STATE OF MAINE
DEPARTMENT OF HUMAN SERVICES
DIVISION OF HEALTH ENGINEERING
10 STATE HOUSE STATION
AUGUSTA, MAINE
04333-0010

May 7, 2002

ANGUS S. KING, JR.
GOVERNOR

KEVIN W. CONCANNON
COMMISSIONER

Huron Environmental
Attn.: Timothy G. Warrow
67 Woodland Road
Windham, ME 04062-5608

Subject: Product Registration, General Use Approval, CMS ROTORDISK Sewage Treatment System

Dear Mr. Warrow:

Thank you for your submission of Excel spreadsheets regarding four long term installations of the CMS ROTORDISK Sewage Treatment System. This information was submitted pursuant to Section 1802 of the Maine State Plumbing Code, Subsurface Wastewater Disposal Rules (Rules), for code registration, for General Use approval in Maine.

Product Description

The CMS ROTORDISK Sewage Treatment System consists of rotating biological disks in a self-contained primary and secondary settling tank. The number of disks varies with system capacity, which ranges from 360 gallons per day (gpd) (Model S12) to 100,000 gpd (Model L1500). Treated wastewater is recirculated to the primary treatment chamber of the tank prior to final discharge. The CMS ROTORDISK Sewage Treatment System received National Sanitation Foundation (NSF) Standard 40 approval in August of 1986, pursuant to NSF Report #S40-15-1. The Division granted Provisional approval for the CMS ROTORDISK Sewage Treatment System in February of 2002.

Claim

According to the additional information you provided, including records for one installation which was monitored beginning in January of 1994, the CMS ROTORDISK Sewage Treatment System routinely produces effluent with BOD_5 TSS, and TKN in single digit values. The device routinely reduces nitrate nitrogen levels to 30 mg/l, and frequently to less than 20 mg/l.

Determination

On the basis of the information submitted, the Division has determined that the CMS ROTORDISK Sewage Treatment System is acceptable for use in the State of Maine on a General Use basis, provided that it is installed, operated, and maintained in conformance with the manufacturer's directions.

Installations of the CMS ROTORDISK Sewage Treatment System for residential use must be accompanied by a contract with an operation and maintenance entity, signed by the property owner and/or system operator, and a copy must be provided to the Local Plumbing Inspector prior to issuance of any permits for such installations.

Because installation and owner maintenance has a significant effect on the working order of onsite sewage disposal systems, including their components, the Division makes no representation or guarantee as to the efficiency and/or operation of CMS ROTORDISK Sewage Treatment System. Further, registration of this product for use in the State of Maine does not represent Division preference or recommendation for this product over similar products.

If you have any questions please feel free to contact me at (207) 287-5695.

Sincerely,

James A. Jacobsen

James A. Jacobsen, Environmental Specialist IV
Wastewater and Plumbing Control Program
Division of Health Engineering
e-mail: james.jacobsen@state.me.us

/jaj
xc: Product File

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SKYWAY

	EFFLUENT						INFLUENT			
Date	BOD	TSS	AMM-N	TP	E-COLI		BOD	TSS	TKN	TP
20-Jan-99	3.4	3.0	0.33	0.14	0		4.8	4.5	0.8	0.18
28-Jan-99	4.5	4.0	1.52	0.39	0					
4-Feb-99	8.8	6.2	1.33	0.40	0					
10-Feb-99	3.5	2.2	1.92	0.22	0		8.1	7.5	0.9	0.35
17-Feb-99	2.9	2.5	0.45	0.21	0					
23-Feb-99	4.4	3.2	0.48	0.29	0					
2-Mar-99	4.2	3.0	0.15	0.25	0					
10-Mar-99	2.3	1.5	0.09	0.19	0		2.2	1.6	0.6	0.21
17-Mar-99	6.2	4.2	0.21	0.25	0					
24-Mar-99	5.2	4.0	0.25	0.23	0					
31-Mar-99	3.2	2.5	0.30	0.15	0					
4-Apr-99	2.2	0.9	0.90	0.10	0					
14-Apr-99	3.2	2.1	0.38	0.19	0		194.0	84.0	13.2	7.20
21-Apr-99	3.8	2.5	0.35	2.67	0					
28-Apr-99	2.5	0.9	0.11	0.02	0					
5-May-99	4.4	3.9	0.21	0.39	0					
12-May-99	3.5	3.0	0.25	0.25	0		236.0	210.0	9.8	7.18
19-May-99	3.8	2.0	0.06	1.76	0					
26-May-99	2.5	2.4	0.22	0.49	0					
2-Jun-99	3.2	2.8	0.41	4.36	0					
9-Jun-99	3.1	1.3	0.05	0.13	0		198.0	140.0	24.0	5.58
15-Jun-99	2.0	1.2	0.06	0.41	0					
23-Jun-99	2.1	1.6	0.27	0.68	0					
6-Jul-99	2.1	2.3	0.19	0.24	0					
13-Jul-99	3.0	2.2	0.09	0.08	0		250.0	180.0	34.1	6.46
20-Jan-99										
20-Jan-99										
20-Jan-99										

20-Jan-99										
20-Jan-99										
20-Jan-99										
20-Jan-99										
20-Jan-99										
20-Jan-99										

BOB-LO

EFFLUENT Test Data

Date	BOD	TSS	AMM-N	TP	E-COLI	ADF
5-Oct-98	2.5	2.1	0.14	0.20	0	
13-Oct-98	3.2	2.1	0.11	0.08	0	
21-Oct-98	2.8	2.1	0.39	0.08	0	
27-Oct-98	2.5	1.8	0.39	0.18	0	31.00
2-Nov-98	2.8	2.5	0.16	0.20	0	
16-Nov-98	3.5	3.2	0.11	0.17	0	
25-Nov-98	2.8	2.1	0.91	0.88	0	30.60
2-Dec-98	2.4	2.2	0.16	0.08	0	
8-Dec-98	2	0.5	0.05	0.08	0	
17-Dec-98	3.2	2.8	0.05	0.18	0	
21-Dec-98	3	2	0.05	0.17	0	28.90
6-Jan-99	3	2	0.11	0.21	0	
20-Jan-99	2.8	2.5	0.05	0.11	0	
28-Jan-99	4.8	3.9	0.10	0.21	0	111.88
4-Feb-99	3.2	3.0	0.05	0.18	0	
10-Feb-99	4.2	3.5	0.13	0.20	0	
17-Feb-99	3.0	2.4	0.13	0.22	0	
23-Feb-99	4.0	3.6	0.31	0.18	0	68.31
3-Mar-99	3.5	2.8	0.12	0.19	0	
11-Mar-99	2.5	2.0	0.05	0.11	0	
17-Mar-99	3.9	3.0	0.20	0.20	0	
24-Mar-99	4.0	3.2	0.19	0.20	0	
31-Mar-99	2.8	2.2	0.11	0.17	0	55.71
4-Apr-99	1.9	0.9	0.09	0.08	0	
14-Apr-99	4.2	2.5	0.29	0.21	0	
21-Apr-99	3.2	2.4	0.08	0.25	0	
28-Apr-99	3.4	1.2	0.15	0.06	0	172.79
5-May-99	3.8	3.2	0.20	0.47	0	
12-May-99	3.6	3.0	0.10	0.60	0	
19-May-99	3.1	0.2	0.19	0.75	0	
26-May-99	3.0	2.2	0.13	0.54	0	65.42
2-Jun-99	4.1	3.4	0.90	0.71	0	
9-Jun-99	2.4	0.9	0.35	0.16	0	
15-Jun-99	3.0	2.4	0.51	0.69	0	
23-Jun-99	2.9	2.1	0.18	0.47	0	59.37
3-Jul-99	2.3	1.5	0.38	0.17	0	
13-Jul-99	2.8	1.5	0.05	0.12	0	
27-Jul-99	3.0	2.4	0.05	0.19	0	65.83
3-Aug-99	4.2	3.0	0.14	0.17	0	
9-Aug-99						
10-Aug-99	2.0	1.5	0.51	0.24	0	
17-Aug-99	2.9	0.6	0.18	0.11	0	

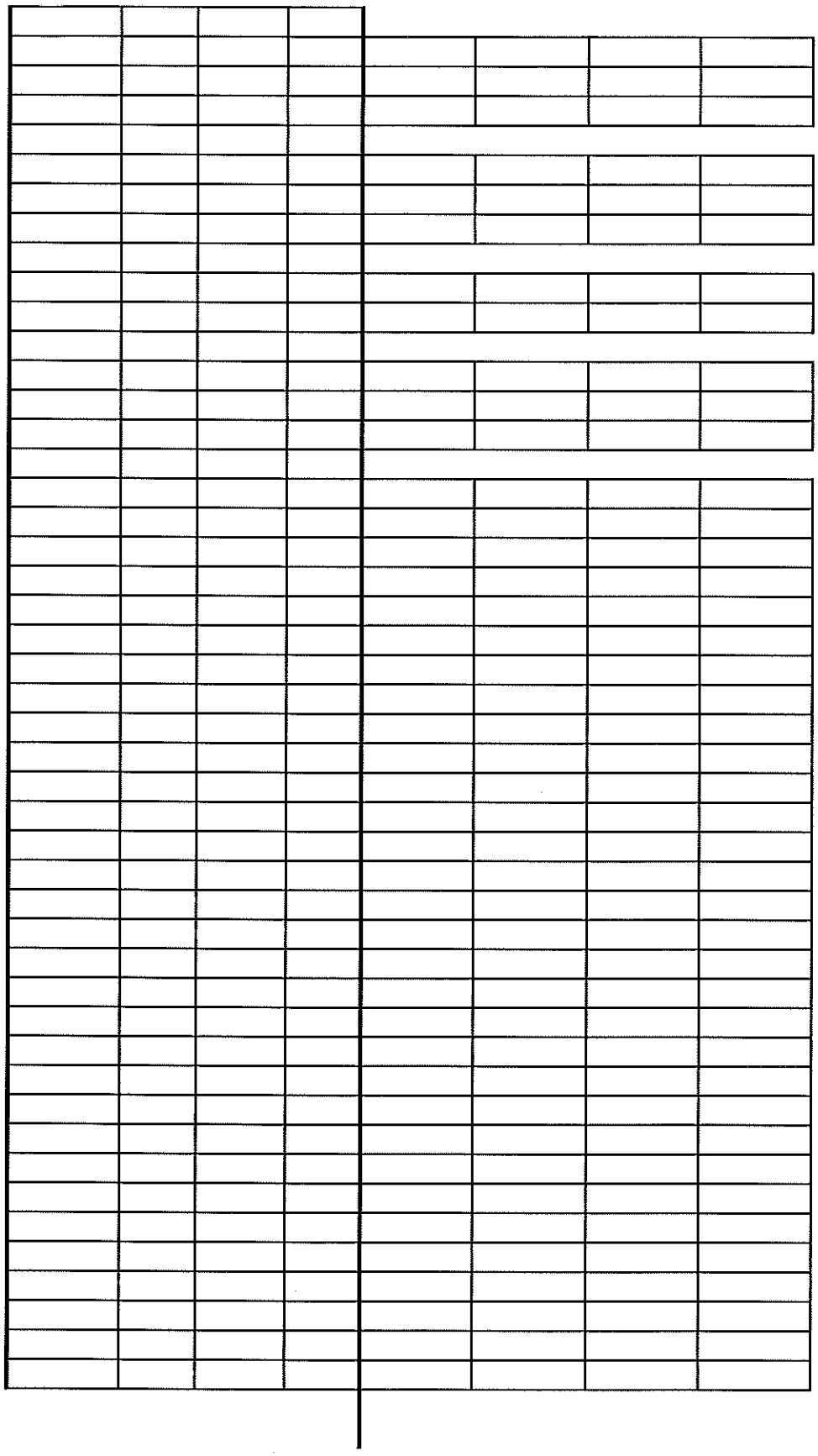
Date
Jan-99
Feb-99
Mar-99
Apr-99
May-99
Jun-99
Jul-99
Aug-99
Sep-99
Oct-99
Nov-99
Dec-99
Jan-00
Feb-00
Mar-00
Apr-00
May-00
Jun-00
Jul-00
Aug-00
Sep-00
Oct-00
Nov-00
Dec-00

23-Aug-99	2.1	1.9	0.17	0.21	0	
31-Aug-99	4.2	3.0	0.19	0.20	0	58.14
7-Sep-99	2.4	2.0	0.26	0.28	0	
13-Sep-99	3.2	2.1	0.10	0.21	0	
21-Sep-99	3.4	2.8	0.11	0.23	0	
28-Sep-99	2.1	2.3	0.14	0.09	0	50.64
5-Oct-99	2.4	3.5	0.11	0.21	0	
12-Oct-99	4.2	3.5	0.25	0.18	0	
19-Oct-99	3.0	2.6	0.12	0.28	0	
26-Oct-99	3.3	3.1	0.11	0.19	0	43.71
1-Nov-99	3.1	2.6	0.16	0.11	0	
9-Nov-99	3.0	3.4	0.11	0.19	0	
15-Nov-99	3.6	3.0	0.09	0.14	0	
23-Nov-99	2.2	3.6	0.19	0.21	0	
30-Nov-99	3.5	3.1	0.09	0.13	0	29.30
7-Dec-99	3.0	3.8	0.13	0.11	0	
14-Dec-99	3.2	2.9	0.14	0.19	0	
21-Dec-99	2.2	1.7	0.08	0.13	0	
29-Dec-99	3.5	1.9	0.17	0.06	0	34.79
4-Jan-00	2.0	2.1	0.13	0.12		
11-Jan-00	3.5	2.2	0.14	0.15		
18-Jan-00	4.3	3.0	0.19	0.22		
25-Jan-00	2.1	2.0	0.05	0.11		20.60
02-Feb-00	2.9	3.6	0.15	0.13		
08-Feb-00	3.8	2.1	0.19	0.24		
15-Feb-00	3.0	2.4	0.16	0.25		
22-Feb-00	2.4	2.1	0.15	0.19		
29-Feb-00	3.0	3.2	0.13	0.19		25.48
07-Mar-00	3.4	2.7	0.14	0.14		
14-Mar-00	3.0	2.2	0.21	0.14		
21-Mar-00	3.0	3.5	0.16	0.13		
29-Mar-00	2.8	1.2	0.08	0.11		51.84
04-Apr-00	3.5	3.1	0.03	0.11		
12-Apr-00	4.0	2.9	0.08	0.11		
18-Apr-00	3.0	1.5	0.02	0.08		
25-Apr-00	1.9	1.3	0.07	0.05		40.20
02-May-00	2.2	4.6	0.18	0.13		
09-May-00	2.3	4.1	0.38	0.05		
16-May-00	3.2	2.6	0.78	0.64		
23-May-00	2.6	4.0	0.54	0.05		
30-May-00	2.2	3.0	0.72	0.05		102.35
05-Jun-00	2.6	3.0	1.17	0.05		
12-Jun-00	2.0	3.1	0.28	0.05		
19-Jun-00	3.5	1.8	0.08	1.27		
28-Jun-00	2.6	2.4	0.05	0.65		83.35
04-Jul-00	3.0	2.1	0.12	0.29		
11-Jul-00	3.4	2.0	0.05	1.30		
18-Jul-00	2.4	6.0	0.24	0.03		
25-Jul-00	2.9	1.0	0.05	1.37		247.66

Jan-01
Feb-01
Mar-01
Apr-01
May-01
Jun-01
Jul-01
Aug-01
Sep-01
Oct-01
Nov-01
Dec-01
Jan-02
Feb-02
Mar-02
Apr-02
May-02
Jun-02

01-Aug-00	2.3	1.0	0.05	0.24		
08-Aug-00	4.1	3.0	0.05	0.29		
15-Aug-00	2.4	1.0	0.05	0.21		
29-Aug-00	2.5	2.0	0.10	1.24		81.60
05-Sep-00	3.6	7.0	1.22	0.13		
12-Sep-00	2.4	5.0	0.05	0.61		
19-Sep-00	2.4	2.0	0.05	0.05	50	
26-Sep-00	2.6	3.0	0.09	0.15		79.40
03-Oct-00	2.4	2.0	0.19	0.56		
10-Oct-00	2.0	1.0	0.05	0.08		
17-Oct-00	3.2	10.0	0.10	0.03		
24-Oct-00	3.1	8.0	0.14	0.52	20	
30-Oct-00	3.6	2.0	0.05	0.41	20	36.76
7-Nov-00	2.9	3.0	0.05	0.09		
14-Nov-00	3.3	2.0	0.10	0.28		
21-Nov-00	3.3	3.0	0.05	0.48		
29-Nov-00	3.6	2.0	0.05	0.41		54.65
05-Dec-00	2.2	2.0	0.05	0.03		
12-Dec-00	3.0	5.0	0.05	0.10		
19-Dec-00	3.4	4.0	0.92	0.20	70	
28-Dec-00	10.0	6.0	0.30	0.71	70	61.34

Monthly Ave EFFLUENT				Monthly Ave INFLUENT				
BOD	TSS	AMM-N	TP	BOD	TSS	TKN	TP	
3.53	2.76	0.16	0.18	91	62	9.8	3.10	
3.60	2.92	0.17	0.18	44	4	0.1	0.21	
3.34	2.64	0.13	0.17	4	2	0.7	0.22	
3.18	1.75	0.15	0.15	4	2	0.6	0.20	
3.38	2.16	0.16	0.59	6	5	3.1	1.14	
3.10	2.20	0.49	0.51	178	129	22.0	3.07	
2.70	1.80	0.16	0.16	188	154	24.3	3.18	
2.57	1.67	0.20	0.16	110	98	7.9	1.09	
2.78	2.30	0.15	0.20	178	75	28.5	7.84	
3.23	3.18	0.15	0.22	144	32	11.5	6.20	
3.08	3.14	0.13	0.16	98	74	10.9	2.91	
2.98	2.58	0.13	0.12	200	165	32.4	9.82	BOD was 490
2.98	2.33	0.13	0.15	210	98	16.2	9.10	
3.05	2.45	0.16	0.22	1140	130	41.3	7.64	
3.05	2.40	0.15	0.13	4	4	2.0	0.34	
3.10	2.20	0.05	0.09	8	3	1.9	0.28	
2.58	3.83	0.47	0.22	980	218	18.6	3.64	
2.68	2.58	0.40	0.51	4	9	0.6	0.35	
2.93	2.78	0.12	0.75	10	11	8.6	0.54	
2.83	1.75	0.06	0.50	9	8	0.8	0.58	
2.75	4.25	0.35	0.24	6	7	3.1	0.41	
2.86	4.60	0.11	0.32	6	11	8.4	0.13	
3.28	2.50	0.06	0.32	101	31	12.9	0.91	
4.65	4.25	0.33	0.26	14	7	10.6	0.84	



HARBOUR LIGHTS

	INFLUENT							EFFLUENT	
DATE	BOD	TSS	Phos.	TKN	pH	Temp		E-Coli	BOD
1997									
2-Jan-97						50		10	2
21-Jan	41	36	0.99	44.2	7.35	50		10	2
3-Feb						50		10	2
20-Feb	9	25	0.37	21.0	7.28	50		10	2
6-Mar						51		10	2
20-Mar	46	29	1.37	23.2	7.28	50		10	2
3-Apr						53		10	2
22-Apr	26	39	1.48	37.1	7.10	53		2	2
11-May						51		100	2
29-May	14	42	1.08	69.7	7.05	56		10	2
8-Jun						57		14	5
16-Jun	16	93	2.23	52.1	7.08	60		4	2
15-Jul						65		240	2
30-Jul	41	78	3.60	51.2	7.01	64		10	2
17-Aug						62		10	
27-Aug	15	25	0.82	41.1	7.68	63		20	2
2-Sep						60		4	2
17-Sep	18	42	2.19	10.5	7.50	59		4	3
13-Oct						57		4	2
21-Oct	39	88	1.65	25.0	7.48	56		4	2
18-Nov						54		4	4
26-Nov	44	26	1.28	20.9	7.53	52		4	2
13-Dec						50		4	2
30-Dec	22	21	1.12	22.5	7.73	50		4	4
13-Jan-98						51		4	2
28-Jan	42	40	0.85	40.3	7.44	50		4	2
16-Feb						50		4	2
26-Feb	11	10	0.39	23.5	8.10	50		0	2
12-Mar						51		4	5
31-Mar	15	39	0.44	43.0	8.08	50		4	2
19-Apr						53		4	2
30-Apr	36	128	1.73	44.7	7.53	53		4	2
11-May						51		4	9
25-May	21	130	2.38	19.5	7.80	56		4	2
4-Jun						57		2	4
2-Jul	87	500	4.60	38.0	7.61	60		32	8
16-Jul						86		2	4
29-Jul	85	140	5.35	48.0	7.55	84		4	3
9-Aug						62		128	5
20-Aug	19	136	5.43	20.0	7.31	63		4	2
9-Sep						60		4	4

