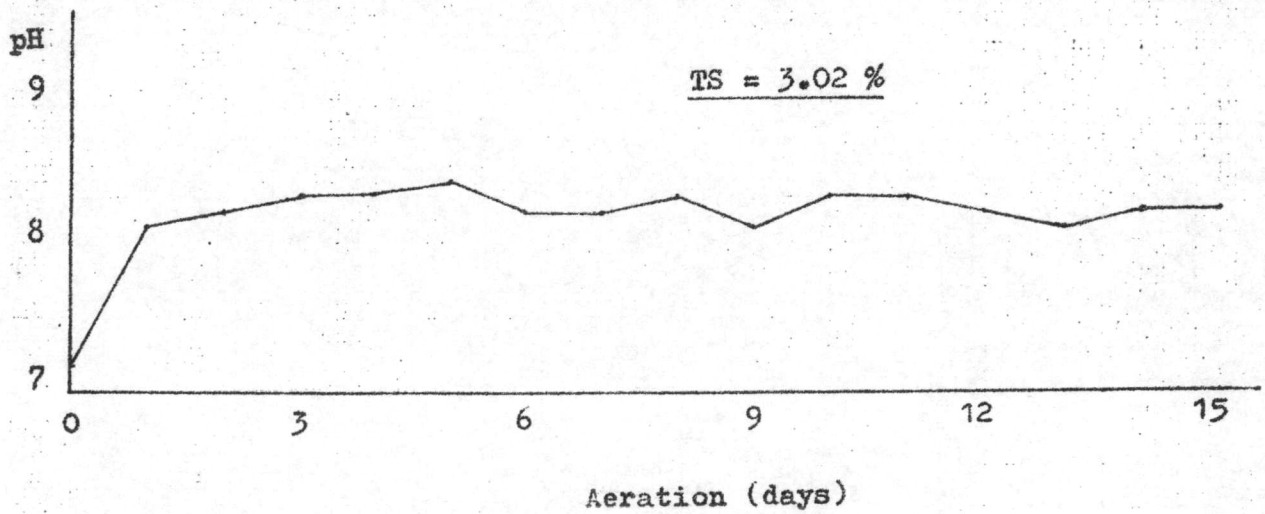
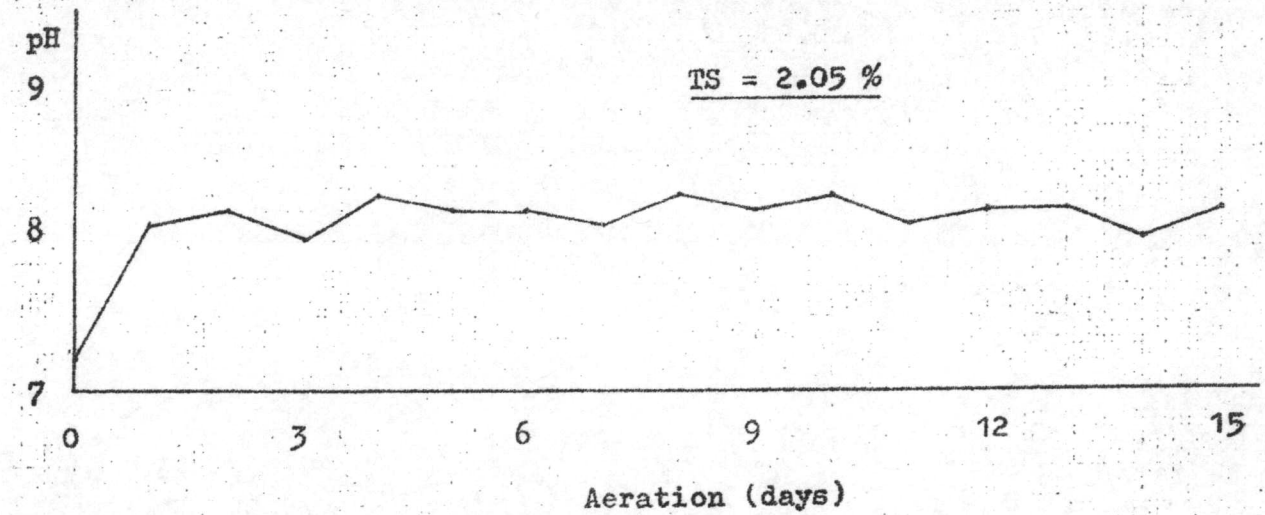
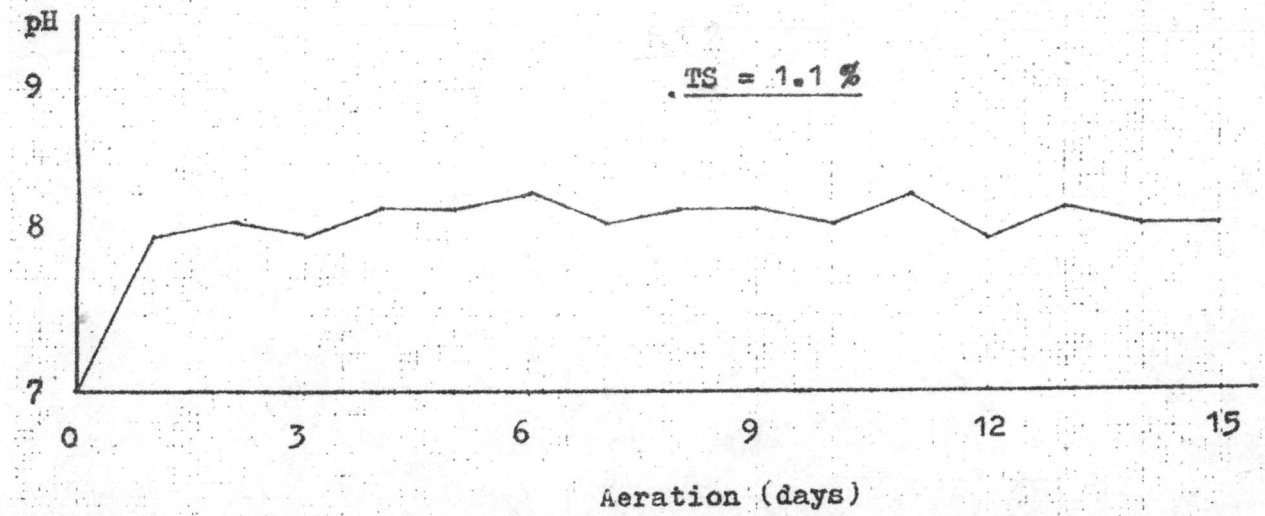