30-Sep	19	51	2.40	24.0	7.36	59		4	2
14-Oct						57		4	2
22-Oct	15	28	2.48	35.0	7.41	56		10	2
18-Nov						58		4	2
24-Nov	16	68	1.68	40.0	7.39	58		36	2
9-Dec						58		12	5
15-Dec	18	88	1.66	26.8	7.91	50		10	4
7-Jan-99						56		10	2
21-Jan	160	237	2.29	55.0	5.82	51		12	2
9-Feb						53		2	3
25-Feb	15	12	0.48	9.0	7.62	52		4	2
11-Mar						51		2	2
29-Mar	14	60	1.12	30.0	8.10	54		230	2
13-Apr						52		4	2
27-Apr	7	10	0.52	18.0	7.56	51		4	2
6-May						52		8	2
27-May	29	188	2.74	45.0	7.27	60		570	2
20-Jun						61		28	2
24-Jun	65	53	3.97	25.0	7.32	60		8	2
9-Jul						66		480	5
26-Jul	87	180	3.93	55.0	7.30	66		120	2
4-Aug						64		160	2
17-Aug	65	70	4.55	30.0	7.50	63		110	2
15-Sep						62		180	2
6-Oct	50	80	4.95	60.0	7.33	68		10	2
14-Oct						68		32	2
11-Nov						60		4	2
15-Dec						58		140	2

TSS	Phos.	TKN	NO2+ NO3	Free Amm	pH
10	0.37	2	3.63	0.10	7.05
10	0.29	9	4.92	0.25	7.35
10	0.42	2	6.49	0.10	7.12
10	0.32	5	4.05	0.28	7.29
10	0.56	5	6.99	0.25	7.08
10	0.22	5	7.99	0.12	7.30
10	0.38	5	6.30	0.16	7.10
10	0.64	5	7.99	0.10	7.36
13	0.48	5	3.71	0.43	7.52
10	0.59	5	4.81	0.41	7.25
10	1.15	5	9.03	0.99	7.48
10	0.60	5	6.17	0.12	7.11
25	0.75	5	4.70	0.82	7.42
30	0.60	5	6.65	0.10	7.09
23	0.89	5	4.67	0.10	7.50
31	0.78	5	3.47	0.11	7.56
16	1.30	5	6.46	0.12	6.80
10	0.78	5	6.75	0.10	7.70
10	0.99	5	8.36	0.33	7.55
10	0.90	5	3.31	0.10	8.14
18	0.79	5	5.40	0.33	6.91
10	0.47	5	8.16	0.66	7.74
10	0.31	5	2.76	0.74	8.03
10	0.45	5	5.59	0.41	7.54
10	0.28	5	3.51	0.23	7.69
10	0.09	5	4.02	0.66	8.52
10	0.14	5	3.51	0.51	8.24
10	0.15	5	2.70	0.10	8.20
10	0.22	5	2.63	0.10	8.11
10	0.52	5	5.05	0.25	8.18
10	1.22	5	7.42	0.49	7.98
10	0.65	5	13.60	0.39	7.59
13	1.21	5	7.64	0.10	7.75
10	1.50	5	8.72	4.10	7.69
10	1.39	5	8.55	0.26	7.88
25	0.70	5	8.72	0.20	7.58
30	1.25	5	10.41	2.30	7.71
23	2.30	5	27.50	0.74	7.77
31	1.38	5	10.46	1.15	7.49
16	0.48	5	10.33	0.82	7.63
10	0.62	5	10.72	0.72	7.61

10	0.78	5	19.30	0.94	7.56
10	0.65	5	26.30	0.82	7.58
10	0.29	5	23.60	0.80	7.49
10	0.80	5	11.30	2.95	7.59
18	0.56	5	13.60	1.07	7.58
10	0.35	5	4.84	3.44	7.71
10	0.39	5	13.20	1.07	8.08
10	0.48	5	11.50	1.31	7.61
10	0.46	5	3.75	0.66	7.42
10	0.47	5	5.41	3.69	7.82
10	0.33	5	4.39	0.25	8.05
10	0.15	5	8.91	0.51	7.48
10	0.41	5	8.93	0.57	8.17
10	0.19	5	6.73	0.46	7.25
10	0.59	5	9.05	0.34	7.73
10	0.98	5	9.11	0.18	7.58
25	0.78	5	10.07	0.10	7.60
10	0.70	5	10.00	1.11	7.62
10	0.37	5	13.50	0.86	7.39
10	0.58	5	11.30	0.54	7.16
10	1.14	5	8.86	0.45	7.50
15	1.20	5	9.03	0.56	7.76
18	0.56	5	10.57	0.13	7.60
10	1.28	5	8.36	0.61	7.58
10	0.65	5	7.42	0.98	7.74
10	1.12	5	6.39	0.54	7.75
10	0.59	5	12.70	0.65	7.04
19	0.28	5	3.00	1.11	7.59

STATE OF MAINE
DEPARTMENT OF HUMAN SERVICES
DIVISION OF HEALTH ENGINEERING
10 STATE HOUSE STATION
AUGUSTA, MAINE
04333-0010

February 25, 2002

ANGUS S. KING, JR.
GOVERNOR

KEVIN W. CONCANNON
COMMISSIONER

Huron Environmental
Attn.: Timothy G. Warrow
67 Woodland Road
Windham, ME 04062-5608

Subject: Product Registration, CMS ROTORDISK Sewage Treatment System

Dear Mr. Warrow:

Thank you for your letter dated January 30, 2002 regarding the CMS ROTORDISK Sewage Treatment System. This information was submitted pursuant to Section 1802 of the Maine State Plumbing Code, Subsurface Wastewater Disposal Rules (Rules), for code registration, for use in Maine.

Product Description

The CMS ROTORDISK Sewage Treatment System consists of rotating biological disks in a self-contained primary and secondary settling tank. The number of disks varies with system capacity, which ranges from 360 gallons per day (gpd) (Model S12) to 100,000 gpd (Model L1500). Treated wastewater is recirculated to the primary treatment chamber of the tank prior to final discharge. The CMS ROTORDISK Sewage Treatment System is designed for use with conventional onsite sewage disposal areas.

The CMS ROTORDISK Sewage Treatment System received National Sanitation Foundation (NSF) Standard 40 approval in August of 1986, pursuant to NSF Report #S40-15-1.

Claim

According to the information you provided, specifically the NSF report, the CMS ROTORDISK Sewage Treatment System produces effluent with median values as follow: BOD5: 12 mg/L; and TSS: 6 mg/L. According to a report titled "*Pine Meadows Retirement Community Nitrification/Denitrification ROTORDISK Unit Profile, June 1993-September 1993*" the ROTORDISK produces effluent with average nitrate Nitrogen levels of 7.3 mg/L and average ammonia Nitrogen levels of 1.1 mg/L.

Determination

On the basis of the information submitted, the Division has determined that the CMS ROTORDISK Sewage Treatment System is acceptable for use in the State of Maine on a Provisional Approval basis, provided that it is installed, operated, and maintained in conformance with the manufacturer's directions.

No more than 50 installations of the CMS ROTORDISK Sewage Treatment System may be installed under Provisional Approval. Provisional product registrations shall not be granted until the Pilot installations have been in operation for at least one year, or if historic data is accepted by the Division. Provisional product registration installations may include sites which require a variance or waiver to the Rules, with the provision that such variances or waivers are also subject to the standard variance requirements of the Rules, i.e., a passing point score for soils related variances, etc. On no less than a monthly basis for a period of not less than one year, the applicant shall test the influent and effluent of **each** installed provisionally approved product for the following parameters: five day Biochemical Oxygen Demand (BOD_5), Total Suspended Solids (TSS), Nitrate Nitrogen (N03), and coliform bacteria.

The results of these tests shall be submitted to the Division on no less than a semi-annual basis. Existing data from other jurisdictions may be submitted, if available. If such data are satisfactory, the applicant may bypass Provisional approval and proceed to General Use status.

In the event that the product fails to perform as claimed by the applicant, use of the new or experimental technology in Maine, including all installations approved pursuant to Section 1801.7 of the Rules, shall cease. Use of the new or experimental technology shall not resume until the applicant and the Division have reached a mutually acceptable agreement for resolving the failure to perform as claimed.

Because installation and owner maintenance has a significant effect on the working order of onsite sewage disposal systems, including their components, the Division makes no representation or guarantee as to the efficiency and/or operation of CMS ROTORDISK Sewage Treatment System . Further, registration of this product for use in the State of Maine does not represent Division preference or recommendation for this product over similar products.

If you have any questions please feel free to contact me at (207) 287-5695.

Sincerely,

James A. Jacobsen

James A. Jacobsen, Environmental Specialist IV
Wastewater and Plumbing Control Program
Division of Health Engineering
e-mail: james.jacobsen@state.me.us

/jaj

xc: Product File

HURON ENVIROMENTAL 67 Woodland Road Windham, Maine 04062-5608
(207) 415-5228 Fax (208) 693-6674 tgwarrow@javanet.com

January 30, 2002

Maine Department of Human Services
Division of Health Engineering
Wastewater and Plumbing Program
State House Station 10
Augusta, Maine 04333

Attention: James Jacobsen

Dear Mr. Jacobsen:

Huron Enviromental, the exclusive manufacturer's representative for CMS Group's products, respectfully submits the attached Application for Registration of Innovative Technology with supporting documents for your approval on CMS Group's behalf. The attached application seeks State of Maine approval of the entire line of ROTORDISK Sewage Treatment Systems including models:

S12 through S40,

M50 through M200, and

L250 through L1500.

CMS Group Inc. is a Canadian company that designs and manufactures Rotating Biological Contactors (RBCs) and has registered several patents for these and other waste treatment systems. From the original ROTORDISK® designed for single family homes, CMS has developed a complete line of treatment systems for residential, commercial, municipal and industrial wastewater applications. CMS focuses on providing practical and cost-effective solutions to wastewater treatment, air and water pollution control problems.

CMS has produced systems, which have met regulatory requirements in many U.S., Canadian and other international jurisdictions. From domestic sewage, to complex industrial wastes such as landfill leachates, CMS has been able to design and build efficient pollution control systems that treat various types of wastewater to stringent effluent limits.

Please see attached index of application materials for your review. If you have further questions or require other supporting documentation please contact me at the above phone or email address.

Sincerely,

Timothy G. Warrow

HURON ENVIRONMENTAL

Tim Warrow

67 Woodland Road
Windham, ME 04062

207-415-5228
208-693-6674 (fax)

tgwarrow@javanet.com

HURON ENVIROMENTAL

67 Woodland Road Windham, Maine 04062-5608
(207) 415-5228 Fax (208) 693-6674 tgwarrow@javanet.com

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Sincerely,

Timothy G. Warrow

Maine Department of Human Services
Bureau of Health
Division of Health Engineering
Wastewater & Plumbing Control Program

APPLICATION FOR REGISTRATION OF EXPERIMENTAL SYSTEM/INNOVATIVE TECHNOLOGY OR ONSITE SEWAGE DISPOSAL SYSTEM PRODUCT

Please complete the following Sections. Please print or type.

Applicant

Company Name: CMS Group Inc.

Contact Person: Frank M. Scriver

Address: 185 Snow Boulevard, Suite 200

Town/City: Concord State/Province: ON Zip Code: L4K 4N9

Country: Canada

Telephone: (905) 660-7580 x 242 e-mail: fscriver@rotordisk.com

Product

Product Name: ROTORDISK Sewage Treatment System

Model: S12 through L1500

Product Classification (choose one)

Primary or Secondary Treatment Unit

[ ] Septic Tank [ ] Extended Aerobic Treatment Unit [ ] Recirculating Aerobic Unit

[X] Aerobic Fixed Film Unit [ ] Other (specify) _____

Effluent Filter

[ ] Septic Tank Outlet Filter [ ] Post-Tank Filter [ ] Other (specify) _____

Disposal Device

[ ] Gravel-less Disposal Pipe [ ] Gravel-less Disposal Bed [ ] Chamber, Plastic

[ ] Chamber, Other [ ] Other (specify) _____

Miscellaneous

[ ] Pipe [ ] Effluent Flow Distribution Device [ ] Other (specify) _____

Claim

Describe the product's features (attach additional sheets if necessary).

See attached literature: "Simple Sewage Treatment System"

"ROTORDISK Aerobic Sewage Treatment System"

Partial List of Installations

Describe the product's performance (attach additional sheets if necessary).

See attached : NSF Report No. S40-15-1

Pine Meadows Retirement Community - Denitrification

Novar Foods - Denitrification

Has the product received National Sanitation Foundation or Canadian Standards Authority approval?

[ ] No [X] Yes (If "yes", enclose a copy of the certification.) (1982)

IMPORTANT NOTE!

Don't forget to enclose relevant product literature, engineering specifications, studies, and third party certifications with this application.

I, TIMOTHY G WARROW, am the [ ] applicant [X] agent for the applicant of the subject product.
(print name)

I state that the information submitted is correct to the best of my knowledge and understand that any falsification is reason for the Department to deny registration for use of the product in Maine.

[ ] Signature of Applicant
[X] Signature of Agent for Applicant

01/29/02
Date

ROTORDISK®

State of Maine Application

Table of Contents

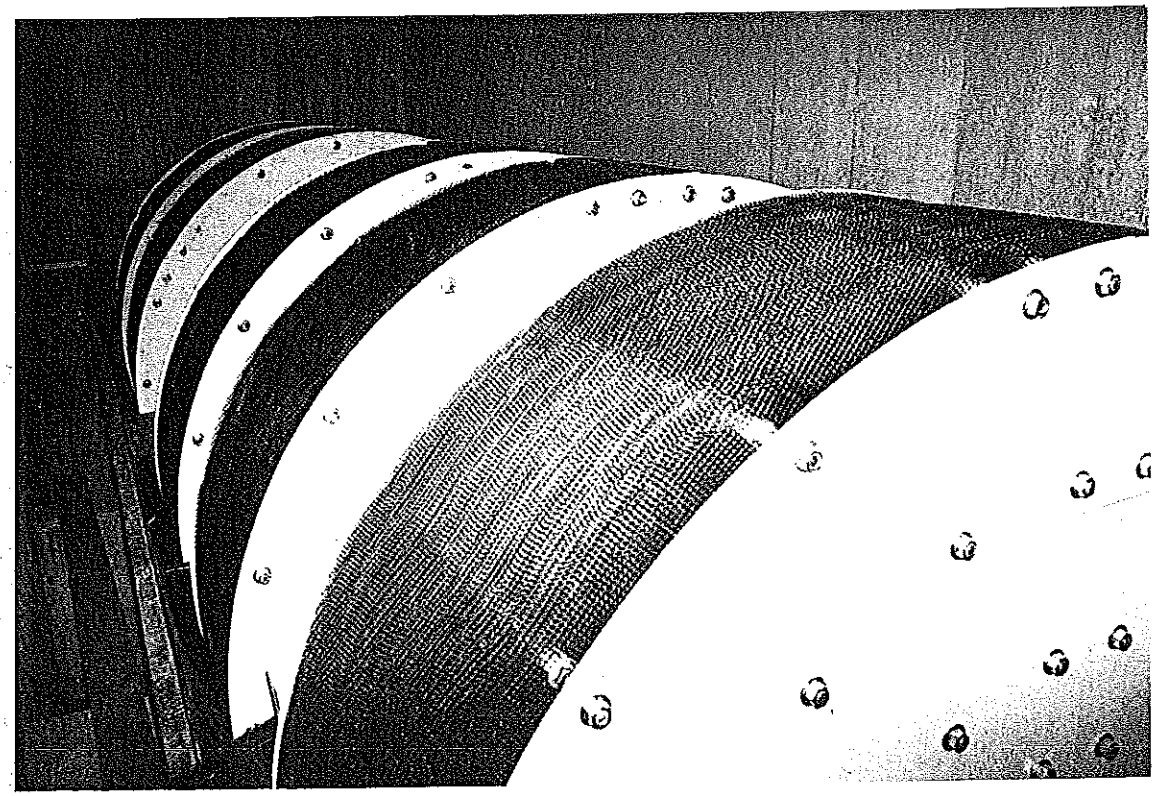
CMS GROUP INC

AIR AND WASTEWATER TREATMENT SYSTEMS

ROTORDISK™

SINCE 1974

The Simple Sewage Treatment System



Sized To Suit Your Needs
360 to 100,000 Gallons Per Day Per Shaft

CMS GROUP INC.

185 Snow Boulevard,

Suite 200, Concord,

Ontario, Canada

L4K 4N9

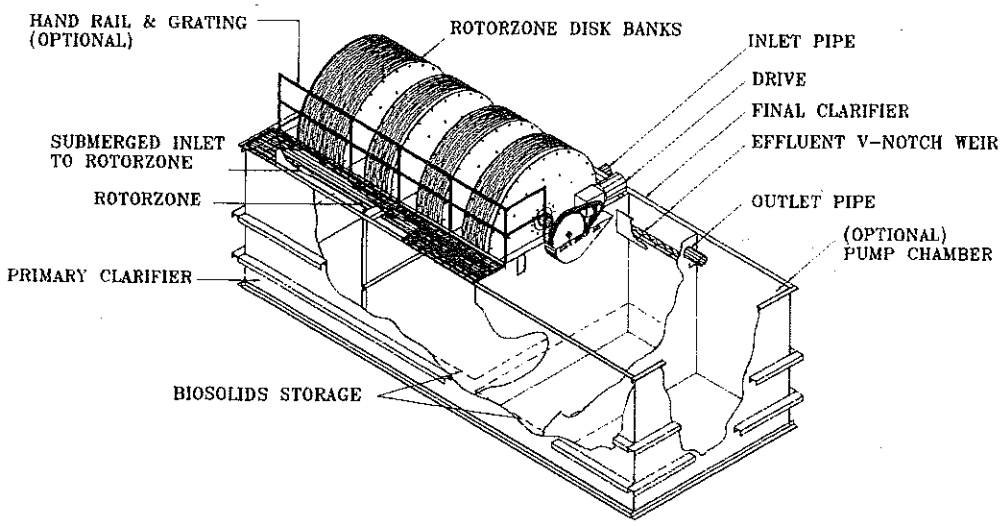
Telephone: (905) 660-7580

(416) 447-4964

Fax: (905) 660-0243

e-mail: cms@rotordisk.com

http://www.rotordisk.com



THE ROTORDISK™ PROCESS

The patented **ROTORDISK™** wastewater treatment plant integrates four separate operations into one system:

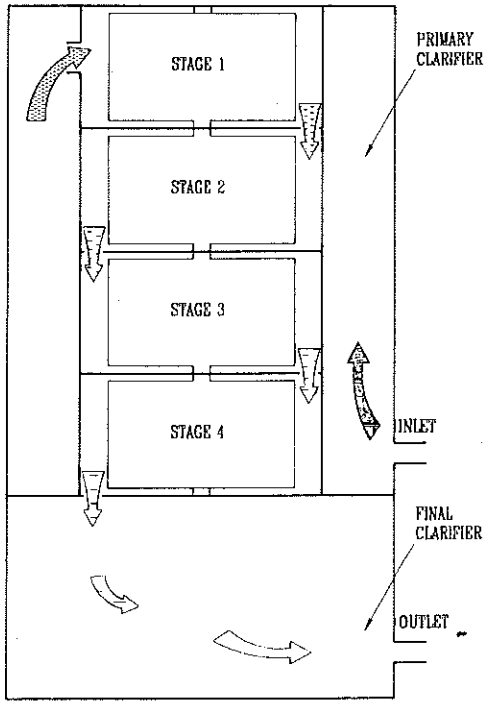
- Primary settling tank for suspended solids and grit removal.
- A multi-stage Rotating Biological Contactor (RBC) for removal of organic matter (BOD) by active biomass.
- Final settling tank for biosolids removal.
- Biosolids storage capacity for low cost solids management.

The ROTORZONE, located over the primary tank, consists of a trough and shaft on which a multiple number of disks are mounted. The disks are 40% immersed in the wastewater being treated. Each disk is made of a high density polyethylene mesh which provides a greater effective surface area than flat or corrugated disks. Slow rotation of these disks alternately expose the attached micro-organisms to the wastewater and air allowing for pollutant absorption and oxygen uptake. The naturally occurring micro-organisms, or biomass, feed on the organic waste and convert it to CO_2 and H_2O.