FIG. 15 pH OF AERATED SLUDGE AT 35° C

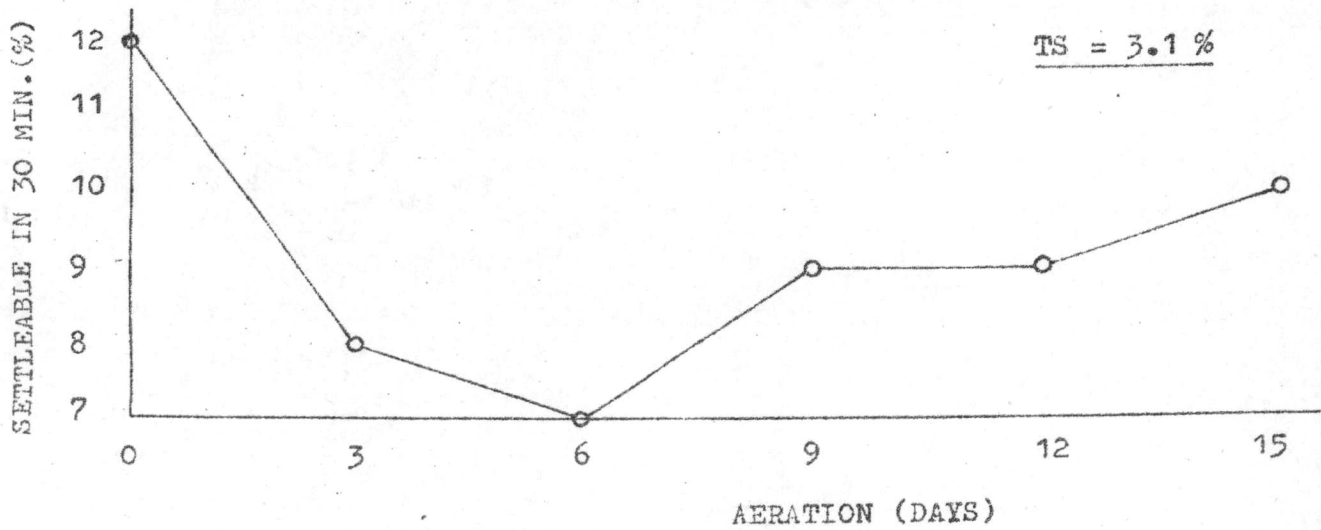
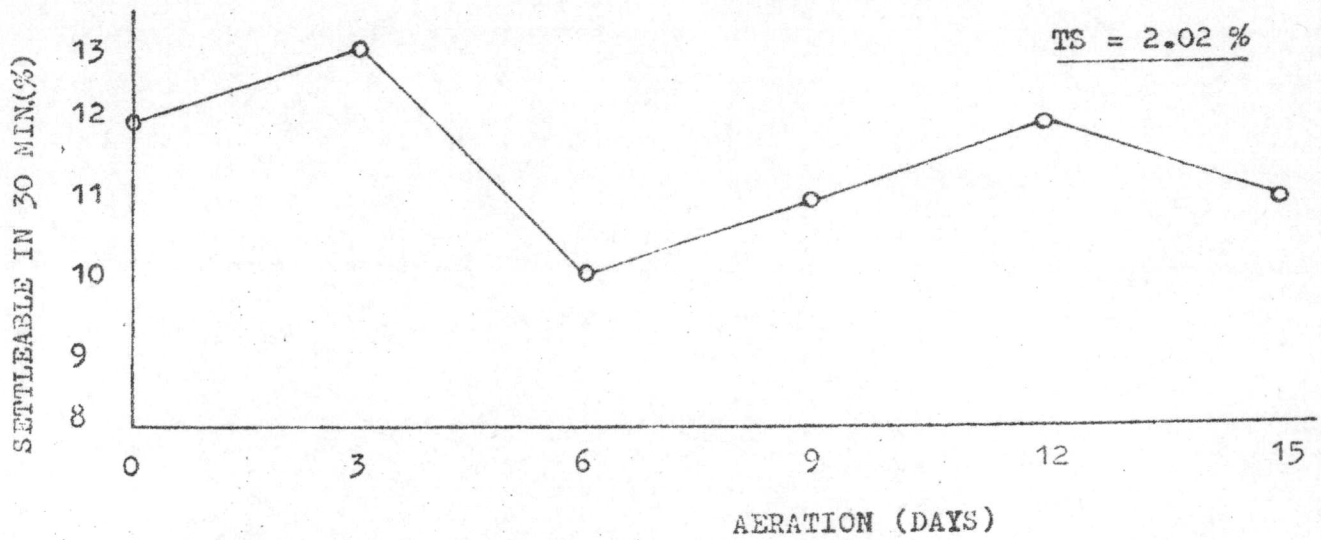
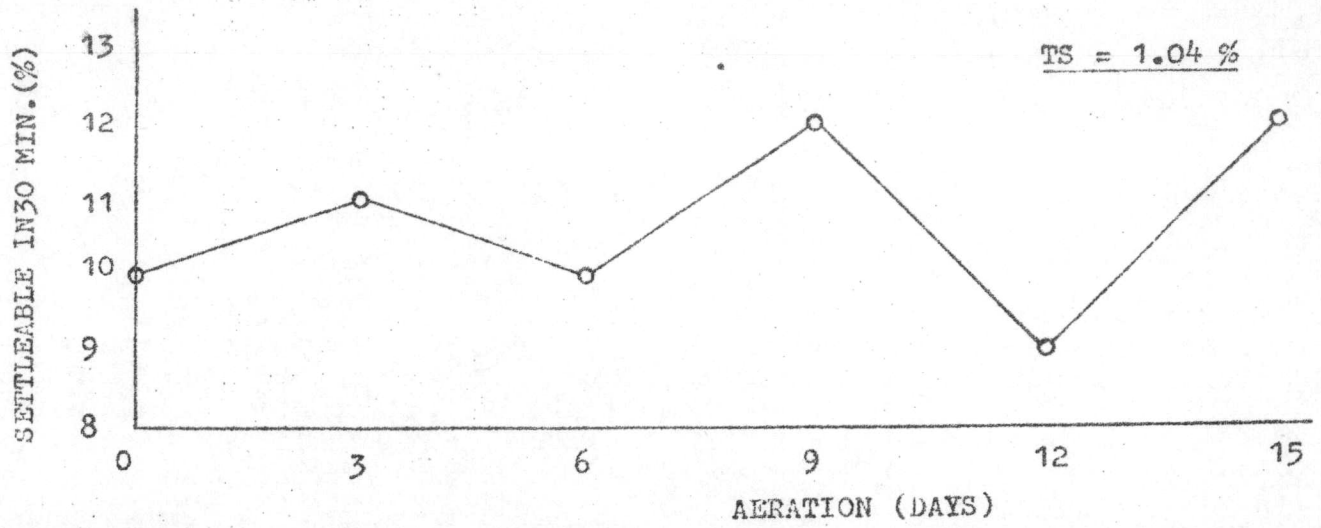