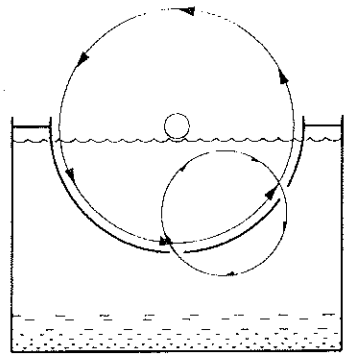
Fixed baffles are used to provide distinct stages in the ROTORZONE and a serpentine flow pattern is used to achieve the maximum retention time.

A small amount of biomass continually sloughs off the disks and is carried by the treated water to the final settling tank where it is settled out.

Two special features of the **ROTORDISK™** are a slot in the bottom of the first stage of the ROTORZONE and a water wheel in the fourth stage of the ROTORZONE. Both features serve to transfer oxygen and recycle most of the excess biomass to the primary settling tank. Recycling dampens shock loadings and maintains aerobic conditions in the upper layers of the primary tank. Extra primary settling tank capacity allows solids to accumulate where further digestion reduces the volume of biosolids for disposal and provides a continual nutrient supply for the biomass on the disks.



Fixed baffles result in distinct staging and ensure maximum contact between biomass and pollutants. The number of stages can be modified to satisfy treatment efficiency requirements.



*Depletion of oxygen in the Primary Settling Tank is eliminated by means of recirculation from the **ROTORZONE.***

ECONOMICAL OPERATION

The ROTORDISK™ has one of the lowest operating costs compared to other mechanical wastewater treatment systems. It does not require a skilled operator, continuous monitoring, or expensive testing. The balanced shaft is slowly turned by a low horsepower motor. The power requirements are one-half to one-eighth of bubble type aeration systems.

EASE OF INSTALLATION

The ROTORDISK™ is a complete package wastewater treatment system. The system is available either as a total steel unit or as an internal steel ROTORZONE assembly to be installed into a concrete primary and final settling tank. The internal assembly is factory assembled, ready to be placed on a suitable foundation, connected to the power supply, and to the influent and effluent piping. All flow within the ROTORDISK™ is by gravity and no mechanical pumps or blowers are required.

SIMPLE, RELIABLE AND ROBUST DESIGN

The ROTORDISK™ avoids complex mechanisms and processes. The shaft mounted disk assembly is the only moving part in the system which rotates at a low speed (2 to 6 rpm, depending on diameter). Routine maintenance is limited to greasing the shaft bearings and periodic drive chain adjustment and lubrication. All drive components are above water level, easily accessible, and designed for long term use.

The ROTORDISK™ biomass is self compensating for fluctuating pollutant loads. The biomass film thickness varies in response to the organic content of the wastewater. The process is naturally resistant to surges in waste loading and quick to re-start after power outages.

DENITRIFICATION SYSTEM

CMS offers denitrification systems that reduce nitrate levels in the effluent to below 10 mg/L. The CMS process uses the raw sewage as the carbon source with no chemical addition required. Numerous CMS denitrification systems are in the field and all are operating to their design criteria.

ROTORDISK™ SPECIFICATIONS

MODEL	MAX. FLOW (USGPD)	MAX. MEDIA (sq.ft.)	SHIPPING DIMENSIONS		
			LENGTH (ft.)	WIDTH (ft.)	HEIGHT (ft.)
S12	1030	720	5'-11"	7'-4"	4'-11"
S20	1558	1500	6'-10"	5'-4"	4'-9"
S30	3065	2300	8'-10"	5'-6"	4'-9"
S40	3857	2800	9'-10"	6'-0"	5'-0"
M50	4253	2975	11'-11"	5'-11"	5'-0"
M60	6102	4275	9'-11"	7'-2"	6'-7"
M75	7318	5130	11'-5"	7'-2"	6'-7"
M100	12654	8855	13'-5"	7'-11"	7'-6"
M125	18705	13090	16'-1"	8'-6"	7'-9"
M150	20343	14245	17'-1"	8'-6"	7'-9"
M175	25865	18095	19'-9"	8'-6"	7'-9"
M200	33580	23500	19'-7"	9'-0"	8'-6"
L250	25733	18000	20'-2"	9'-6"	8'-9"
L300	32867	23000	22'-6"	9'-6"	8'-9"
L333	40713	28500	25'-3"	9'-6"	8'-9"
L400	48586	34000	28'-3"	9'-6"	8'-9"
L500	57860	40500	31'-3"	9'-6"	8'-9"
L666	60026	42000	33'-3"	9'-6"	8'-9"
L833	69431	48600	36'-6"	9'-6"	8'-9"
LI250	119313	83500	46'-3"	11'-0"	10'-6"
LI500	142536	99750	23'-1"	13'-8"	12'-9"

For conversion from USGPD to LPD multiply by 3.7854
For conversion from feet to metres multiply by 0.3048

DESIGN FLEXIBILITY

ROTORDISK™ systems are available in three series encompassing 21 different sizes. Single units range in capacities from 360 gallons per day for a small household, to over 100,000 gallons per day per shaft for a serviced population of 1,000 to 2,000.

Existing septic tanks or extended aeration units can often be upgraded to functional ROTORDISK™ systems by the addition of internal ROTORZONE assemblies.

ROTORDISK™ can be installed above or below grade. Prefabricated enclosures can be provided where desired.

ROTORDISK™ systems can be designed to meet the most restrictive effluent criteria, including tertiary systems for nutrient removal and suspended solids.

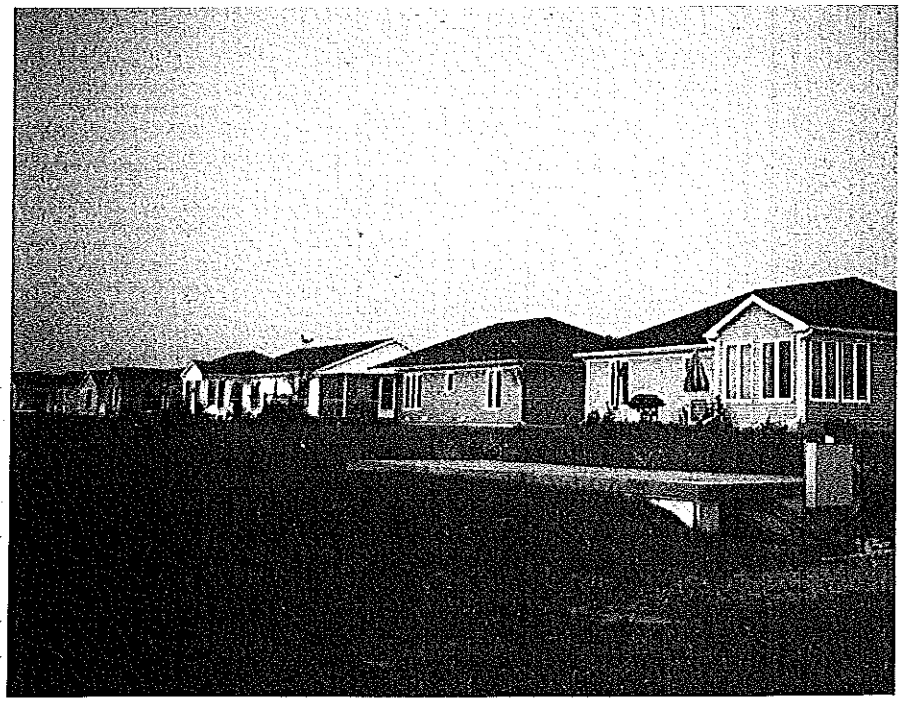
ROTORDISK™ systems have been used for the servicing of temporary facilities such as work camps. The complete package unit can be relocated for reuse at different work sites.

ROTORDISK™ ADVANTAGES

•	**COST EFFECTIVE**	- Low capital outlay, operation and maintenance costs
•	**ENERGY EFFICIENT**	- No blowers or compressors with minimal or no pumping
•	**STABLE OPERATION**	- The large inventory of biomass maintained on the disks resists surges in waste strength and flow without process upset
•	**EFFICIENT TREATMENT**	- Multiple stages of treatment maximize treatment effectiveness with BOD and suspended solids removal of up to 96%
•	**LABOUR EFFICIENT**	- Simple operation with no complex sludge monitoring or handling, no complex instrumentation and requires low operator skills
•	**SMALL FOOTPRINT**	- Compact and self-contained, minimizing land use
•	**INOFFENSIVE OPERATION**	- Enclosed system controls odours and limits noise
•	**MODULAR DESIGN**	- Additional units can be added as required for expansion
•	**EASY INSTALLATION**	- Factory pre-assembled for minimum site construction

ROTORDISK™ APPLICATIONS

- Towns
- Subdivisions
- Hotels/Motels
- Apartment/Condominiums
- Shopping Malls/Plazas
- Homes/Cottages
- Schools
- Hospitals/Nursing Homes
- Campgrounds
- Trailer Parks
- Construction Camps
- Marinas
- Restaurants
- Golf Courses



REPRESENTED BY:

HURON ENVIRONMENTAL

67 Woodland Road Windham, ME 04062-5608

(207) 415-5228 **Fax (208) 693-6674**

Tim Warrow tgwarrow@javanet.com

ROTORDISK™

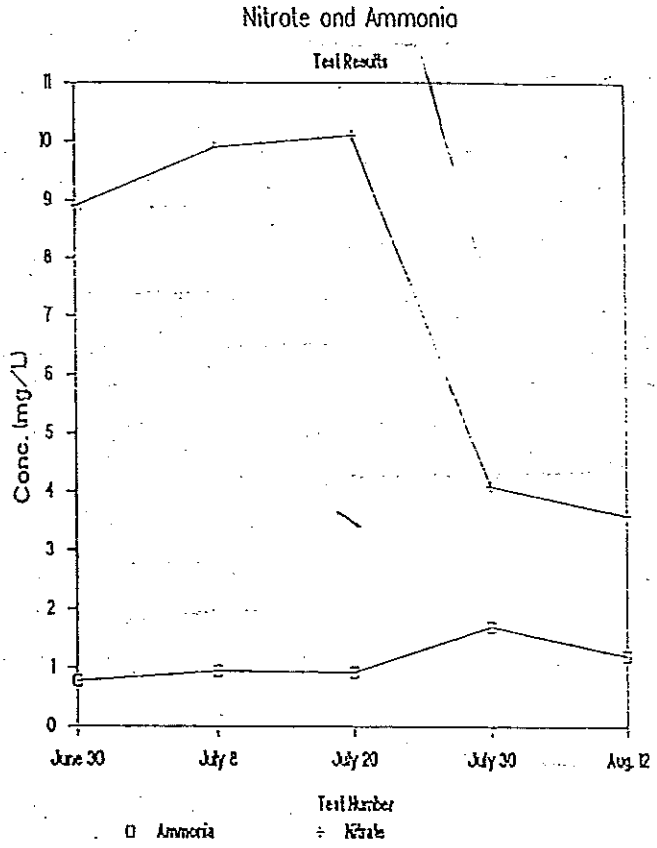
PINE MEADOWS RETIREMENT COMMUNITY NITRIFICATION/DENITRIFICATION ROTORDISK™ UNIT PROFILE JUNE 1993 - SEPTEMBER 1993

OBJECTIVE

The ROTORDISK™ pilot plant at Pine Meadows in Belwood, Ontario is currently under observation for the purpose of monitoring the effectiveness of a denitrification application in an aerobic treatment system using an internal carbon source.

PURPOSE

This ROTORDISK™ unit is designed to accommodate a wastewater flow rate of 21, 200 L/day. This fixed-film aerobic treatment system is mounted on a single shaft containing four aerobic disks with an additional fixed-film anoxic stage for denitrification. Standard removal processes include BOD, suspended solids, ammonia, and nitrate. The primary clarifier is responsible for removal of gross solids by gravitational settling and flotation. Wastewater proceeds through the anoxic stage where denitrifying bacteria convert nitrates to nitrogen gas. BOD and suspended solids are then removed in the aerobic stage by bacteria contained on Vexar™ disk banks. Within this aerobic stage, ammonia is removed by oxidation, thereby forming nitrate. Further settlement of spent biomass occurs in the final clarifier. The wastewater effluent is then discharged by subsurface absorption.



TECHNICAL DATA

Design Flow	21, 200 L/day
Average Flow	11, 420 L/day
Average WW Temp.	16.7 °C
Design Influent BOD, S.S.	200 mg/L
Design Effluent BOD, S.S.	10 mg/L
Design Influent Ammonia	30 mg/L

ROTORDISK™ PERFORMANCE

- 92.7% BOD Removal Rate
- 94.3% Suspended Solids Removal Rate
- 88.7% Ammonia Removal Rate
- 7.3 mg/L avg. effluent Nitrate concentration
- 1.1 mg/L avg. effluent Ammonia concentration

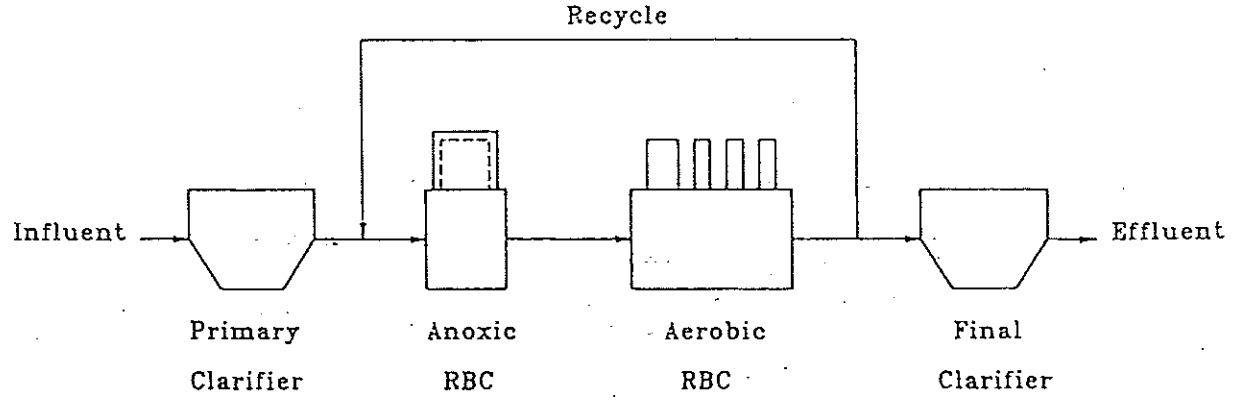
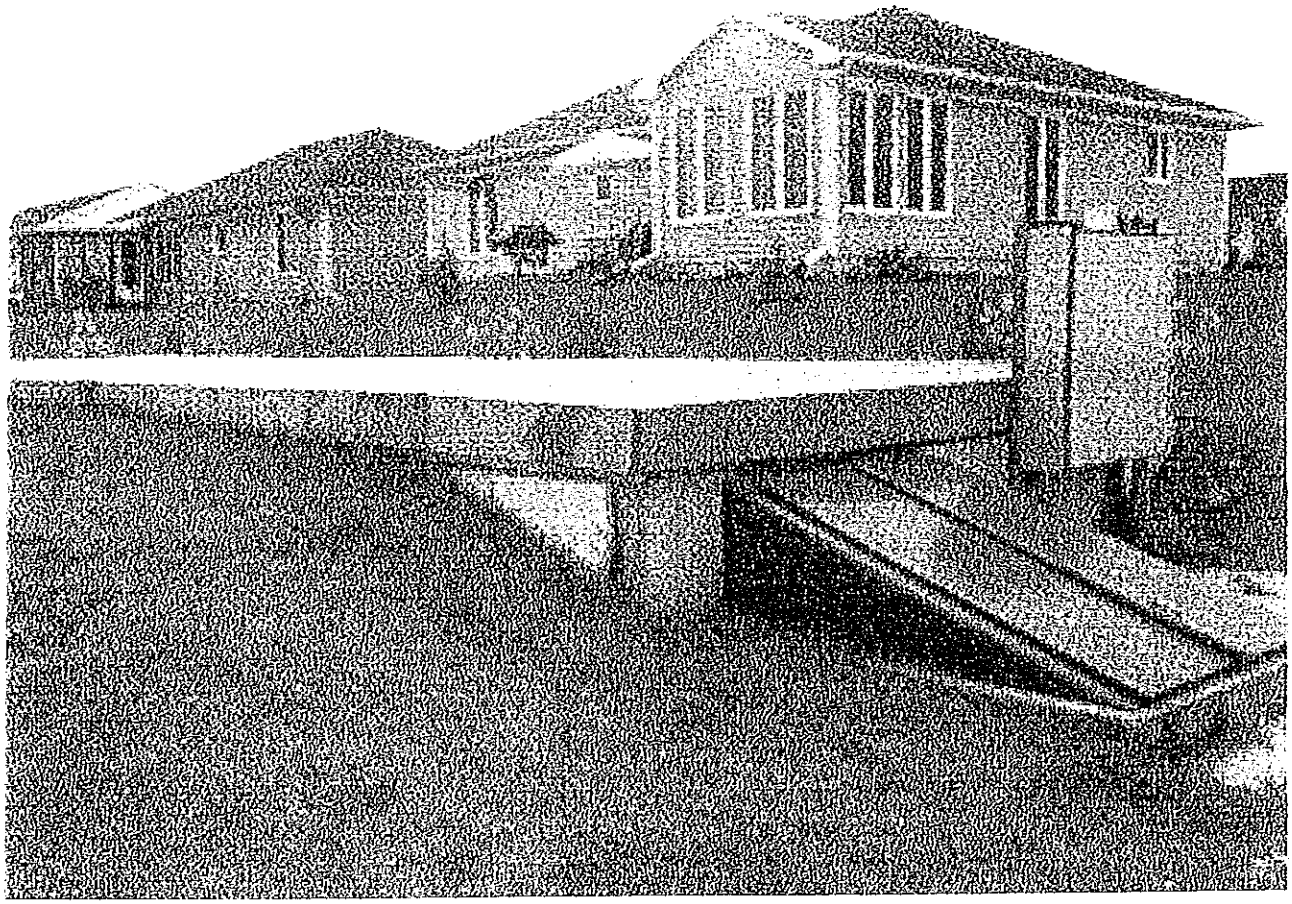


TABLE 1: AVERAGE INFLUENT AND EFFLUENT CONCENTRATIONS

PARAMETER	INFLUENT		EFFLUENT	
	Ave.	Range	Ave.	Range
BOD_5 (mg/L)	244	80-530	14.4	9-25
S.S. (mg/L)	139	76-210	7.3	4-11
NO_3-N (mg/L)	-	-	7.3	3.6-10.1
NH_3-N (mg/L)	13.7	7.4-33	1.1	0.77-1.7

TABLE 2: COMMERCIAL LABORATORY RESULTS

TEST	BOD		S.S.		NO_3-N		NH_3-N	
	INF.	EFF.	INF.	EFF.	INF.	EFF.	INF.	EFF.
06/30	300	13	130	11	-	8.9	7.4	0.77
07/08	530	25	6200	16	-	9.9	33.0	0.94
07/19	80	<10	22	13	-	10.1	5.1	0.91
07/30	180	16	220	7	-	4.1	12.0	1.7
08/20	130	<10	74	4	-	3.6	11.0	1.2



PROJECT

Pine Meadows, Ontario

Hydraulic Loading:	**Phase 1**	**Phase2**
	7,100 USG/d	**13,900 USG/d**
	(26,900 L/d)	**(53,000 L/d)**
Population:		**130 homes**
Design Parameters:	**BOD**	**15 mg/L**
	SS	**15 mg/L**
	TKN	**10 mg/L**
Units Used:	**One (1) DM150 and One (1) DL300**	
Effluent Discharge:	**Tile Field**	
Date Installed:	**1992 and 1994**	

CMS GROUP INC.
185 Snow Boulevard, Suite 200
Concord, Ontario L4K 4N9 Canada
tel: (905) 660-7580 fax: (905) 660-0243
email: cms.group@aims.on.ca
http://www.rotordisk.com

AIR AND
WASTEWATER
TREATMENT
SYSTEMS

ST. THOMAS OF VILLANOVA HIGH SCHOOL

LASALLE, ONTARIO

ROTORDISK® UNIT PROFILE

In September 1993, the Essex County Catholic School Board opened a state-of-the-art high school in Lasalle, Ontario with an enrolment of 1186 students.

This school is the first in Essex County to utilize an on-site sewage treatment system. The effluent was approved by the M.O.E.E. for surface disposal into a storm drain for ultimate discharge to the River Canard. A ***ROTORDISK®*** *Model L-500, manufactured by CMS Group Inc. was selected as the preferred alternative. This unit utilizes Rotating Biological Contactor (RBC) technology for BOD removal and nitrification. It is also equipped with phosphorus removal, ultra-violet disinfection, and filtration using the CMS patented* ***BUGS™*** *Filtration Device. The system has a design capacity of 70,000 L/d.*

Test data of the performance of the treatment system since start-up indicate that all effluent strength parameters have successfully met the required limits specified in the Certificate of Approval.

Test results for BOD, suspended solids, TKN, and Total Phosphorus are shown on the reverse page.

CMS GROUP INC.

185 Snow Boulevard,

Suite 200, Concord,

Ontario, Canada

L4K 4N9

Telephone: (905) 660-7580

(416) 447-4964

Fax: (905) 660-0243

e-mail: cms@rotordisk.com

January 1996

ST. THOMAS OF VILLANOVA HIGH SCHOOL
ROTORDISK®/BUGS™ TEST RESULTS

DATE	BOD		TSS		TKN		TP	
	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent
01/94	63	3.3	90	4.0	22	9.2	2.18	0.36
02/94	78	2.1	105	4.4	39	7.1	3.85	0.39
03/94	17	1.9	24	3.9	11	0.94	1.05	0.25
05/94	71	5.1	46	8.4	23	2.05	2.15	0.24
06/94	31	2.6	47	4.2	9	1.06	1.15	0.23
07/94	6	2.8	6	2.9	3	0.47	0.35	0.12
08/94	15	2.0	11	3.9	3	0.51	0.64	0.15
09/94	74	3.2	64	7.4	23	3.5	2.80	0.71
10/94	89	4.0	45	7.0	21	6.7	1.64	1.45
11/94	123	2.1	157	6.1	20	2.6	2.95	0.3
12/94	36	2.3	43	2.5	10	2.3	1.28	0.12
01/95	73	3.5	74	6.8	31	2.8	2.88	0.36
02/95	180	4.2	330	6.5	51	3.0	4.85	0.97
03/95	63	2.4	72	6.9	10	1.4	1.09	0.67
04/95	99	3.0	169	7.0	20	1.63	3.25	0.26
06/95	31	2.9	60	8.3	18	1.02	2.5	0.58
07/95	13	2.5	17	9.2	5	0.8	0.5	0.14
08/95	7	4.8	15	8.0	1.8	0.12	0.3	0.11
09/95	33	5.1	46	6.9	18	0.8	1.2	0.14
10/95	50	5.2	48	7.6	15	1.6	1.4	0.12
11/95	82	3.8	79	9.2	21	2.3	1.8	0.18
Average	**59**	**3.1**	**74**	**6.2**	**18**	**2.5**	**1.9**	**0.37**

AIR AND WASTEWATER TREATMENT SYSTEMS

NOVAR FOODLAND

HUNTSVILLE, ONTARIO

ROTORDISK™ UNIT PROFILE

*A Certificate of Approval was issued in October 1989, to provide a **ROTORDISK™** Sewage Treatment Plant with a denitrification component to service Novar Mall. The plant flow from the mall combines commercial and domestic wastewater. A laundromat contributes to 38% of the total wastewater flow.*

*This installation, retrofitted into existing concrete tanks, is deigned for removal of BOD, suspended solids, ammonia, and nitrate. The **ROTORDISK™** Pre-Denitrification technology has been incorporated for the removal of nitrate.*

Test results for BOD, suspended solids, ammonia, nitrate, and TKN are shown on the reverse side. Despite organic and hydraulic overloading of the system, the performance indicates high removals of BOD and suspended solids as well as consistent removal of nitrate concentrations, below the limit specified in the Certificate of Approval.

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CMS GROUP INC.

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http://www.rotordisk.com

NOVAR FOODLAND
DENITRIFICATION ROTORDISK™
FIELD TEST RESULTS

DATE	BOD		TSS		NH_3-N		NO_3-N		TKN	
	Inf.	Eff.	Inf.	Eff.	Inf.	Eff.	Inf.	Eff.	Inf.	Eff.
01/92	95	46	10	10	19.6	2.2	0.1	1.6	50	50
02/92	171	12	850	402	17	1.0	41.1	30.9	148	156
04/93	288	18	-	84	4.7	2.9	0.1	0.9	28	9
05/93	432	84	280	124	38.6	3.9	3.9	3.6	247	43
10/93	1510	188	2410	24	91	3.8	0.1	6.8	91	4
01/94	2830	28	1990	42	45.1	0.1	0.1	0.5	78	6
03/94	712	210	520	60	52.9	3.4	1.9	3.1	70	23
04/94	720	52	620	158	58.3	0.1	0.1	3.8	378	144
05/94	1210	182	610	22	51.1	6.1	1.0	8.7	360	48
10/94	86	32	53	31	14.5	17.7	0.1	5.9	45	23
Average	**805**	**85**	**815**	**95**	**39.3**	**4.1**	**4.8**	**6.6**	**144**	**45**
% Rem.	**89%**		**88%**		**90%**		**-**		**69%**	

ROTOR DISK

SINCE 1974

Aerobic Sewage Treatment System

Quiet. Compact. Simple.

ROTORDISK and Our Environment

It's a fact that about 30% of us have homes and cottages in suburban, rural and cottage areas where there are no municipal sewage systems.

A simple, effective sewage treatment system is needed to protect the quality of our environment, particularly in these areas. It is also required to prevent damage to public health.

The answer to this need is the ROTORDISK system.

Designed and manufactured by CMS ROTORDISK INC., ROTORDISK consistently produces superior treatment results. It has proven itself time and time again in a variety of applications including resorts, factories, schools, golf courses, and subdivisions. Twenty different sizes of ROTORDISK are available to handle virtually any requirement.

For homes and cottages, the system to ask for is ROTORDISK S5 or S12.
Unbeatable.

When a Septic Tank Won't Do

Traditionally, the simplest pollution control system for homes and cottages has been the septic tank and tile field.

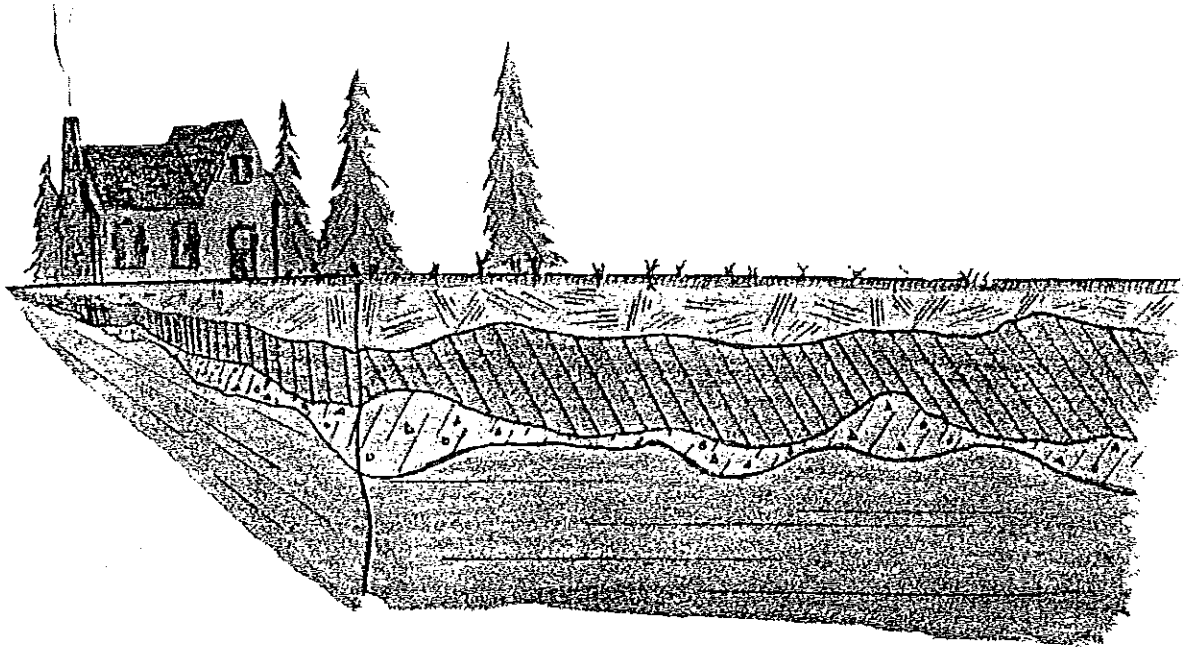
It still may be, providing your property meets some pretty stringent conditions: a large area of land with several feet of porous soils over bedrock, groundwater tables, and impervious layers of soil. Also, the area must be well removed from lakes, streams, wells and buildings.

When the traditional septic system won't do, you can look to ROTORDISK to solve your sewage problems.

ROTORDISK solves sewage treatment problems for homeowners in suburban, rural and recreational areas who don't have enough space. ROTORDISK is a problem solver when the soil is wrong, when the groundwater table is too near the surface, where there is little or no soil over the bedrock, and so on.

There are many lots in suburban, rural, and recreational areas which simply don't have enough space. Property owners may also prefer to use the land they do have in ways other than for septic systems: by adding a room, building a sundeck, or simply by leaving more trees and shrubs standing to increase the natural beauty and value of their property.

ROTORDISK is at your service to conserve space.

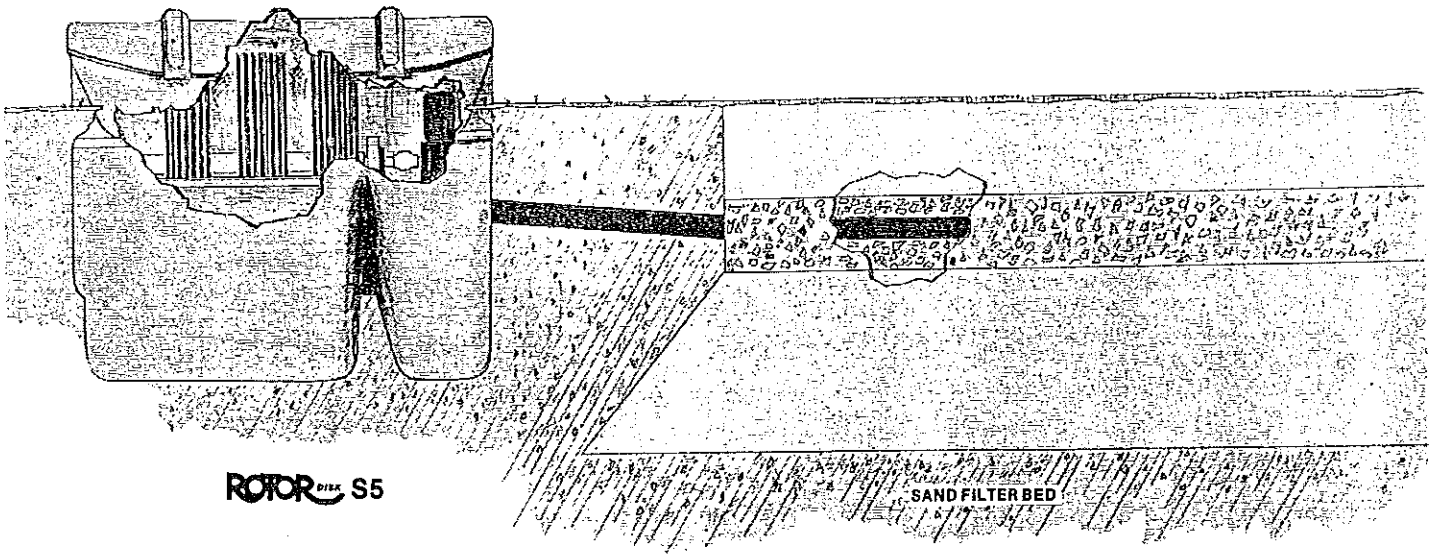


Understanding ROTORDISK—The UNseptic System

Where a septic tank won't do, the solution is ROTORDISK. Simply put, ROTORDISK employs a process known to engineers as "rotating biological contactors". A small motor rotates (drawing 1/16th h.p.) a shaft. Mounted on the shaft are a multiple number of discs. Purifying micro-organisms naturally present in the sewage attach themselves to these discs. As the disc assembly rotates half-submerged at a slow, easy 3 rpm, the biological growth on the discs absorb pollutants from the sewage. During the part of the rotation in the air, the organisms get the oxygen they need to break down the pollutants and purify the water.

Want to get a little more technical? Aerobic (meaning, with oxygen) biological reactions proceed many times faster than septic (without oxygen) reactions. Also, aerobic treatment breaks down pollutants much more completely.

That's what the ROTORDISK Aerobic Sewage Treatment System is all about: increased efficiency.



The ROTORDISK has an efficiency rate of 90%—95% in removing pollutants from normal domestic waste water. That leaves only 10% of the job to be done in the tile field; as opposed to the 60% of the job that the tile field for a septic tank must do. As a result, tile fields of the conventional type can be as small as one-third those required for septic tanks.

And we can do better than that: in most applications of the S5 ROTORDISK, a filter bed made of selected sand materials is used instead of a conventional tile field. Our filter bed takes up only 10 to 20 percent of the area required for traditional septic tank tile fields, under various lot conditions. Also, our filter can be used over high groundwater tables, and impervious or shallow soil layers.

Low Maintenance. Easy Installation.

Government regulatory agencies often require that a service contract accompany any installation of mechanical treatment systems. Your piece of mind is assured by local area representatives for the CMS/ROTORDISK System who are constantly alert for signs of trouble—even if they aren't expecting any from the mechanically simple ROTORDISK. It's also reassuring to know that the only requirement for years of trouble-free operation is a little lubrication from time to time.

The S5 ROTORDISK comes complete in a single, tough, compact fibreglass tank which is installed quickly nd simply. The only thing left to do is to hook up the motor to the house current. It's as easy as wiring a lamp. These features add up to low installation cost.

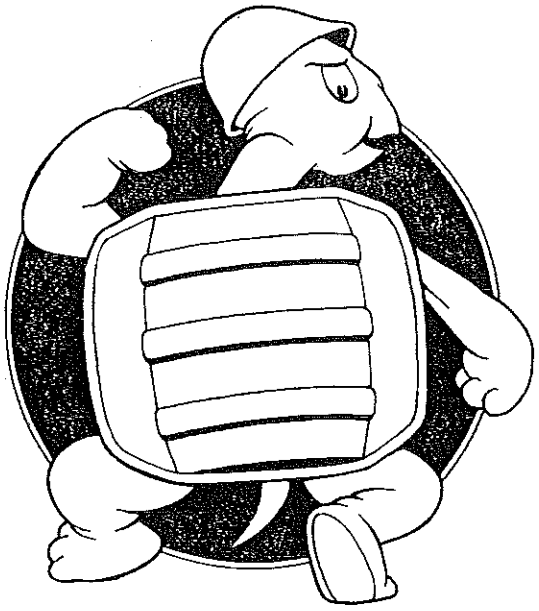
Economical and Quiet

ROTORDISK operates continuously at a steady, slow speed. The lack of on/off power surges makes ROTORDISK extremely economical.

The same simplicity makes ROTORDISK quiet. If you listen closely while standing next to it, you may hear the quiet, smooth hum of the motor. If you move a few feet away, you won't hear it at all.

Government Approved. Ample Treatment Capacity. Proven in the Cold.

With its proven ability to achieve a high degree of wastewater purification, the ROTORDISK is fully approved and accepted by environmental regulatory agencies.



The S5 ROTORDISK is designed and approved for a treatment capacity of up to 500 gallons a day. This is equivalent to up to eight persons (or four bedrooms) in the home or cottage. Wastewater flows of less than 500 gallons a day result in even better treatment efficiency.

Cold weather is no problem to a ROTORDISK. The aerobic treatment process, the simple motor, and sewage itself are all sources of heat within the ROTORDISK. Units of various sizes have operated trouble-free over several winters in the Canadian North.

ROTOR DISK

It's The Simple Solution

When a septic tank system won't get the job done, or would take up too much valuable space, or eliminate too much of the beauty and value of the natural surroundings, the solution is the S5 ROTORDISK. It has no internal pumps, no noisy air compressors, and no complicated mini-computers or control panels to go haywire.

We call it 'The Turtle' because of its appearance and simple dependability. 'The Turtle' is aerobic sewage treatment at its best: Quiet. Compact. Simple.

How to find out more about our simple solution for your sewage treatment problems? That, too, is simple. For further information about the S5 ROTORDISK, or larger ROTORDISK units treating up to 50,000 gallons per day, contact CMS ROTORDISK INC. or your local area representative:

CMS ROTORDISK INC.

185 SNOW BOULEVARD, SUITE 200,
CONCORD, ONTARIO,
CANADA L4K 4N9
TEL: (905) 660-7580
TOR:(416) 447-4964
FAX: (905) 660-0243

Area Representative,CMS/ROTORDISK sewage treatment systems:

Publication No. S5B

ROTORDISK

Ontario Reference List

January 29, 2002

1. Anderdon Central School, Mr. Ray Kenney, Principal, 519 736 2592.
   Model M125, installed 1998

2. Bob-lo Island Development, Mr. Barney Zielinski, operator, 519 733 6833,
   Model L1500, installed 1997

3. Sudbury Downs Race Track and Casino, Mr. Gabi Laplant, 705 855 9001,
   Model L1250, installed 1999

4. Gosfield North Central School, Mr. Kieth Balkwill, Principal, 519 839 4811,
   Model M100, installed 1998

5. Teopoli Camp. Mr. Frank Tedesco, 705 687 4488, seasonal operation,
   Model L250, installed 1992

6. Millcreek Camping and Country Club, Mr. Mike Katchur, owner, 519 763 1048,
   Model M125, installed 1995

7. Leisure Lakes Campground, Mr. Gary Sartori, 519 326 1255,
   Model L400, installed 1994

8. Hope Foodland, Mr.` Phil Hope, owner, 705 789 1777,
   Model DS-40, installed 1990

9. Town of Tecumseh-Skyway Plaza, Mr. Rick Wood, 519 735 2184,
   Model L500, installed 1997

10. Active Burgess Mould & Design, Mr. Terry Chartarnd, 519 737 1341,
    Model S30, installed 1997

11. Pine Meadows, Mr. Don Vallery or Sandy, 519 787 7000,
    Model DM150 and DM300, installed 1992 & 1994

WASTEWATER TECHNOLOGY

Report on Evaluation
of CMS Rotordisk
Model S-12 Rotordisk
Individual Aerobic Wastewater Treatment Plant
Report No. S40-15-1

under the provisions of
NSF Standard 40
Relating to Individual
Aerobic Wastewater
Treatment Plants

National Sanitation Foundation
3475 Plymouth Road
P.O. Box 1468
Ann Arbor, Michigan 48106 USA

REPORT ON THE PERFORMANCE EVALUATION OF
CMS ROTORDISK
INDIVIDUAL AEROBIC WASTEWATER TREATMENT PLANT
MODEL S-12 ROTORDISK

CONTENTS

REPORT NO. S40-15-1

AUGUST 1986

PREFACE

National Sanitation Foundation Standard 40 requires the testing laboratory to provide the manufacturer of an individual aerobic wastewater treatment plant a report including significant data and appropriate commentary relative to the performance evaluation of the plant. Publication of the report was an option of manufacturers of plants tested prior to the November 1978 revision wherein the report requirement became effective. NSF policy specifies provision performance evaluation reports to appropriate state regulatory agencies at publication. Subsequent direct distribution of the report by NSF is made only at the specific request of or by permission of the manufacturer. This report supersedes any earlier editions as the official report on the NSF Standard 40 performance evaluation.

With adoption of revised Standard 40, November 1978, the additional requirement for completion of stress testing of individual aerobic wastewater treatment plants took effect. Stress testing became an integral part of the performance evaluations of plants commencing after the effective revision date. Manufacturers of plants entering the program prior to November 1978 were accorded a three year exemption from the requirement for completion of the supplemental stress testing.

The following report contains results of the entire testing program, a description of the plant, its operation and key process control equipment, and a narrative summary of the test program, including test location, procedures and significant occurrences. Where the standard performance evaluation and stress testing programs were conducted independently in location and/or time, herein reflects the equipment authorized to bear the NSF seal following satisfactory completion of the stress testing, and otherwise complying with all requirements of the standard.