FIG. 16 SETTLEABLE OF SLUDGE IN 30 MINUTES (%) AT 30° C

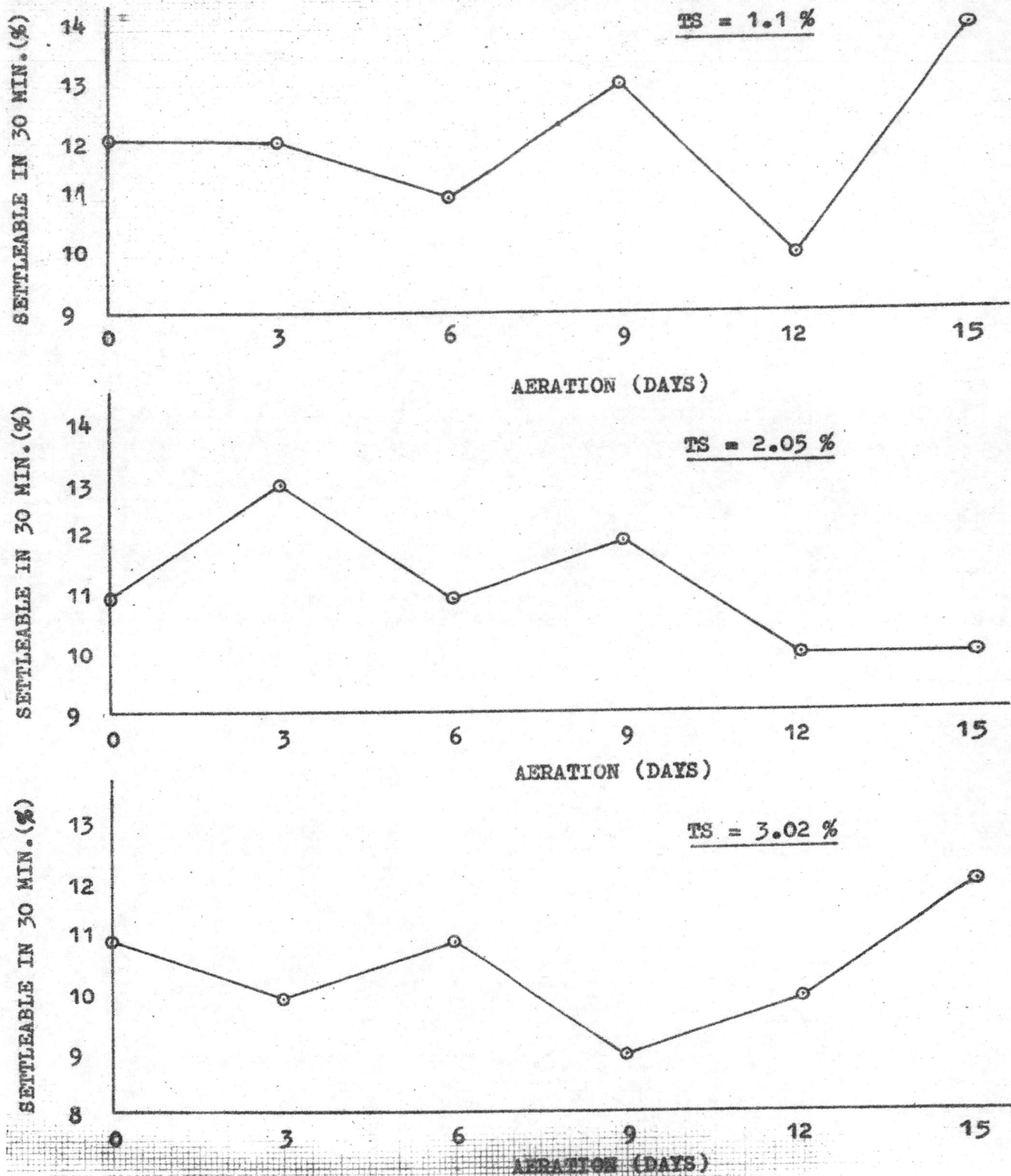


FIG. 17 SETTLEABLE OF SLUDGE IN 30 MINUTES (%) AT 35°C