NSF STANDARD 40

Performance evaluation of individual aerobic wastewater treatment plants is achieved within the provisions of NSF Standard 40, prepared by the NSF Joint Committee on Special Processes or Devices used in Treating Wastewater and adopted by the NSF Board of Trustees in November, 1970. Revisions proposed by the Joint Committee on Wastewater Technology were adopted in 1978. Certain provisions of the revised standard took effect immediately. However, the stress test requirements were not immediately compulsory for manufacturers of plants whose test programs were initiated prior to November 1978. These manufacturers were granted a three year extension to complete the additional testing for listed plants.

The standard is consistent with the methodology established by the National Sanitation Foundation in the development of standards and criteria for special equipment having a bearing on public health and/or the environment. It provides for uniformity of requirements and interpretation applicable to processes intended to treat wastewater from individual homes and other sources having similar types and volumes of liquid wastes.

There are five fundamental principles which relate to application of the standard:

A. the standard represents minimum and basic requirements for evaluation.

B. Performance evaluation is independent of design and construction although the evaluation recognizes structural weaknesses, undesirable noise, and other detriments to the environment as part of the test results.

C. Installation and operation of the equipment is performed according to the instructions of the manufacturer consistent with actual field installation and use.

D. Appropriate warranties and service provisions must support field applications of the equipment to enable continuous operation within the demonstrated performance characteristics of the plant or process.

E. Sample collection, preservation and storage, and analytical methods by the testing agency are in accordance with Standard Methods for the Examination of Water and Wastewater[1] and Manual of Methods for Chemical Analysis of Water and Wastes[2], when applicable, and the data produced are certified as a true and accurate record of performance under the known conditions of the test.

Conformance with the standard is recognized by issuance of the NSF seal. This is not to be construed as an approval of the equipment but rather a certification of the data provided by the test and an indication of compliance with the requirements expressed in the standard.

Plants conforming to Standard 40 are classified as Class I or Class II plants according to the quality of effluent produced by the plants during their performance evaluation. Class I plants must also demonstrate performance consistent with the effluent color, odor, oily film and foam requirements of the standard. With revision of the standard, Class I plants must satisfy the requirement of meeting "EPA Guidelines for Secondary Treatment"[3] for five day biochemical oxygen demand, suspended solids and pH. Appendix B of this report includes the specific effluent quality requirements of Standard 40.

Permission to use the NSF seal is granted only after the equipment has been tested and found to perform satisfactorily, and all other requirements of the standard have been satisfied. Continued use of the seal is dependent upon evidence of compliance with the standard as determined by periodic reinspections of the equipment in the factory and reports from the field.

CERTIFICATION

The National Sanitation Foundation has determined by performance evaluation under the provisions of NSF Standard 40 that the aerobic wastewater treatment plant Model S-12 Rotordisk manufactured by CMS Rotordisk of Mississauga, Ontario, Canada has fulfilled the requirements of Standard 40. The S-12 Rotordisk has therefore been authorized to bear the NSF seal so long as it continues to meet the requirements of Standard 40.

All tests were performed at the research site of the National Sanitation Foundation, McKinley Street, Chelsea, Michigan. The raw waste utilized for treatment by the test plant was the comminuted municipal waste of the Village of Chelsea. The characteristics of the waste are included in the tabulated data of this report.

The observations and analyses included in this report are certified to be correct and true copies of the data secured during the performance tests conducted by the National Sanitation Foundation Testing Laboratory on the wastewater treatment plant described herein.

The certified data are the property of the manufacturer of the subject plant and can be released or reproduced only with his permission. The manufacturer has agreed to present the data in this certification in its entirety whenever it is used in advertising, prospectuses, bids, or similar uses.

James L. Brown

Director

Equipment Program

JLB:klk

August 20, 1983

PERFORMANCE EVALUATION

This report is applicable to the individual wastewater treatment plant manufactured by CMS Rotordisk, Mississauga, Ontario, Canada and designated as Individual Aerobic Wastewater Treatment Plant Model S-12 Rotordisk.

S-12 Rotordisk is marketed as a complete, preassembled home aerobic unit with a rated treatment capacity of 500 gallons per day of raw domestic sewage. The plant is represented by manufacturer's drawings, parts list, and specifications as included in Appendix A. For testing purposes the manufacturer delivered a control panel and a standard 641 gallon fiberglass tank containing all treatment components to the NSF Wastewater Testing Facility at Chelsea, Michigan. The four polyethylene (PE) rotating media packs comprised of 35 PE panels (see process description) were installed in the S-12 Rotordisk unit by the manufacturer prior to shipment. The listed S-12 Rotordisk model uses concrete and fiberglass tankage.

The fiberglass tank was installed with the tank lip seven inches above grade and the lid totally exposed. No structural defects or weaknesses were found in the tank or mechanical equipment at any time during the test.

NSF Standard 40 delineates a standard method for the performance evaluation of individual home aerobic wastewater treatment plants. The details of the method have been included in this report as Appendix B. Sampling points and associated analytical parameters are outlined in Figure 1 and Table I respectively.

Operation of the plant was initiated on October 11, 1981 and concluded on May 10, 1982 completing the required six months of standard performance evaluation at design flow required by Standard 40. The stress test phase is described and the results reported on page 16.

TABLE I. SAMPLING SCHEDULE

Sampling Points \ Parameters	Dissolved Oxygen	Biochemical Oxygen Demand	Suspended Solids & Volatile Fraction	pH	Temperature	Settleable Solids	Color	Threshold Odor	Oily Film
Influent		C	C	C	I				
Biological Contact Zone	I		G	G	I	G			
Effluent	I	C	C	C	I		G	G	G

C = 24 hour composite sample G = grab sample I = *in situ* measur

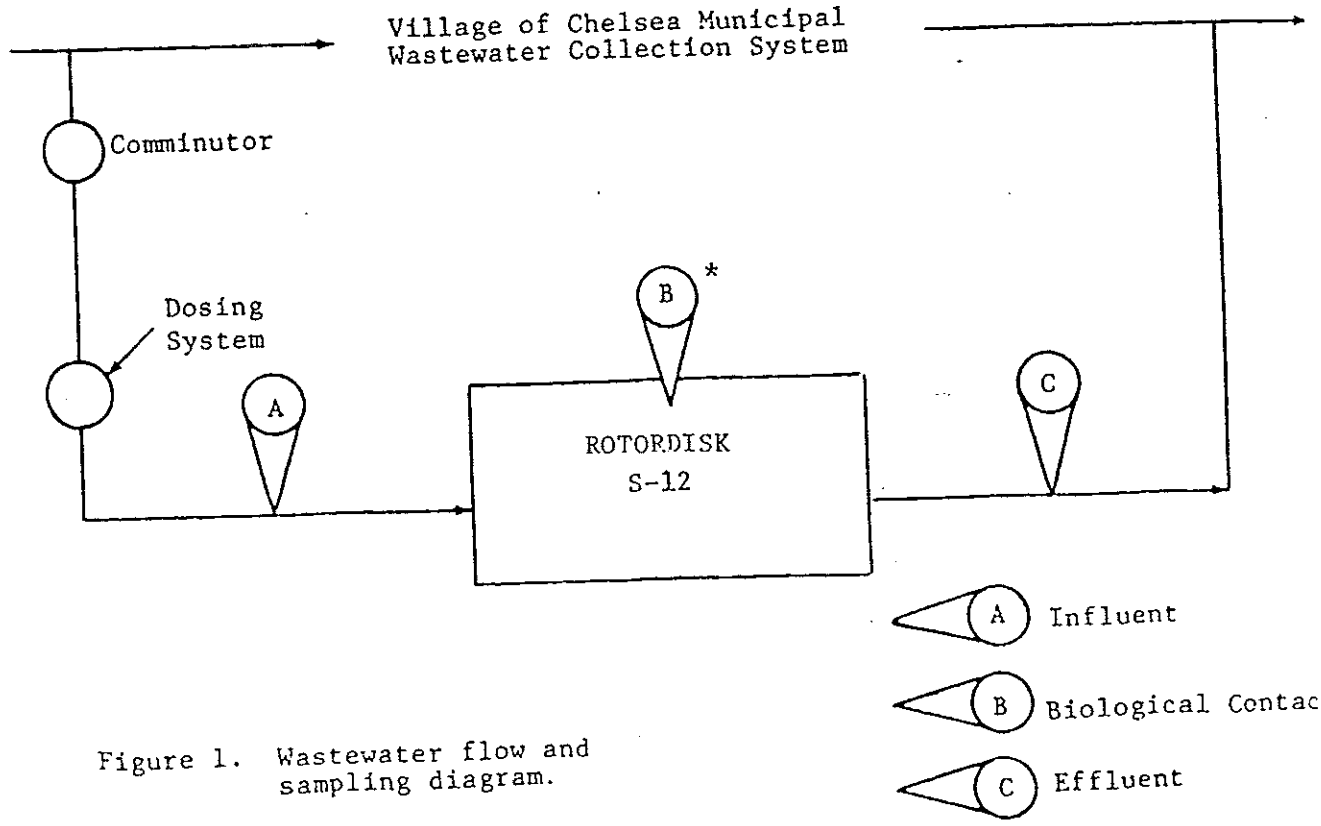


Figure 1. Wastewater flow and sampling diagram.

*See narrative for
zone sampling des

Sewage for the test was comminuted raw wastewater of typical domestic character obtained from the collection system of the Village of Chelsea, Michigan. Temperature of the raw wastewater for the test period ranged from 8 to 18 degrees Centigrade (° C) (46° to 64° Fahrenheit). This variation is attributable to normal seasonal temperature variations. Other characteristics of the test wastewater for the period of performance evaluation are summarized in Table II by analytical parameters specified in the Standard Performance Evaluation Method for Standard 40.

Influent flow was initially programmed to deliver 600 gallons per day to the plant in 80 doses of 7.5 gallons each. It was later discovered that the specifications had been misinterpreted and influent flow was reprogrammed on November 20, 1981 to deliver 500 gallons per day in 80 doses of 6.25 gallons each. The doses for both programs were delivered according to the following distribution pattern: twenty-eight doses between 6:00 a.m. and 9:00 a.m., twenty doses between 11:00 a.m. and 2:00 p.m., and thirty-two doses between 5:00 p.m. and 8:00 p.m.

During the 209 days of operation 78 percent of the daily flow totals were within five percent of the 500 gallons design flow. The median was 497.8 gallons. It should be noted, however, that the initial 33 days of operation during which the unit was dosed with 600 gallons per day are included in these figures. If these days are excluded, 95 percent of the daily flow totals are within five percent of the 500 gallon design flow. During periods of reduced flow, power to the rotating media panels was maintained. Variations in applied influent flow were noted on laboratory forms, and analytical data were used in the evaluation regardless of departures from daily design flow.

Samples were collected and analyzed on five consecutive days each week, utilizing procedures outlined in Standard Methods for Examination of Water and Wastewater and Manual of Methods for Chemical Analysis of Water and Wastes. (See Appendix C for methods used.) Flow proportionate composite samples of the influent and effluent were taken daily by an automatic sampler, actuated on every other dose by a signal from the master dosing timer. All other samples taken from the S-12 Rotordisk unit were grab samples, or the measurements were

made in situ. To determine which of the four biological contact zones yielde the most representive grab samples, all were initially sampled and analyzed The results of this evaluation were discussed with the manufacturer an agreement was reached that the second biological contact zone was the mos appropriate sample location. Sludge accumulation was measured in the primar and final clarifiers following completion of the full evaluation. The measure ments for each analytical parameter are summarized in Table II in terms o median, minimum, and maximum values, and interquartile range. The median an interquartile range indicate, respectively, the central tendency and vari ability of each parameter in a manner that is free from assumption abou overall shape of the distribution.

Table III summarizes effluent five day biochemical oxygen demand (BOD_5) an suspended solids measurements which shows S-12 Rotordisk produced an effluen characterized by a median BOD value of twelve and median suspended solid value of six. Table III C-90 values demonstrate performance by S-12 Rotordis that is consistent with the Class I effluent requirements of NSF Standard 40 Removal efficiencies determined from mean influent and effluent values ar tabulated as indicators of overall efficiency and presented in Table IV Effluent values for BOD have been tabulated by increasing magnitude and fre quency of occurrence in Table V. Similar tabulations for effluent suspende solids appear in Table VI. Figures 2 and 3 are histograms for the frequenc distributions displayed in Tables V and VI, respectively.

The effluent quality requirements set forth by the standard may be fulfille in one of two classes. The class designation for any particular plan represents only the level of effluent quality that the plant has been able t achieve under the conditions of the test. It is not intended to imply th manner in which the effluent may be introduced into the environment. Discharg to surface or subsurface waters must necessarily be governed by the receivin waters' ability to assimilate the treated wastewater, and as regulated b local and state quality standards which prevail.

ADVERSE CONDITIONS OCCURRING DURING THE TEST

The following events created non-standard conditions and therefore could have adversely affected plant performance and the data that were generated.

Analysis of the data indicated that two of these occurrences (Item A) did not significantly affect the conclusions of the performance evaluation. However, the block of data gathered for the week following the events of November 1 and November 8, 1981 (Item B) were deleted for the purposes of evaluation. The data were discounted following an assessment of the impact on plant performance caused by the inadvertent termination of power to the plant by NSF laboratory staff, consistent with the stress test provisions for seven days resting between events, and the determination that the outage did create an adverse condition exceeding the standard performance evaluation specifications. The standard performance evaluation was extended two weeks to acquire the required number of data points.

A. On two occasions short dosing of the S-12 Rotordisk unit occurred. On both of these dates (October 18, 1981, and March 7, 1982) the short dosing was caused by a malfunction of the dosing equipment and all problems were remedied by the site operator.

B. On November 1, and November 8, 1981, power to the unit was lost for approximately 22 hours although sewage dosing continued. As previously mentioned, data for the period of one week following each event were deleted from the evaluation. This should not be construed as similar to the power outage sequence of the stress testing phase which is required after the conclusion of the six month standard performance evaluation (see page 16).

PROCESS DESCRIPTION

The S-12 Rotordisk wastewater treatment system is composed of three unit processes operating in series and consists of primary settling, biological treatment, and final settling. Aerobic wastewater treatment is accomplished using a rotating biological contactor and a flow through process scheme.

The test plant was a 500 gallon per day aerobic treatment unit contained in a 641 gallon fiberglass tank. In operation, the untreated sewage flows into the 369 gallon primary settling chamber where solids are settled out. Flow from the primary settling chamber passes into the 108 gallon biological contactor zone which contains four packs of high density polyethylene mesh discs which provide a fixed media for the growth of microorganisms. Each pack of polyethylene discs rotate in a liquid zone separated from the adjacent pack by partitions to effectively provide four separate stages of biological treatment. The contactor discs are partially submerged in the wastewater and are rotated by a small 1/4 HP electric motor. The contactor rotates at 6 rpm alternately exposing the biomass to the wastewater and air, consequently providing an aerobic environment. From the biological contactor zone the flow passes into the 164 gallon final settling zone where final clarification of the wastewater occurs prior to discharge from the system.

A lamp located on the front of the control panel provides a visual indicator of non-operation. The control box is provided for installation inside a home to permit monitoring and control of power to the unit.

MODIFICATIONS MADE TO THE PLANT DURING TEST

No maintenance or service was performed or indicated on S-12 Rotordisk during the period of NSF performance testing. However, daily observations of operation were made and reported to the manufacturer.

TABLE II. SUMMARY OF PERFORMANCE DATA

Period: 10/11/81 - 5/10/82		Median	Minimum	Maximum	Interquartile Range
Dissolved Oxygen mg/L 12:00 noon	Biological contact zone (B.C.Z.)	5.4	0.2	9.4	4.7-6.6
	effluent	5.4	1.4	10.0	4.8-6.0
Temperature °C 12:00 noon	influent	10.7	8.0	18.0	9.5-13.3
	B.C.Z.	9.2	2.0	16.0	7.1-10.6
	effluent	7.3	2.0	17.0	5.6-9.5
pH	influent	7.4	6.8	8.0	7.3-7.6
	B.C.Z.	7.8	7.0	8.1	7.7-7.9
	effluent	7.7	6.4	8.2	7.6-7.9
5 day Biochemical Oxygen Demand mg/L	influent	159	12	370	131-194
	effluent	12	4	34	10-14
Suspended Solids mg/L	influent	169	47	373	126-203
	B.C.Z.	78	15	272	46-100
	effluent	6	3	38	5-10
Volatile Suspended Solids mg/L	influent	78	56	94	74-81
	B.C.Z.	76	54	82	73-79
	effluent	76	33	100	67-83
Settleable Solids 30-min. ml/L	B.C.Z.	<20	<20	<20	<20

Median: Fifty percent of the values are less than or equal to this value.

Interquartile Range: The range of variability about the median which is sufficient to contain 50 percent of the observations. It lies between the upper and lower 25 percent of the observations.

ANALYTICAL RESULTS

During the 30 weeks of standard performance evaluation operation, the S-12 Rotordisk produced a treated effluent of a quality consistent with NSF Standard 40 Class I requirements i.e., BOD less than or equal to 20 milligrams per liter and suspended solids less than or equal to 40 milligrams per liter on at least 90 percent of the sample days used for evaluation (see Appendix B, Item 6.0). The S-12 Rotordisk also satisfied the Class I requirements of meeting the EPA Secondary Treatment Guidelines. The laboratory results summarized in Table II are described as follows:

FIVE DAY BIOCHEMICAL OXYGEN DEMAND (BOD_5)

A. INFLUENT

The range of BOD values, determined from 124 observations, was from 50 to 370 mg/L. The median value was 159 mg/L with 50 percent of the observed values in the range from 131 to 194 mg/L.

B. EFFLUENT

BOD determined for 124 samples, ranged from a value of 4 to 34 mg/L with a median of 12 mg/L. Table V depicts the actual distribution of data and the proportion, expressed as a percentage, of the total number of values which were equal to or less than any particular value. The Class I effluent quality standard states that the 20 mg/L limit may not be exceeded by ten percent of the values. Since 93 percent of all observations are equal to or less than 20 mg/L, the BOD requirement for Class I has been satisfied. The histogram in Figure 2 represents the distribution of effluent BOD data.

A BOD reduction of 93 percent was calculated from the mean influent and effluent BOD values. The numbers presented in Table IV were used in the calculation. It should also be noted that S-12 Rotordisk effluent BOD never exceeded the EPA Secondary Treatment Guidelines, i.e., less than 45 mg/L for a seven day running average, less than 30 mg/L for a 30 day running average and greater than 85 percent removal. Also, pH limits specified in the guidelines were satisfied, i.e., all values were between pH 6 and 9 units.

SUSPENDED SOLIDS

A. INFLUENT

The 130 values for suspended solids in the plant influent ranged fro 47 to 353 mg/L. The median suspended solids influent value for th test period was 169 mg/L with an interquartile range of 126 to 20 mg/L.

B. EFFLUENT

A median value of 6 mg/L was established from the 130 measurements o effluent suspended solids. The interquartile range was 5 to 10, wit 90 percent of the values being less than 20 mg/L. None of the value exceeded the Class I limit of 40 mg/L as specified in NSF Standard 4 for effluent suspended solids. Figure 3 is a histogram of th distribution of data for the S-12 Rotordisk effluent suspended solids.

Table IV presents the mean values for influent and effluent suspende solids which were used to compute the percent reduction achieved by S-12 Rotordisk. A 96 percent removal of suspended solids was achieved. Again, S-12 Rotordisk effluent suspended solids were in compliance with the requirements of the EPA Secondary Treatment Guidelines.

C. BIOLOGICAL CONTACT ZONE

The concentration of suspended solids in the biological contact zone ranged from 15 to 272 mg/L with a median value of 78 mg/L. Of the 42 values 50 percent were between 46 and 100 mg/L.

SOLIDS ACCUMULATION

After testing was concluded, NSF staff measured the depth of the accumulated solids on both sides of the primary and final clarifiers. The portion of the primary on the side where raw sewage enters the S-12 Rotordisk contained settled solids to a depth of 23 inches. The opposite portion of the primary had a scum layer which met the sludge layer, which represents a depth of

36 inches. The final clarifier had accumulated solids to a depth of 18 inches, and this settled material occupied approximately 50 percent of the volume available.

DISSOLVED OXYGEN

A. BIOLOGICAL CONTACT ZONE

S-12 Rotordisk demonstrated the capacity to maintain an aerobic environment in the biological contact zone process fluid although approximately four percent of the values fell below 1.0 mg/L dissolved oxygen. The minimum value observed for dissolved oxygen was 0.2 mg/L, while the maximum value was 9.4 mg/L. The median value was 5.4 mg/L and the interquartile range was 4.7 to 6.6 mg/L.

B. EFFLUENT

A median of 5.4 mg/L was calculated, based on 139 determinations of effluent dissolved oxygen. The minimum value was 1.4 mg/L, with a maximum value of 10.0 mg/L. The interquartile range was 4.8 to 6.0 mg/L.

COLOR, ODOR, OILY FILM, FOAM

Samples were collected for analysis on three separate occasions and were diluted to 1:1000 before measurement.

A. Effluent color of all samples was equal to or less than five units (Platinum-Cobalt standard).

B. There was no evidence of threshold odor, oily film, or foam from any sample.

NOISE

Measurement of noise at a distance of 20 feet from the plant indicated the level to be below 60 decibels, "A" scale, as required by the standard.

STRESS TESTING RESULTS

In accordance with NSF Standard 40, revised, the S-12 Rotordisk unit was subjected to stress testing immediately following completion of the six month standard performance evaluation. The stress testing protocol is designed to simulate the actual use conditions of wash day loading, working mother loading, equipment or power failure (no loading) and return from a nine day vacation with the shock loading typical of return from vacation. Details of individual loading sequences and effluent requirements are described in Appendix B, pages 26 and 29. An analysis of the results obtained from samples collected for a one week period beginning immediately after each stress sequence indicates that the S-12 Rotordisk unit satisfies the requirements of Item 6.1 in NSF Standard 40, revised, i.e., beginning 24 hours after the completion of each stressing condition effluent values shall not exceed the Class II limits of 60 mg/L for BOD , and 100 mg/L for suspended solids. The effluent results for the seven day period immediately following each stressing sequence are depicted in Figures 4 and 5, which shows that the stress limits are not exceeded.

TABLE III. EFFLUENT QUALITY SUMMARY

Parameter	Number of Observations	Minimum	Maximum	Median Q_2	Interquartile Range $Q_1 - Q_3$	Limit $C_{.90}$
5 day Biochemical Oxygen Demand mg/L	124	4	34	12	10-24	19
Suspended Solids mg/L	130	3	38	6	5-10	20

Q_2: The median value; 50 percent of the values are less than or equal to this value.

$Q_1 - Q_3$: The interquartile range; the range of variability about the median that is sufficient to contain 50 percent of the observations. It lies between the upper and lower 25 percent of the observations.

$C_{.90}$: 90 percent of the values are less than or equal to this value.

TABLE IV. REMOVAL EFFICIENCIES

Parameter	Influent Mean mg/L	Effluent Mean mg/L	Reduction mg/L	Percent Reduction
5 day Biochemical Oxygen Demand	168	12	156	93
Suspended Solids	169	6	163	96

TABLE V. S-12 ROTORDISK EFFLUENT BIOCHEMICAL OXYGEN DEMAND FREQUENCY OF OCCURRENCE

BOD_5 mg/L	FREQUENCY OF OCCURRENCES	SUMMATION OF FREQUENCY	OCCURRENCE EQUAL TO OR LESS THAN AS PERCENT
4.0	3	3	2.4
5.0	6	9	7.3
6.0	3	12	9.7
7.0	4	16	12.9
8.0	5	21	16.9
9.0	4	25	20.2
10.0	13	38	30.6
11.0	13	51	41.1
12.0	15	66	53.2
13.0	17	83	66.9
14.0	12	95	76.6
15.0	6	101	81.5
16.0	4	105	84.7
17.0	1	106	85.5
18.0	3	109	87.9
19.0	2	111	89.5
20.0	4	115	92.7
21.0	2	117	94.4
24.0	1	118	95.2
25.0	1	119	96.0
28.0	2	121	97.6
33.0	2	123	99.2
34.0	1	124	100.0

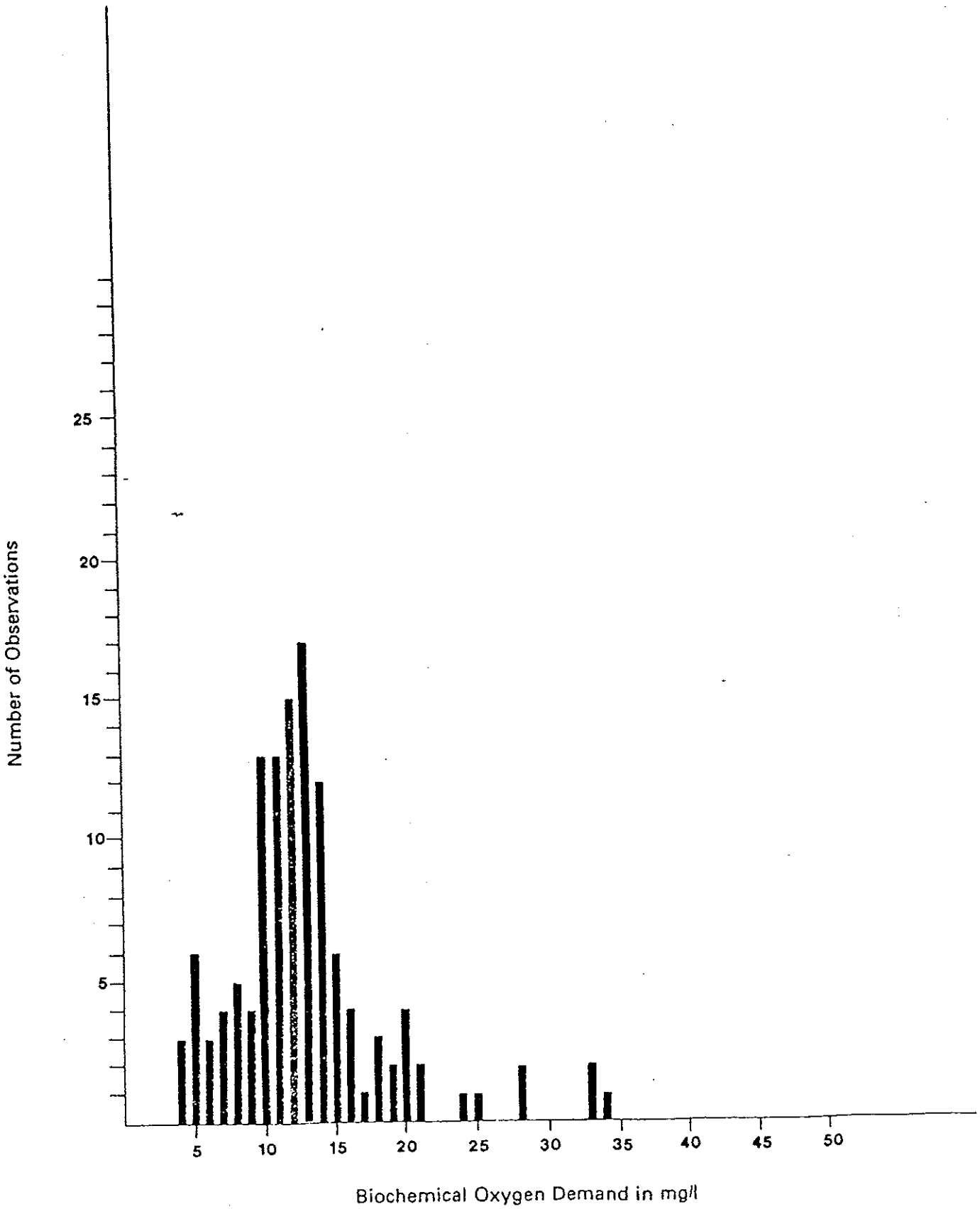


Figure 2. Distribution of S-12 ROTORDISK effluent. biochemical oxygen demand results.

TABLE VI. S-12 ROTORDISK EFFLUENT SUSPENDED SOLIDS
FREQUENCY OF OCCURRENCE

SUSPENDED SOLIDS mg/L	FREQUENCY OF OCCURRENCES	SUMMATION OF FREQUENCY	OCCURRENCE EQUAL TO OR LESS THAN AS PERCENT
3.0	2	2	1.5
4.0	12	14	10.8
5.0	24	38	29.2
6.0	26	64	49.2
7.0	10	74	56.9
8.0	10	84	64.6
9.0	8	92	70.8
10.0	5	97	74.6
11.0	6	103	79.2
12.0	2	105	80.8
13.0	1	106	81.5
14.0	4	110	84.6
16.0	2	112	86.2
18.0	3	115	88.5
19.0	1	116	89.2
20.0	1	117	90.0
21.0	1	118	90.8
22.0	3	121	93.1
24.0	1	122	93.8
25.0	1	123	94.6
28.0	1	124	95.4
30.0	4	128	98.5
32.0	1	129	99.2
38.0	1	130	100.0

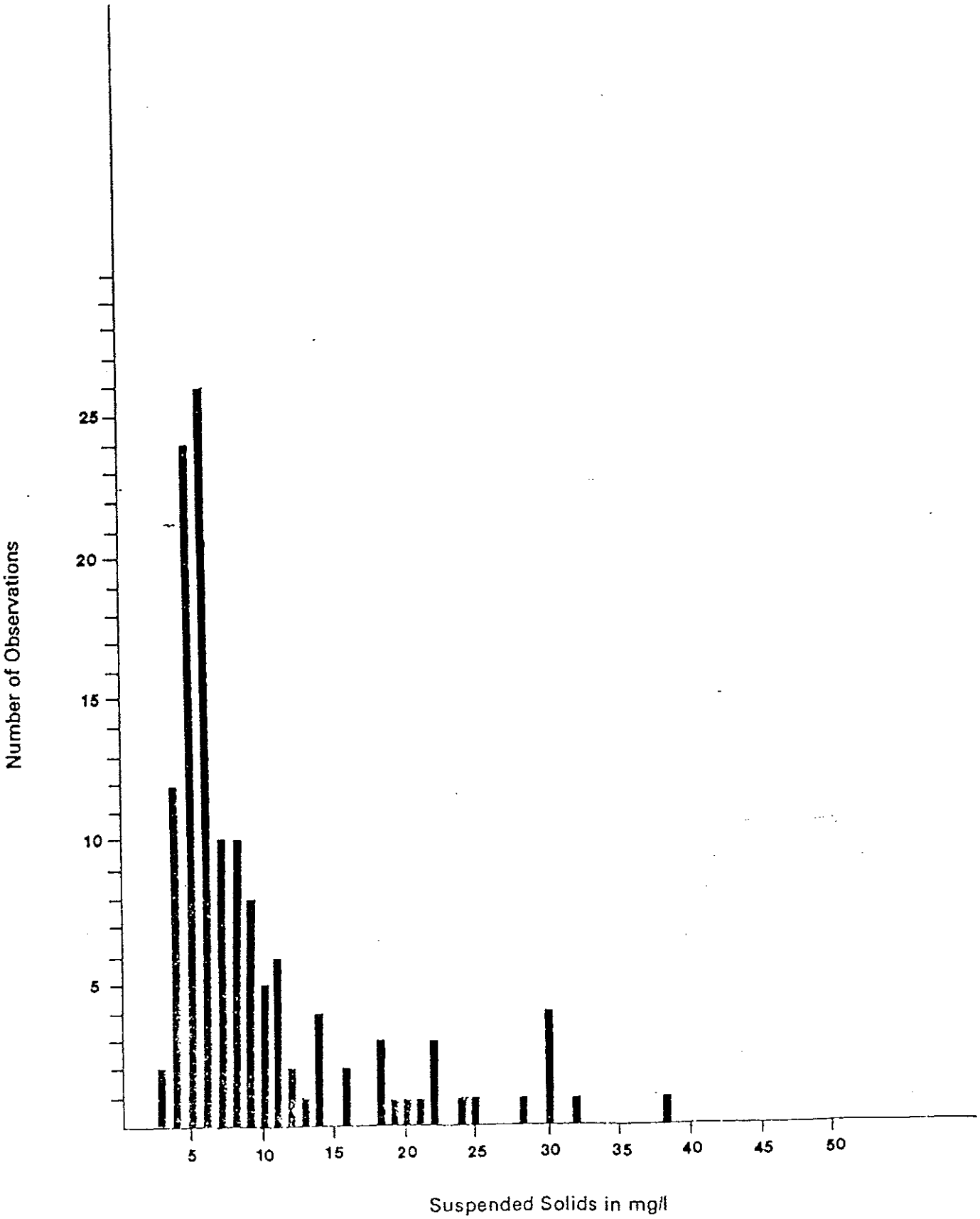
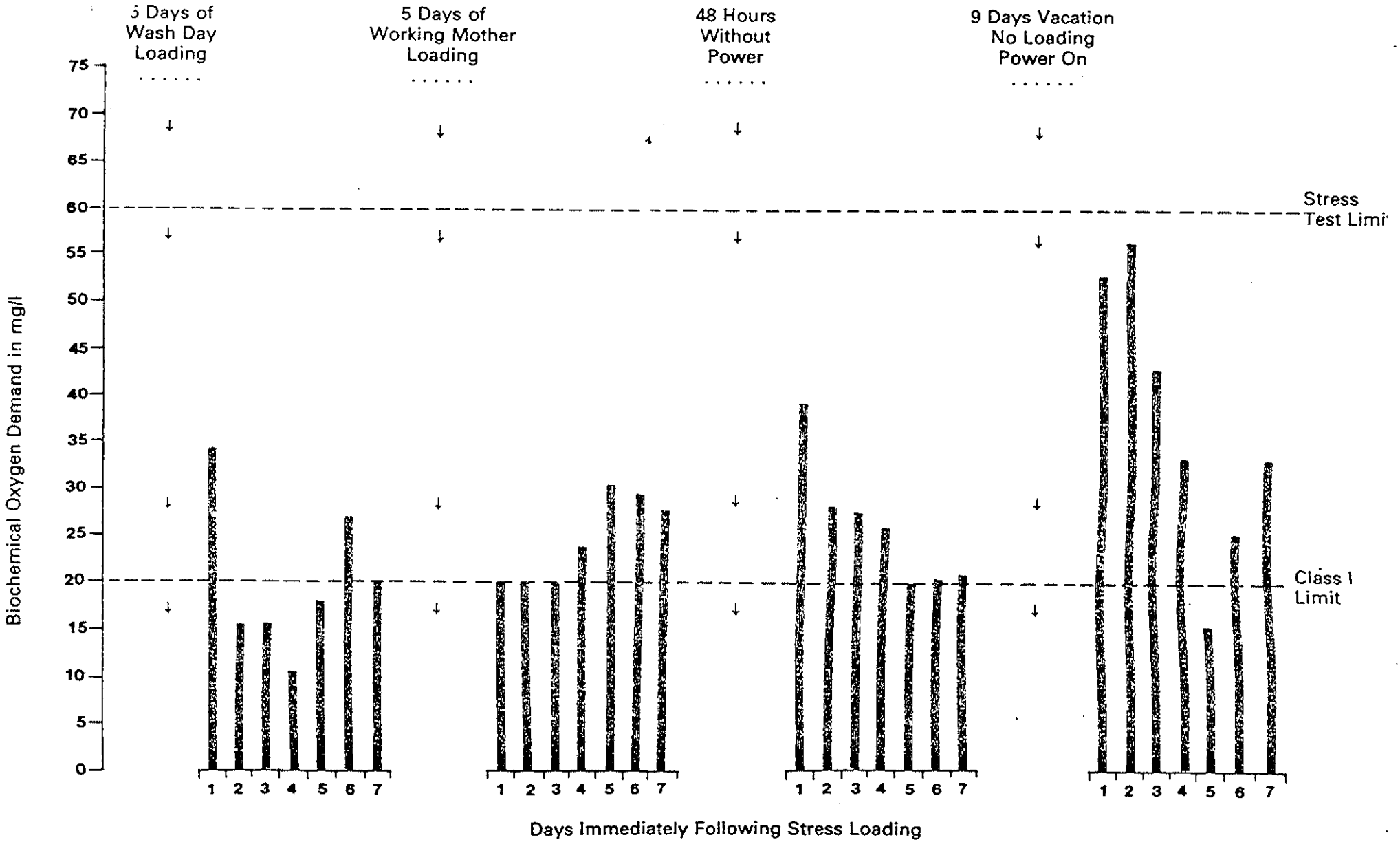
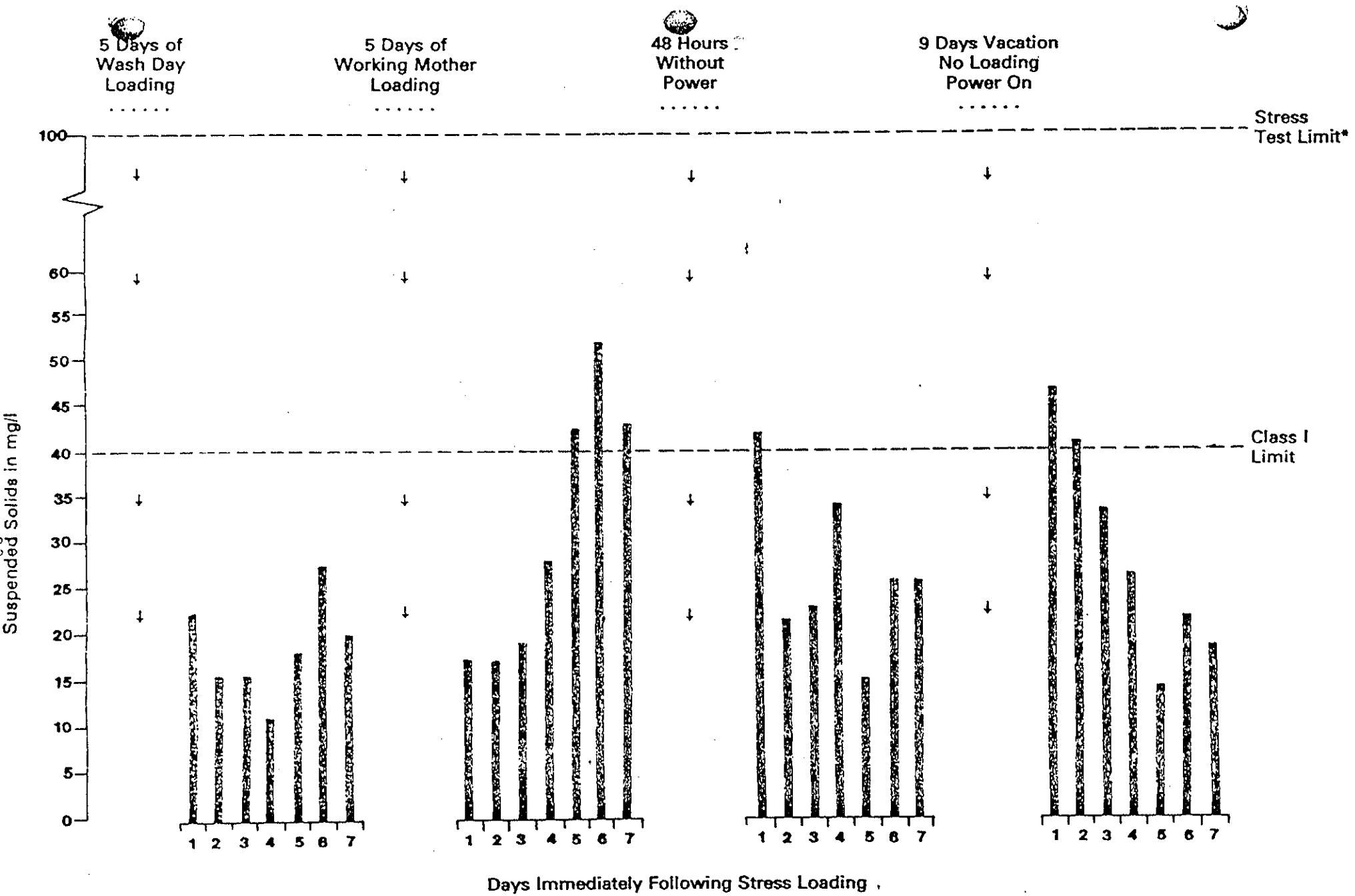


Figure 3. Distribution of 8-12 ROTORDISK effluent suspended solids results.