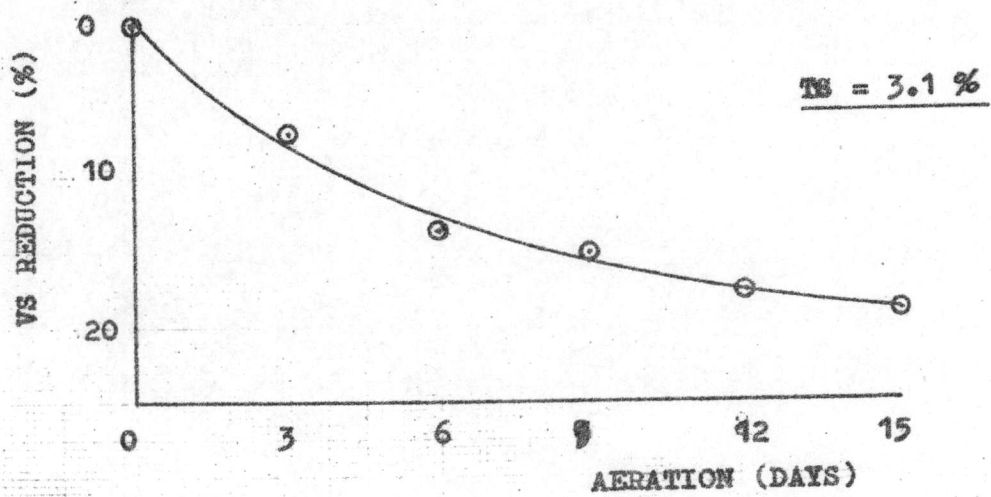
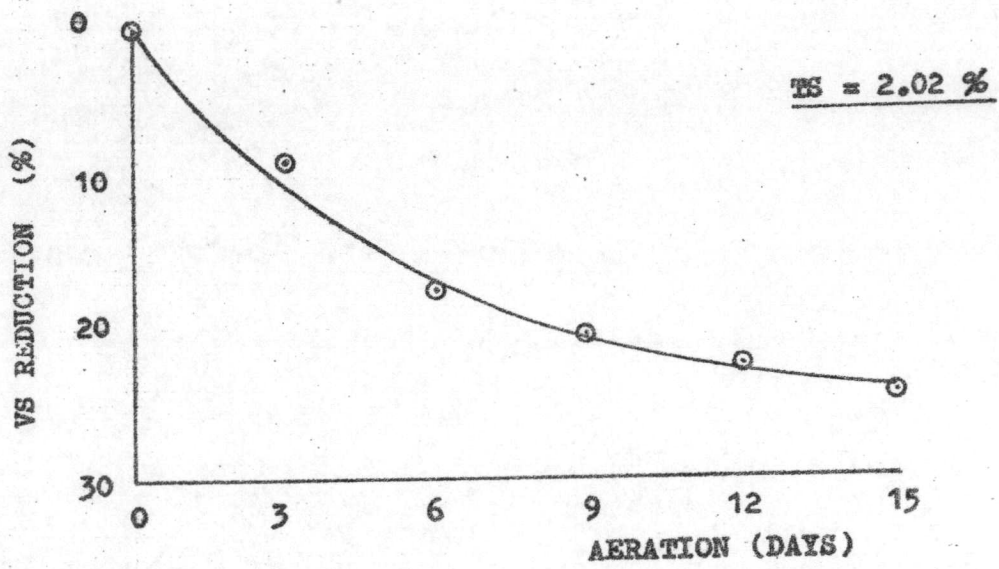
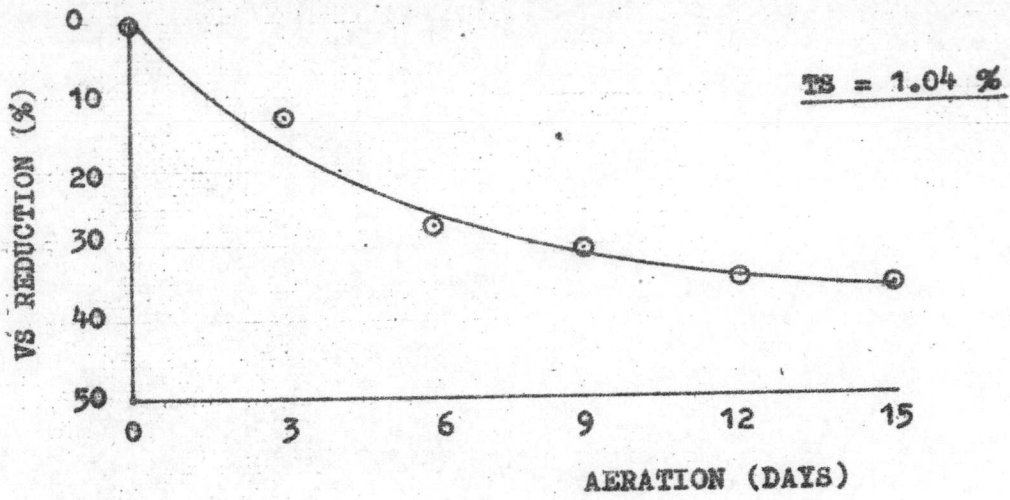


FIG. 18 VS REDUCTION AT 30° C

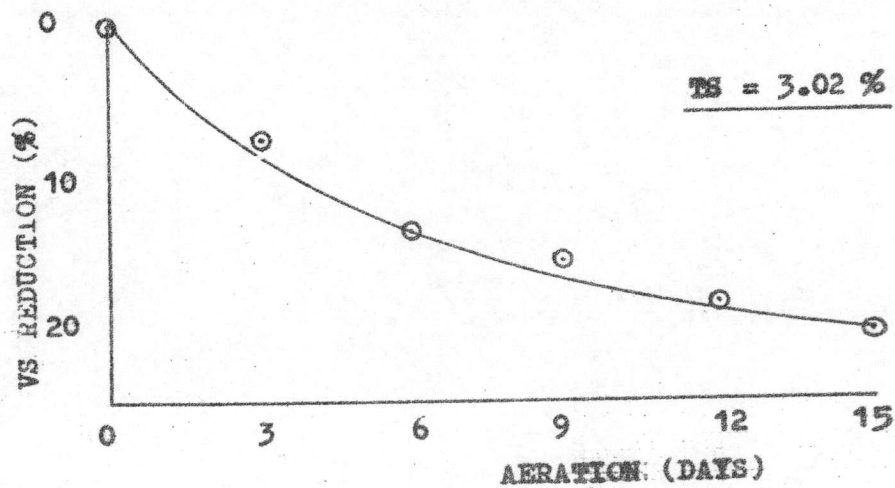
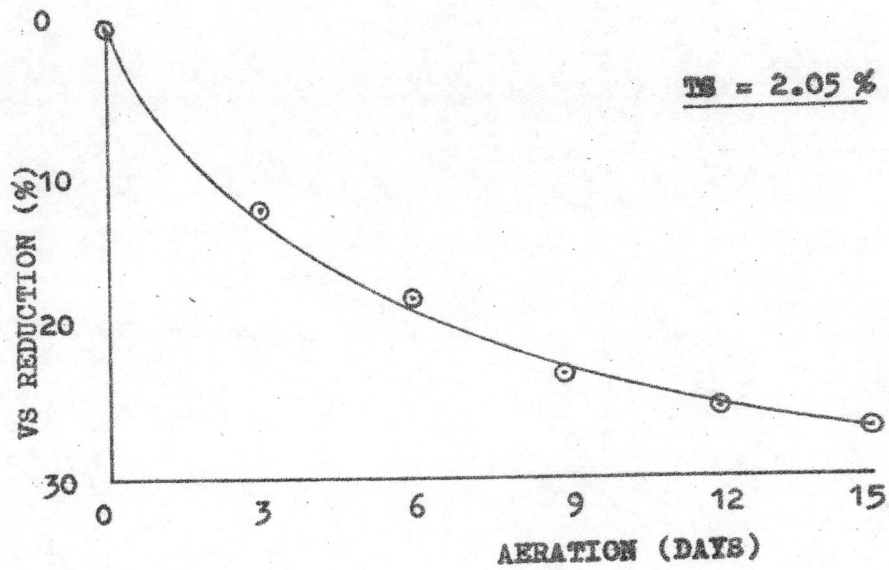
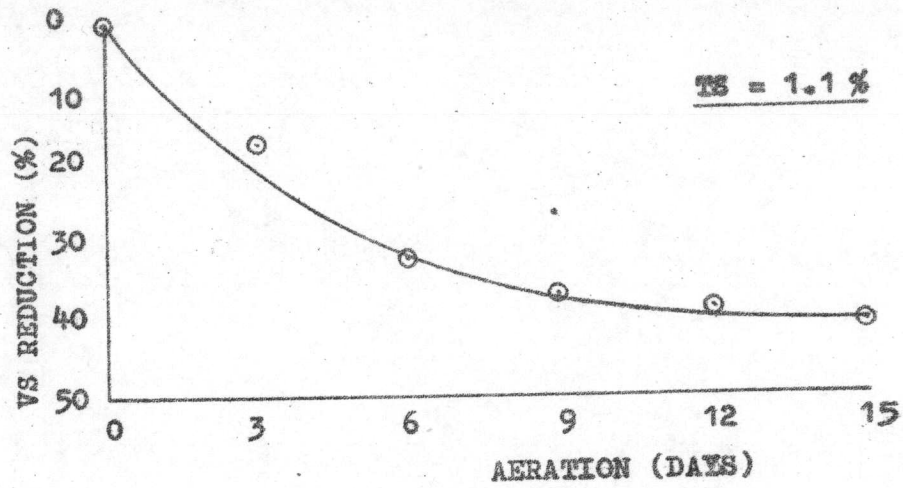


FIG. 19 VS REDUCTION AT 35° C

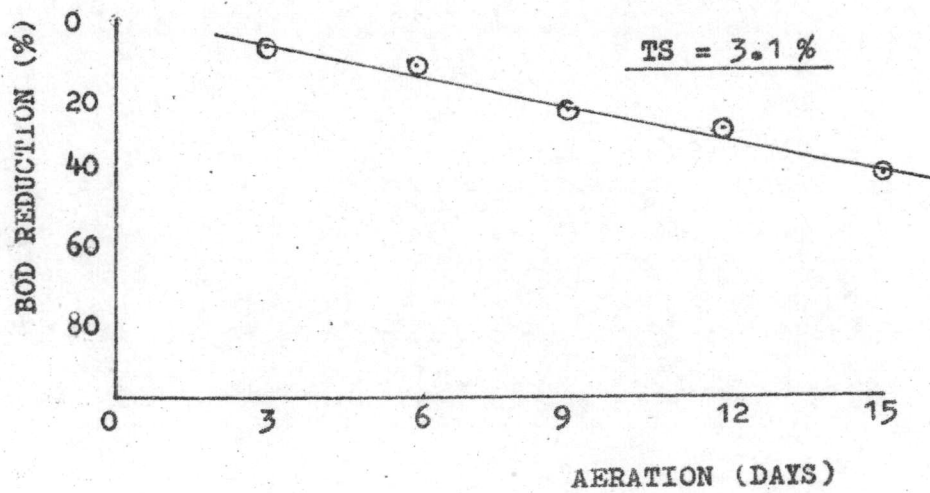
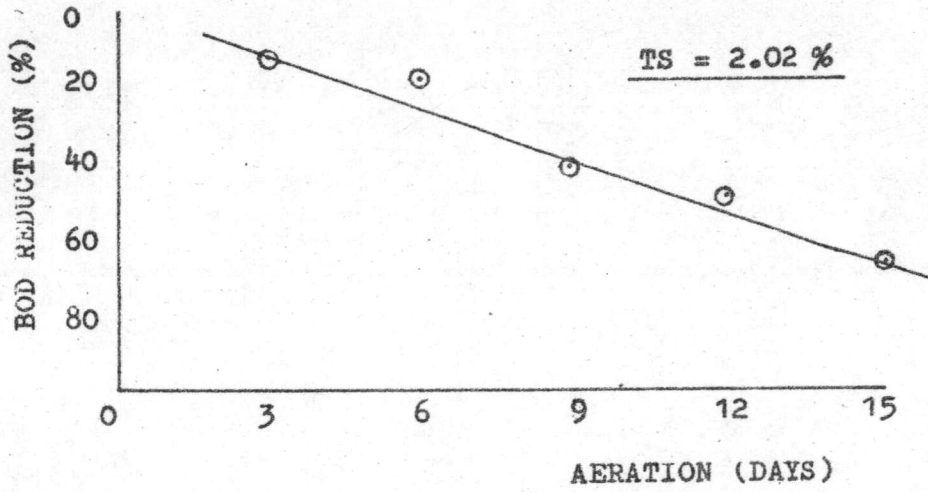
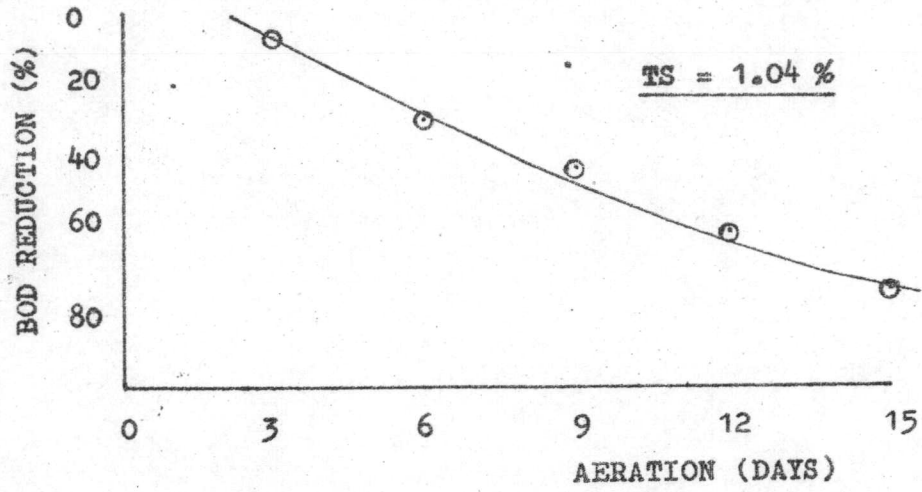