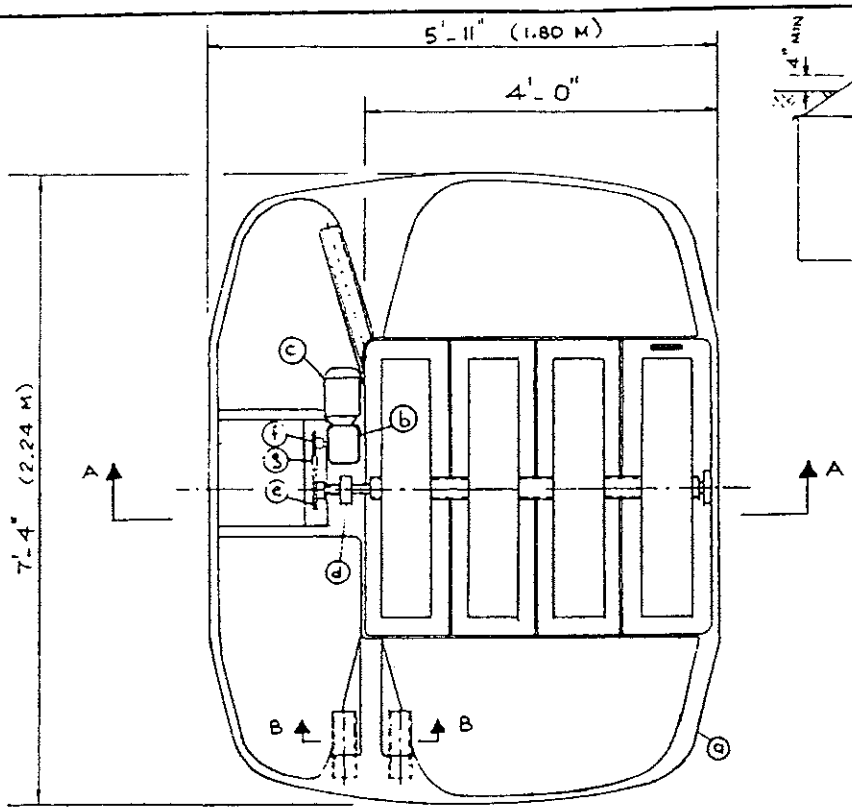


*Day one of each recovery period is reported for information purposes only. Section 6.1, NSF *Standard 40* specifies performance limit based on values derived for days 2 through 7.

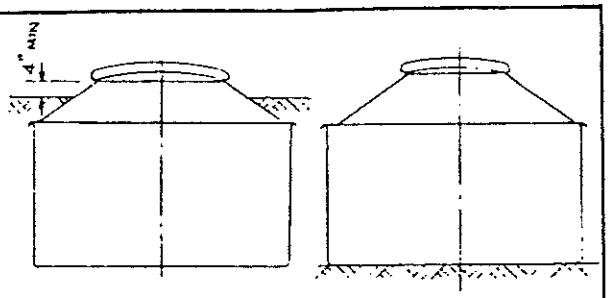
Figure 4. S-12 Rotordisk effluent biochemical oxygen demand stress test results.



*Day one of each recovery period is reported for information purposes only. Section 6.1, NSF Standard 40 specifies performance limit based on values derived for days 2 through 7.

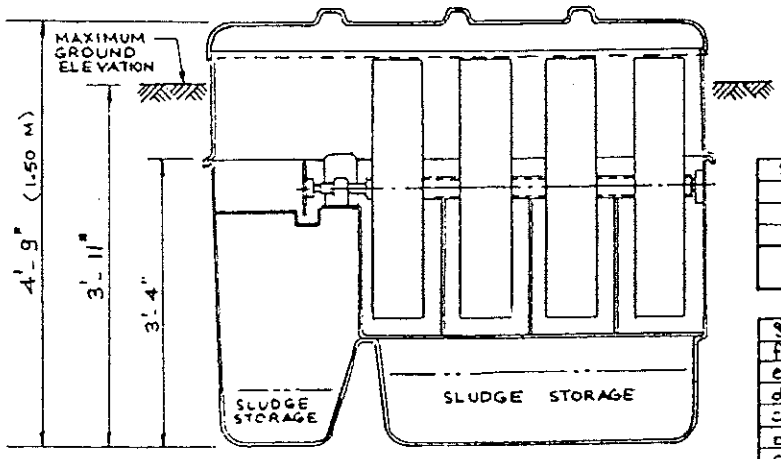


PLAN VIEW



TYPICAL INSTALLATIONS:

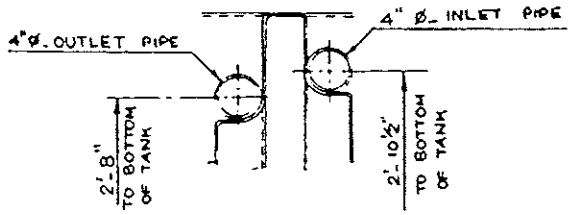
UNIT TO BE PLACED LEVEL ON CRUSHED GRAVEL BASE OR CONCRETE PAD



SECTION A-A

SHIPPING WEIGHT	320 KG	700 LBS
OVERALL HEIGHT	1.50 M	4'-11"
OVERALL WIDTH	1.80 M	5'-11"
OVERALL LENGTH	2.24 M	7'-4"
SHIPPING DETAILS		

ITEM	DETAILS	MAT'L	QUANT
g	CHAIN	STD	1
f	SMALL SPROCKET	STD	1
e	LARGE SPROCKET	STD.	1
d	BEARINGS		2
c	MOTOR : ¼ H.P, TEFC, 1800 RPM, 110/1/60		1
b	REDUCER		1
a	FIBERGLASS TANKAGE	F.R.P	1



SECTION B-B

15	BIO MEDIA DIAMETER	0.92 M	3.0 FT.
14	HYDRAULIC CAPACITY	2.27 L/P/D	500 I.G.P.D
13	ROTORZONE RETENTION		4.38 HRS.
12	ROTORZONE CAPACITY	0.41 CU M	14.5 CU.FT
11	SLUDGE STORAGE FINAL	0.11 CU M	4.0 CU.FT
10	SLUDGE STORAGE PRIMARY	0.66 CU.M	23.4 CU.FT
9	T.W.L FINAL	0.76 M	2.50 FT.
8	T.W.L PRIMARY	0.83 M	2.71 FT.
7	BIO SUPPORT MEDIA	47 SQ.M	500 SQ.FT
6	CHLORINE TANK RETENTION		
5	CHLORINE TANK CAPACITY	OPTIONAL	
4	FINAL TANK RETENTION		5.4 HRS
3	FINAL TANK CAPACITY	0.62 CU.M	21.9 CU.FT
2	PRIMARY TANK RETENTION		8.4 HRS
1	PRIMARY TANK CAPACITY	1.40 CU M	49.3 CU.FT

DETAILS

ROTORDISK

CMS ENVIRONMENT LIMITED

APPROVED BY:

CHECKED BY:

DRAWN BY: M.Y.

DRAWING TITLE

GENERAL ARRANGEMENT OF S12 ROTORDISK IN FIBERGLASS TANK

SCALE N.T.S | DATE NOV. 19/85 | DRAWING NO. S12-95.D

APPENDIX A

DESIGN SPECIFICATIONS

CMS MODEL S-12 ROTORDISK

Hydraulic Capacity	500 GPD
Volumetric Capacity (Total)	641 gal.
Sludge Storage:	
Primary tank	369 gal.
Final tank	164 gal.
Electrical Requirements:	
HP	1/4
Voltage	115
Phase	1
Cycle	60
Power	.37 KWH

PARTS SPECIFICATIONS

Tankage	Concrete/FRP
Inlet/Outlet Piping	ABS
Shaft Body	ASTM A-335
Shaft Stubs	AISI C-1020
Media	LDPE
Media Supports	FRP
Motor	1/4 h.p., 1800, TEFC
Reducer	Double Reduction Worm Gear
Bearings	Self-aligning
Sprockets & Chain	#40CS & #40 SL chain

APPENDIX B

SECTION 5. STANDARD PERFORMANCE EVALUATION METHOD

5.0 PREQUALIFICATION: The application for performance evaluation of a particular plant model or model series, shall include a basic description of the plant or model series, design data, drawings, and specifications for the plant and all equipment and appurtenances. A complete installation, operation, and maintenance manual which includes a thorough discussion of the process fundamentals shall accompany the application.

5.1 GENERAL TEST CONDITIONS AND REPORTING: The evaluation analysis program shown in Table I shall be followed in evaluation of each treatment plant. Tests shall be conducted for a minimum of six months. All samples shall be collected and analyzed on a five-days-per-week basis.

TABLE I

Sample Location	Type of Sample	Frequency of Test	DO mg/l	BOD_5 mg/l	Suspended Solids (SS), mg/l	Volatile Suspended Solids (VSS), %	Settleable Solids ml/l/30 min.	Temp. °C
Raw Influent	24 hr. composite*	Daily		X	X	X		X[1]
Final Effluent	24 hr. composite*	Daily	X[1]	X	X	X		X[1]
Aerator	Grab	Daily	X[1]		X	X	X	X[1]

*See Item 5.8.3
[1]In situ measurement

5.2 LOADING (MANUFACTURER'S DESIGN): Except during stressing sequence, the plant shall be hydraulically loaded at its rated capacity[2] according to the following pattern of flow:

Therefore, testing at rated daily capacity provides greater loading to plant than average family might be expected to contribute.

If minimum plant size - 500 gpd (1892.7 lpd),
then design loading simulates:
Use by 10 persons @ 50 gals/person/day (189.3 l/person/day),
Use by 5 persons @ 100 gals/person/day (378.5 l/person/day), or equal.

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6 a.m. - 9 a.m. 35 percent of total daily flow
11 a.m. - 2 p.m. 25 percent of total daily flow
5 p.m. - 8 p.m. 40 percent of total daily flow

5.3 METHODOLOGY: All sample collection and analytical methods employed shall be those set forth in the 15th Edition of Standards Methods for the Examination of Water and Wastewater, published by the American Public Health Association, except as otherwise specified.

5.4 OPERATION, INSTALLATION, AND MAINTENANCE: Plants shall be installed, operated, and maintained according to the manufacturer's instructions during the test period. If these instructions conflict with provisions of the Standard Performance Evaluation Method, the provisions of the Method shall be complied with.

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[2]Rated daily capacity is the design treatment capacity of the plant. However, please note the example below:

Effect of Testing at Design Loading
Assume average family = 5 persons and average water use = 50 gal/person/day (189.3 l/person/day); then daily household waste = 250 gpd (946.4 lpd).

5.5 TESTING SEASON: The Standard Performance Evaluation Method can be carried out at any time of year. If the test is conducted during cold weather, the plant and equipment shall be protected from freezing. If the test is conducted during warm weather, temperature of the aeration compartment contents shall not exceed 30°C (86°F) during the test period.

5.6 DESIGN AND CONSTRUCTION: Performance evaluation of a plant shall be independent of design and construction except that structural weaknesses or defects and failures of process support equipment during the test shall be reported in the test results.

5.7 MODEL SERIES: For a series of plants of the same model which vary in rated treatment capacities between 400 and 1500 gallons (1514 and 5677.51) per day, results achieved by the smallest plant in the model series shall be taken as indicative of the capabilities of all other plants in the series. The basic design[3] and configuration of larger capacity plants shall not differ from the plant tested.

5.8 START UP PERFORMANCE SPECIFICATIONS AND PROCEDURES: The plant shall be completely assembled, according to the manufacturer's directions. Equipment shall be checked by the manufacturer to determine that it is free of mechanical defects and operable. The plant shall be examined to determine that it is structurally sound. All defects shall be reported. If no defects are detected, that fact shall be indicated by the testing agency.

5.8.1 If no defects are detected and the plant is judged to be structurally sound, it shall be filled with water. Sampling and testing shall begin when the plant is filled and placed into operation, and continue without interruption until the end of the standard performance evaluation.

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[3]Basic design is interpreted to mean the actual design of the plant tested.

5.8.2 The wastewater used as feed for the unit shall be raw wastewate: of reasonably typical domestic character or of character equa to the intended use.

5.8.3 The daily composite sample shall consist of flow proportiona samples collected at least once per hour during periods o: influent flow.

5.8.4 The daily influent and effluent composites shall be subjected t: laboratory analyses as specified in Table I, Item 5.1.

5.9 STRESS TESTING: Stress testing shall be conducted to simulate actual us= as described in Appendix A. The situations include wash day, workin= mother, equipment or power failure, and return from one week vacatio= plus shock loading typical of return from vacation.

5.9.1 Samples collected during each stressing sequence shall includ= 24-hour composites of influent and effluent (see Item 5.8.3 collected immediately before and each 24 hours for 7 days following the special dosing requirement and daily aeratio= chamber grab samples. Analysis shall be in accordance with Tabl= I (Item 5.1).

5.10 REPORTS: The testing agency shall provide the manufacturer a repor= including significant data showing test results on the plant tested i= accordance with this standard. Appropriate commentary shall also b= provided.

SECTION 6. PERFORMANCE REQUIREMENT[4]

6.0 EFFLUENT QUALITY: Plants shall be classified according to the effluent quality results obtained under loading and operating conditions set forth in Items 5.2 and 6.1.

6.0.1 Plants listed for Class I effluent must be shown to meet EPA Secondary Treatment Guidelines[5] for BOD_5, SS, and pH. These are as follows:

6.0.1.1 BOD_5 and SS

- Arithmetic mean of all effluent samples collected in a period of 30 consecutive[6] days $\leq$ mg/L and $\geq$ 85 percent removal.

- Arithmetic mean of all effluent samples collected in a period of 7 consecutive[6] days $\leq$ 45 mg/L.

6.0.1.2 pH

- Effluent values shall remain between the limits of 6.0 and 9.0.

6.0.2 Plants listed for Class II effluent must be shown to meet an effluent quality level for BOD_5 of 60 mg/L and for SS of 100 mg/L. These maximum values shall not be exceeded more than 15 percent of the time.

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[4]The performance limits set forth in Section 6 take into account limitations of the respective analytical techniques relative to precision and accuracy. The limits shall be rigidly applied in the evaluation of test data in lieu of statistical interpretation.

[5]Federal Register, Vol. 38, No. 159 - Friday, August 17, 1975 Title 40 - Protection of Environment, Chapter 1 - EPA, Subchapter D - Water Programs. Part 133 - Secondary Treatment Information, Item 133.102 - Secondary Treatment.

[6]For Standard 40 application, consecutive days shall be interpreted as consecutive sampling days.

rpt/3/

6.0.3 Effluent shall be tested three times during the six-month evaluation period for color, odor, oily film, and foam. The effluent shall be diluted 1:1000 with distilled water. Plants listed for Class I effluent characteristics shall not exceed the following limits:

6.0.3.1 Color - 15 units;

6.0.3.2 Threshold Odor - nonoffensive;

6.0.3.3 Oily Film - nonvisible evidence other than air bubbles;

6.0.3.4 Foam - none

6.1 STRESS TESTING REQUIREMENTS: Measured values for BOD_5 and SS of effluent composite samples collected for the period beginning 24 hours following completion of each stressing condition (as described in Item 5.9 and appendix A), shall not exceed the performance limit specified for Class II ($BOD_5 \leq 60$ mg/L, SS $\leq$ 100 mg/L).

6.2 NOISE: Mechanical component parts shall be installed or protected so the noise produced does not exceed 60 dbA when measured at a point 20 feet (6.1 m) from the plant or appurtenances.

APPENDIX C

LABORATORY PROCEDURES

1. DISSOLVED OXYGEN: Direct readings on oxygen meter; polarographic cell with thermistor sensor to provide temperature compensation, sensitivity ± 1 percent of full scale, range 0-10 and 0-20 mg/L. Reference, Standard Methods for the Examination of Water and Wastewater, 14th Edition, 1975 pp. 450-454

2. pH: Direct readings on pH meter; glass measuring electrode with calomel reference electrode; temperature compensation 0 to 100°C; accuracy ± 0.1 unit. Reference, Standard Methods for the Examination of Water and Wastewater, 14th Edition, 1975, pp. 460-465

3. BIOCHEMICAL OXYGEN DEMAND (5 day): Iodometric Method, using the azide modification. Reference, Standard Methods for the Examination of Water and Wastewater, 14th Edition, 1975, pp. 543-549

4. TOTAL SUSPENDED AND VOLATILE MATTER: Gravimetric Method. Reference. Standard Methods for the Examination of Water and Wastewater, 14 Edition, 1975, pp. 94-95

5. SETTLEABLE SOLIDS (30 minute): Reference, Standard Methods for the Examination of Water and Wastewater, 14th Edition, 1975, pg. 130

APPENDIX D

REFERENCES

1. APHA, AWWA, WPCF, Standard Methods for the Examination of Water and Wastewater, current edition, American Public Health Association. Washington, DC.

2. USEPA, Methods for Chemical Analysis of Water and Wastes, current edition. U. S. Environmental Protection Agency, Washington, DC.

3. "Environmental Protection Agency Guidelines for Secondary Treatment" Federal Register, Vol. 28, No. 159, August 1973.

ROTORDISK™

1. INTRODUCTION

The **ROTORDISK™** manufactured by CMS is a RBC used extensively for the purpose of domestic wastewater treatment. A unique quality of the **ROTORDISK™** is that its simple design allows for successful and trouble free advanced wastewater treatment.

With minor modifications, two alternative forms of the **ROTORDISK™** have been manufactured. Extensive filtration using the patented **BUGS™** filter together with a **ROTORDISK™** may improve removal efficiencies. The **ROTORDISK™** has also been modified for the removal of nitrogen in the forms of nitrate and ammonia.

2. DESCRIPTION OF TECHNOLOGY

The major components of the **ROTORDISK™** include a primary clarifier (settlement tank) used for storage of wastewater and sludge. Above the clarifier is the Rotorzone where the biological disks are located and mounted on a slowly rotating single shaft. A motor and reducer configuration is the only mechanical part of the **ROTORDISK™**, none of which is submerged. The next stage is a final settlement tank which has the option of providing disinfection by use of a chlorine chamber, or a U.V. radiation unit.

The wastewater purification process begins when wastewater enters the primary clarifier. Suspended solid matter is removed in the clarifier by gravitational settling and flotation. The flow then proceeds into the Rotorzone through a submerged inlet. Contact is made between the wastewater and the biological growth (biomass) on the disks as they slowly rotate through the wastewater. The wastewater is treated by the biomass on the disks by pollutant adsorption and oxygen uptake. A special feature of the **ROTORDISK™** is a slot located at the bottom of the Rotorzone. This facilitates recirculation between the Rotorzone and the primary clarifier providing oxygen to the clarifier and a continuous supply of food to the biological growth in the Rotorzone. These conditions are satisfied even during no flow periods.

Maximum retention time and pollutant-to-biomass contact is achieved by a serpentine flow pattern within the Rotorzone. Pollutants are broken down into simple compounds such as carbon dioxide and water. New biomass is synthesized by the small amount of chemical energy involved in the reaction. Small amounts of the purifying biomass are continually sloughed off the disks and the final clarifier provides quiescent conditions allowing for settlement of these solids. All flow associated with the **ROTORDISK™** is by gravity. The final effluent can be directed to sub surface disposal, to a main watercourse after disinfection, or to a disposal area such as a lagoon. Effluent can also be used for spray irrigation.

3. APPLICATIONS OF THE ROTORDISK™

3.1 Standard Application

3.1.1 Domestic Sewage Treatment

Domestic wastewater applications of the **ROTORDISK™** occur in both the public and private sectors. Several applications exist within these sectors.

The private sector encompasses single family units, private communal uses, and native peoples. Examples of communal uses are subdivisions, apartments, hotels, trailer parks, mining camps, and industrial and commercial developments. A single communal sewage treatment system is a logical alternative to individual septic tanks and leaching beds for each lot. A communal system reduces governmental monitoring of installations and compares favourably to standard systems on a cost per lot basis. The **ROTORDISK™** may also serve as a temporary treatment system, beneficial for facilitating initial construction until a municipal sewer system is implemented.

Applications in the public sector include municipalities and school boards. Many school sites in rural Ontario require the application of class IV systems (typically septic systems and tile fields) for sewage treatment. The MOEE policy requires school boards to acquire excessively large sites for adequate dilution of the subsurface effluent prior to leaving the property. Since nitrate reduction is of primary concern, a **ROTORDISK™** capable of denitrification would significantly reduce this land requirement. Municipalities containing larger Water Pollution Control Plants (WPCPs) would also benefit from the **ROTORDISK™**. As population increases, additional wastewater flow reduces the capacity of these WPCPs. The modular installation of the **ROTORDISK™** may be used on a temporary basis to accommodate the additional flow while expansion of the existing plant proceeds. Many hamlets which use septic systems experience a curtailment of development due to the implementation of the Reasonable Use Policy of the MOEE. A **ROTORDISK™** unit with direct discharge of plant effluent could be used which would satisfy this policy and hamlet development would not be curtailed.

3.2 Denitrification

Nitrogenous compounds such as ammonia and nitrate are commonly found in wastewater and must be removed to achieve an acceptable quality of effluent. Nitrogen control in wastewater occurs by the processes of nitrification and denitrification. These processes are both biological and therefore occur widely in the natural environment.