FIG. 20 BOD REDUCTION AT 30° C

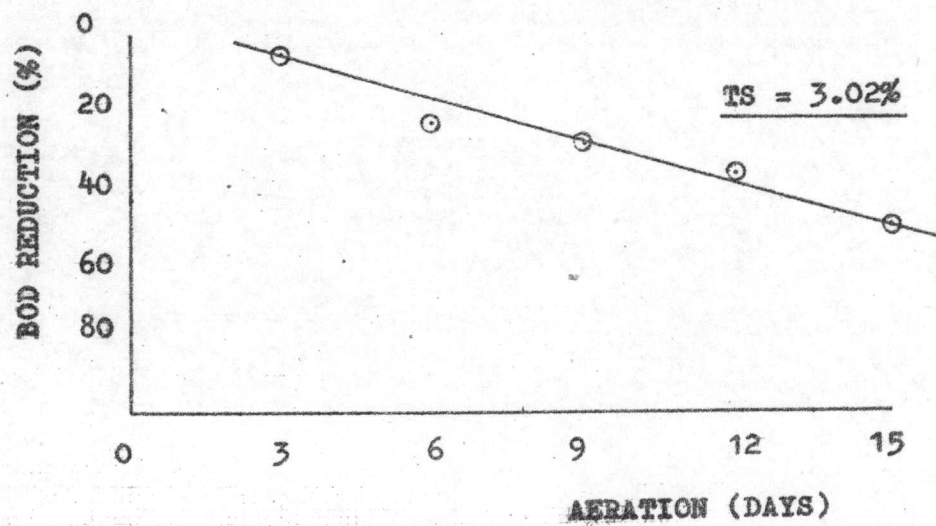
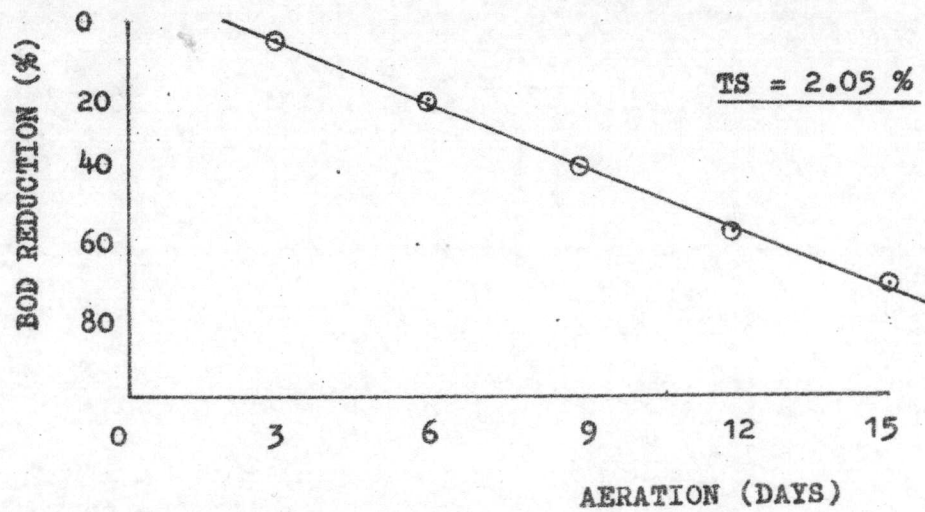
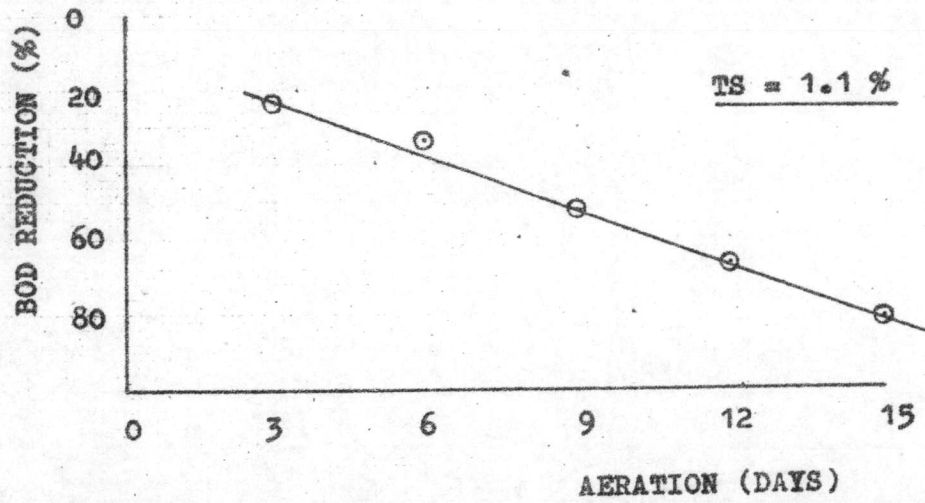


FIG. 21. BOD REDUCTION AT 35° C

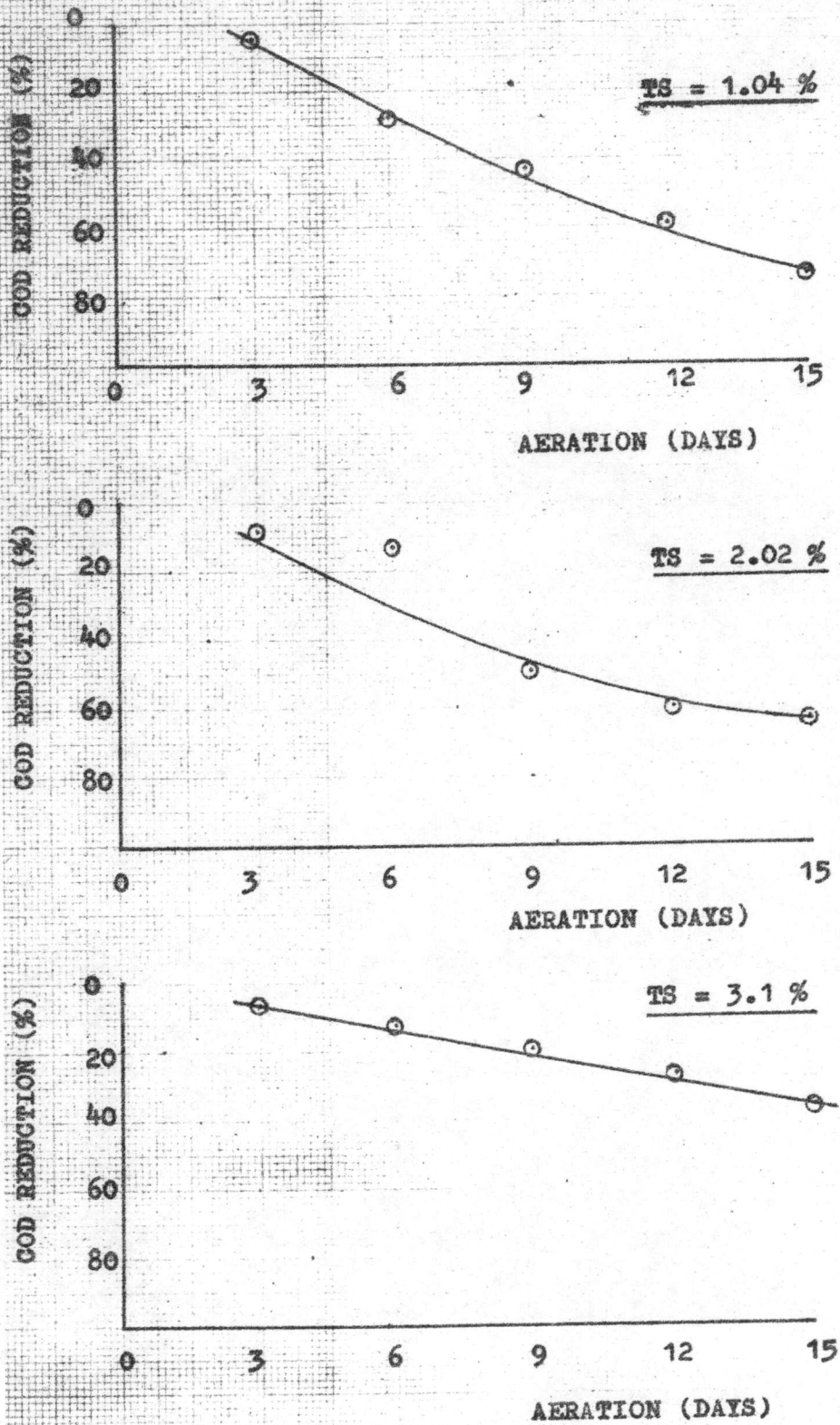


FIG. 22 COD REDUCTION AT 30° C

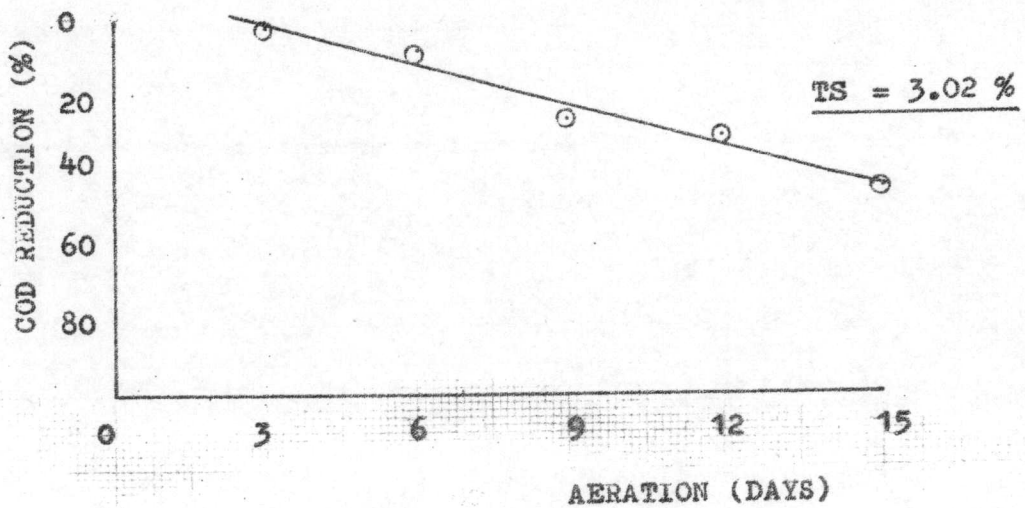
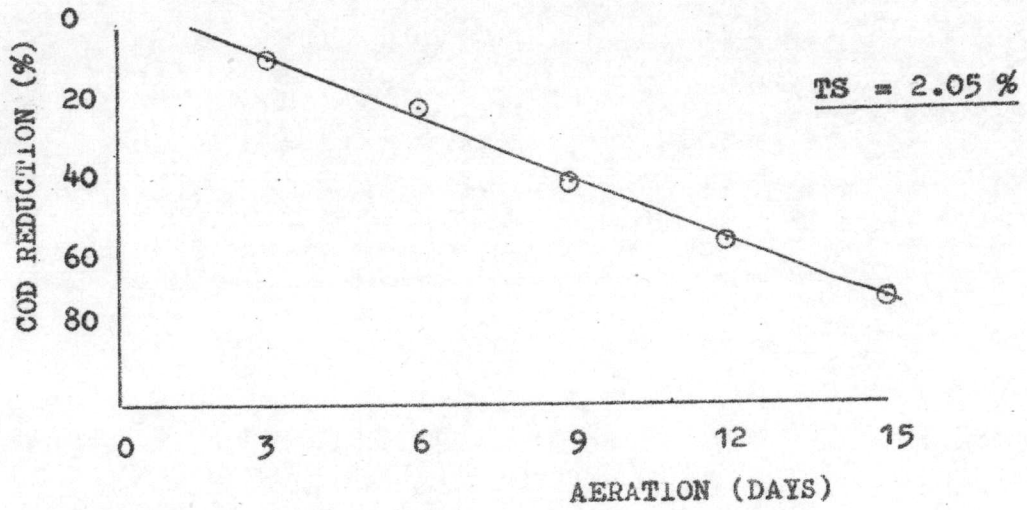
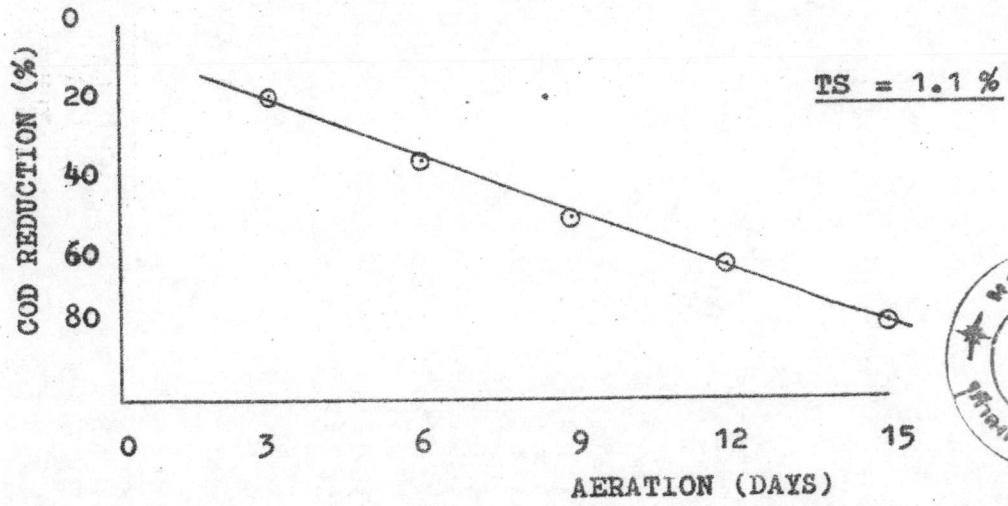


FIG. 23 COD REDUCTION AT 35° C

TABLE 16 SLUDGE CHARACTERISTICS BEFORE AND AFTER
TREATMENT IN THE LABORATORY-SCALE DIGESTER
AT 30° C

Characteristics of Sludge	Start (0 day)	End (15 days)	% Removal
<u>Total Solids = 1.04 %</u>			
BOD*, mg/l	212	54	74.5
COD*, mg/l	251	65	74.1
pH	7.5	8.2	--
VS/FS, mg/mg	2.395	1.542	--
Volatile SS	-	-	35.6
Settleable in 30 min. %	10	12	--
<u>Total Solids = 2.02 %</u>			
BOD*, mg/l	224	76	66.1
COD*, mg/l	254	92	63.8
pH	7.3	8.2	--
VS/FS, mg/mg	2.495	1.882	--
Volatile SS	-	-	24.6
Settleable in 30 min. %	12	11	--
<u>Total Solids = 3.1 %</u>			
BOD*, mg/l	242	143	40.9
COD*, mg/l	280	172	38.6
pH	7.2	8.1	--
VS/FS, mg/mg	2.515	2.056	--
Volatile SS	-	-	19.3
Settleable in 30 min. %	12	10	--

* Centrifuged Supernatant

TABLE 17 SLUDGE CHARACTERISTICS BEFORE AND AFTER
TREATMENT IN THE LABORATORY-SCALE DIGESTER
AT 35° C

Characteristics of sludge	Start (0 day)	End (15 days)	% Removal
<u>Total Solids = 1.1 %</u>			
BOD*, mg/l	228	42	81.6
COD*, mg/l	262	52	80.2
pH	7.0	8.1	--
VS/FS, mg/mg	2.473	1.493	--
Volatile SS	--	--	40.2
Settleable in 30 min. %	12	14	--
<u>Total Solids = 2.05 %</u>			
BOD*, mg/l	221	64	71.0
COD*, mg/l	264	72	72.7
pH	7.2	8.2	--
VS/FS, mg/mg	2.491	1.818	--
Volatile SS	--	--	27.0
Settleable in 30 min. %	11	10	--
<u>Total Solids = 3.02 %</u>			
BOD*, mg/l	245	122	50.2
COD*, mg/l	270	146	45.9
pH	7.2	8.2	--
VS/FS, mg/mg	2.438	1.937	--
Volatile SS	--	--	20.5
Settleable in 30 min.	11	12	--

* Centrifuged Supernatant