Nitrification is the process by which specialized bacteria convert ammonia (NH_3) to nitrite (NO_2^-) and then to nitrate (NO_3^-) using oxygen. Denitrification uses a broad range of bacteria to convert nitrate to nitrite and then to nitrogen gas. The bacteria utilize

organic matter to convert nitrate to nitrogen gas when denied oxygen (anoxic environment).

CMS has designed two separate denitrification sewage treatment plants, each a modification of the standard **ROTORDISK**™ unit. The first plant involves pre-rotorzone denitrification, in which the denitrification process occurs prior to the carbonaceous oxidation and nitrification processes. The second plant is post-rotorzone denitrification in which denitrification occurs after carbonaceous oxidation and nitrification.

These denitrification processes represent an innovative method of nitrate removal because of their simplicity and the elimination of the need for an external carbon source. This design also represents a cost effective method of nitrate removal in wastewater.

The most common small flow domestic sewage treatment technology comparable to the **ROTORDISK**™ is the septic tank system, which does not offer denitrification and provides only minimal organic removal.

4. ADVANTAGES OF RBC's

The **ROTORDISK**™ shows a number of strengths and advantages over competing technologies:

1. Low Energy Consumption
   The RBC uses as little as 20% of the electricity consumption compared to an activated sludge process.

2. No Sludge Recycle
   Since sludge recycle is not required, less maintenance and equipment is needed. As a comparison, an activated sludge system requires monitoring of sludge return pumping rates, defoamer addition rates, aeration, system pressure, etc.

3. Resistance to Toxic Shock
   The RBC is resistant to toxic shocks due to short residence times and large inventories of biomass.

4. Dense Biomass
   The RBC produces a dense, rapidly settling biomass which allows the use of smaller clarifiers and filters, and results in lower sludge disposal costs. The fixed nature of this biomass also adds resistance to hydraulic surges and intermittent operation that is often a problem in the activated sludge process.

5. Low Noise and Odour
   Since blowers are not used for aeration, large volumes of malodorous gases and air-borne bacteria are not encountered.

Covers further prevent odours from entering the atmosphere. Low noise levels are created by the motor/reducer.

6. Modular Design
RBC's can be expanded by the addition of RBC modules when the demand is warranted.

7. Limited Air Requirements
No compressed air needs to be introduced into the sewage. This is particularly important in cold climates as cold air impedes biological treatment.

8. Low Maintenance and Operating Skills
RBC's have very limited moving parts and therefore require very limited maintenance. The simplicity of design does not require highly skilled operators.

9. Recyclability
Modular construction allows the RBC and associated components to be easily transported to other sites should the initial need be eliminated.

5. DESIGN ADVANTAGES OF THE ROTORDISK™

The **ROTORDISK™** has several advantages over conventional rotating biological contactors due to differences in design. Some of these advantages include:

1. The **ROTORDISK™** shaft design supports the average weight of 0.13 inch thick biological growth, whereas other RBC manufacturers base their design on 0.1 inches.

2. **ROTORDISK™** shafts are round, seamless pipe with continuously welded circular collars used to support the disk banks. The shafts are sized at least 30% bigger than other RBC's.

3. Self aligning, spherical roller bearings are used on the **ROTORDISK™**. These bearings are easily accessible and have a life span of over 100 years when properly lubricated.

4. Recirculation, at the rate of 100% of average daily flow is provided from the last stage of the **ROTORDISK™** into the primary clarifier. Advantages associated with this include:

   i) No additional pumps are required for recirculation.
   ii) Half of the flow going through the Rotorzone is returned to the primary settling tank containing half the sloughed spent biomass from the disks. This reduces the solids content entering the secondary clarifier, ultimately increasing the effluent quality.
   iii) Since flow through the Rotorzone is increased by an amount equal to the average daily flow, nutrients stored in the primary tank are provided to sustain bacterial

growth on the disks during periods of little or no flow. The possibility of biological overload in the first stage is reduced since some of the load is passed onto the latter stages.

iv) Dissolved oxygen levels in the fourth stage are considerably higher than in the primary settling chamber due to recirculation. This prevents the primary from going septic.

5. At the end of the first stage, 65% of the BOD has been removed and the resulting spent biomass is allowed to return to the primary settlement tank. This reduces loading on the subsequent stages.

6. The **ROTORDISK**^{TM} system provides up to 5 hours of retention time in the Rotorzone. The volume-to-media surface area is 0.25 U.S. gal/sq.ft. compared to 0.12 U.S. gal/sq.ft. for other RBCs.

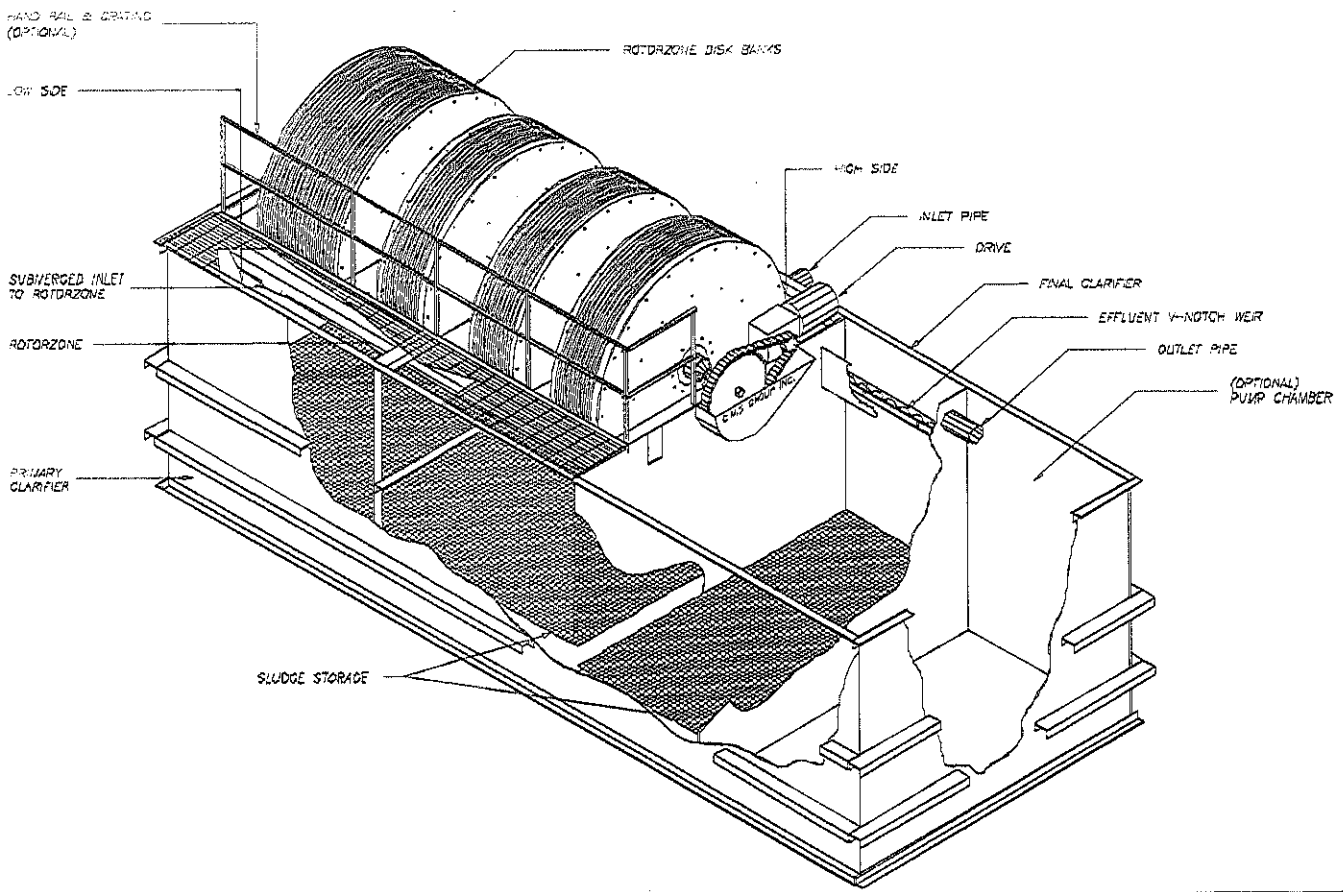
7. The **ROTORDISK**^{TM}'s open grid media has greater oxygen transfer capability right through to the shaft. The flat disk allows maximum oxygen transfer and sloughing of the spent biological growth is enhanced.

8. Disk banks can be removed individually by removing 12 mounting bolts without disassembling the shaft system.

6. CONCLUSION

The **ROTORDISK**^{TM} system is a single unit reactor of simple design, able to remove many wastewater contaminants that are detrimental to the surrounding environment. Associated with domestic wastewater treatment only, **ROTORDISK**^{TM}s can be used for single family dwellings or commercial applications. It can also be modified for added filtration using the **FILTORDISK**^{TM} system.

The versatility of the **ROTORDISK**^{TM} system has been exemplified by the wide range of applications varying from individual single family units to communal and municipal applications. The simple design of the **ROTORDISK**^{TM} provides several advantages over other RBC's while maintaining a high quality level of treatment.



CMS GROUP INC.

ISOMETRIC VIEW OF "M" MODEL ROTORDISK IN FULL STEEL TANKAGE

SEP 25, 1990 | B | N.T.S | CM-0300 | 0

WASTEWATER

TREATMENT

SYSTEMS

SPECIFICATIONS FOR ROTORDISK™ PRE-PACKAGED SEWAGE TREATMENT SYSTEM

1. Design Specifications

Treatment Process

The ROTORDISK™ is s fully integrated system , consisting of a primary settlement tank, Rotating Biological Contactor (RBC) for biological treatment, and a final settlement tank. The system incorporates a dissolved oxygen recirculation device used to add oxygen to the primary settlement tank and lead RBC stages.

RBC Module

The RBC module is housed in a semi-circular steel trough and is designed for installation in the primary settlement tank. The RBC round body shaft is equipped with stress relieved stub ends and rectangular collars for biological support media attachment. The media assemblies are supported by plated or stainless steel tierods attached to FRP endplates. The media is made from medium density polyethylene mesh and is separated by polyethylene spacers.

The drive component includes a TEFC motor, a double reduction gear box with synthetic lubricant, chain and sprocket, coupling (applicable for multiple shaft models) and spherical roller bearings with split pillow block housing. The drive system is fully assembled as an integral part of the ROTORDISK™ unit.

Optional Equipment

Additional process equipment may be added to the standard ROTORDISK™ to improve the effluent quality. Equipment for denitrification, phosphorus reduction, tertiary filtration and disinfection can be added for additional treatment.

Denitrification is accomplished by adding an additional RBC to the treatment plant. This RBC is submerged 60% and sealed to maintain anoxic conditions. Nitrate is recycled from the aerobic RBC into the anoxic RBC for reduction.

Chemical dosing equipment (dosing pump, mixer, storage tank) is used to add precipitants for phosphorus removal into the final RBC stage where mixing occurs due to the rotation of the disks.

Filtration is added to increase the removal rates of suspended solids and associated BOD. A BUGS Filter is a backwash, upflow, gravity, self-cleaning device which is installed into the final clarifier. The unfiltered effluent enters the filter through a stilling chamber and flows down by gravity to the settlement zone where heavier solids accumulate. The effluent then reverses direction and flows upwards through the filter media for secondary filtration. The filtered effluent flows under a flat-faced weir to a tertiary chamber and exits into the filtrate channel to discharge.

Disinfection is added to the process prior to discharge for the reduction of fecal coliform. Disinfection may be achieved by chlorination or ultraviolet disinfection.

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2. Equipment and Material Specifications

Chain and Sprocket
The roller chain drive is designed for high torque capacity and start-up shock loading. The chain uses a cottered pin and is continuously lubricated by immersion in an oil bath. The small and large sprocket is carbon steel. A taperlock bushing is used on the large sprocket for ease of installation.

Motor
A totally enclosed, fan-cooled (TEFC) motor is used for high humidity environments. The high purity corrosion-proof aluminum enclosure deflects water and protects oil seals. The motor has been tested to meet the CSA C390-93 standard.

Reducer
The gear reducer is a double reduction, helical bevel unit, lubricated with a synthetic lubricant. The unit is sealed for high humidity service. Reducer bearings result in maximum load capacity and minimum noise output.

Bearings
The bearings are self-aligning, spherical roller, with a cast iron split pillow block housing. Bearings are fixed at the drive and free at the non-drive end.

Coupling
A flexible, heavy duty steel coupling is used with units having multiple shaft arrangements.

End Plates
Rigid woven mat FRP endplates are manufactured under high heat and pressure in matched metal moulds, meeting NEMA standards.

Biological Support Media
Media is made from 3/8" extruded medium-density polyethylene material with U.V. light inhibitors.

Steel Tank
The semi-circular tank is manufactured from 1/4" steel plate which conforms to A-36 and is fabricated with continuous fillet welds.

Welding and Galvanizing
All welds conform to AWS-DI and AWS-D3 (CSA W59-1-1-1970 - W55.2-2-1957) standards. A zinc hot galvanized coating (ASTM A 123-75) is used after all welding is complete.

Painting
All fabricated parts are corrosion protected in accordance to manufacturers specifications. Parts are sandblasted to SSPC-SP-10-63 white metal blast and painted with two coats of coal tar epoxy to a 16 mil thickness.

3. Site Installation Instructions

Site Preparation

Where there is a complete ROTORDISK™ unit supplied, site preparation is as follows:

1. A level concrete or gravel base to be supplied by Customer/Contractor.
2. Unit to be lifted only at the four (4) lifting posts by use of hooks and spreader bars.
3. Anchoring and leveling of the unit to be done by Customer/Contractor.
4. Hydraulic piping to and from the unit to be supplied and installed by Customer/Contractor.
5. Input electrics and power hookups to be done by Customer/Contractor. All electrical installation is to be moisture and humidity proof.
6. If requested, CMS Group Inc. will supply a representative on site to assist Customer/Contractor at a specified hourly rate.

Installation of ROTORDISK™ Internal Assembly

The internal assembly, consisting of the RBC and the Rotorzone tank (Figure 3), is lowered into the concrete primary settlement tank onto concrete pedestals located around the perimeter of the tank. The assembly is fitted into the tank such that the effluent pipe is placed into the opening of the intermediate wall between the primary and secondary settlement tanks (Figure 1). The assembly is then secured to the pedestals by anchor bolts (Contractor's supply).

All anchors bolts should be set vertically in the concrete and equipped with a leveling nut (Figure 2). The assembly should be centered in the clarifier and bolted down. After the assembly has been bolted down, the shafts must be checked for misalignment and leveled, if required. Leveling must not exceed 0.75" along a 20' length.

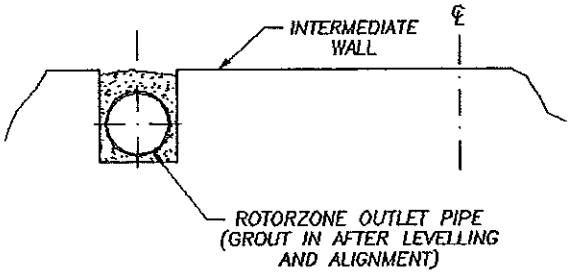

Figure 1: Rotorzone Pipe Placement

Installation of External Components

All above ground cold weather installations should be protected with an insulated cover placed around the perimeter of the concrete structure. Common construction methods include wooden shed-type structures or FRP enclosures. Proper insulation must be included to ensure that inside temperature above 8°C is maintained.

A control panel may be installed inside or outside the protective structure with an appropriate NEMA rating for high moisture or outside environments. Standard components of the control panel include a 2 or 3 pole AC magnetic starter with overload protection, CB disconnects and a NEMA 3, 4 or 4X enclosure.

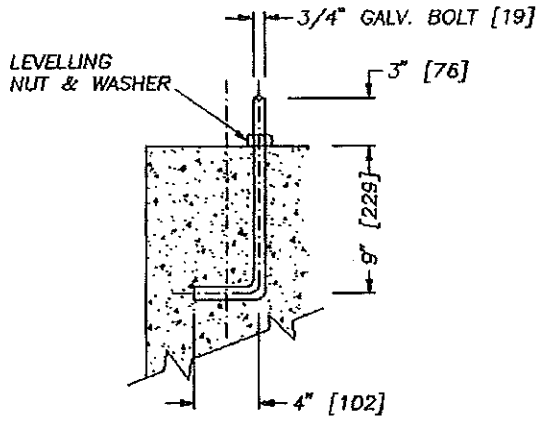

Figure 2: Anchor Bolt Detail

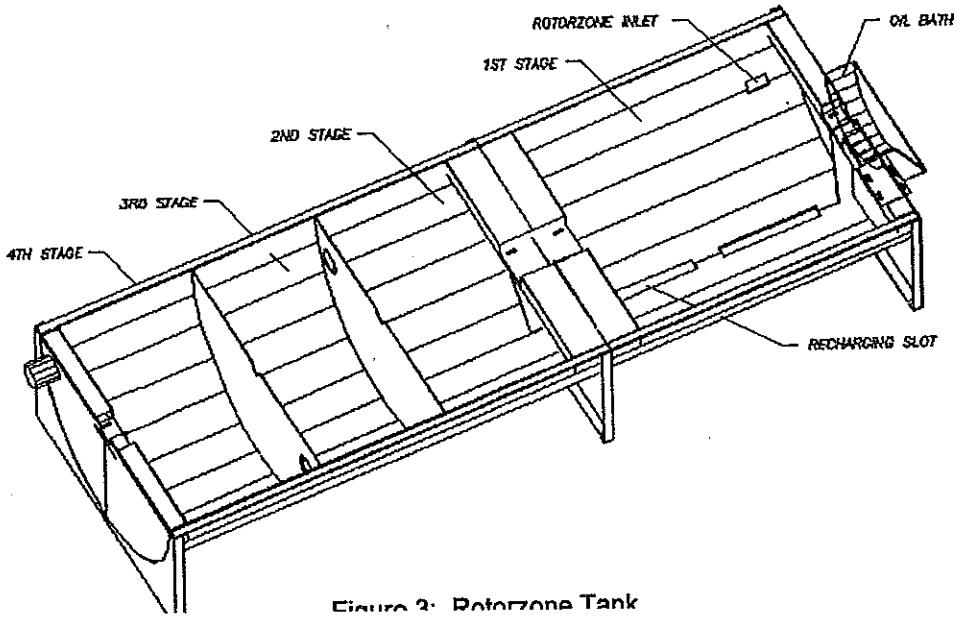

Figure 3: Rotorzone Tank

4. Assembly Instructions for ROTORDISK™ Mechanical Components

Disk Bank Mounting

Disk banks are shipped separately by CMS Group Inc. in half sections. Disk banks are mounted to the shaft with ½" diameter mounting bolts. 24 bolts (20 NF x 1½" LG) are used for each bank assembly.

Bearing Installation

1. Slide the tapered bearing adapter sleeves on the ends of the ROTORDISK™ shaft.
2. Measure the unmounted starting bench clearance by placing the bearing on a flat surface and measure the clearance between the bearing rollers and the outer race.
3. Slide the bearing on the tapered sleeve and gradually drive the bearing on the sleeve by screwing on the locking nut. Keep the bearing loosely fitted on the sleeve to allow the shaft to be mounted on the bearing housings.
4. Place the bottom half of the split pillow block housings on the Rotorzone tank bearing pads. Hand tighten the bearing mounting bolts to secure the bearing housing onto the pads. Grease the bearing seals and install onto the bearing housings. Allow for some play on the movement of the housings, prior to installing the ROTORDISK™ shaft.
5. With the bearings mounted on the shaft ends, slowly lower the shaft onto the prepared bearing housings. Centre and align the bearing housings.
6. After the shaft is aligned and centered, fix the shaft in place. Tighten the mounting bolts in place.
7. Tighten the bearing locking nut, gradually driving the bearing onto the tapered adapter sleeve. As the bearing is driven tighter, continually check the reduction in internal bearing clearance based from the starting bench clearance. Stop tightening the bearing when the maximum residual clearance is reached. CMS will specify the maximum residual clearance. NOTE: residual clearance is the difference between the unmounted clearance and reduced clearance when the bearing is being driven on the tapered adapter sleeve.
8. Apply LGEP2 grease inside the bearing and inner bearing housing. Place on the other half of the bearing seals, place them on the top half of the bearing housings and install to cover the complete bearing assembly.
9. Install the grease nipples on the bearing housings. Pump the housings full of grease to ensure that most of the air voids inside the bearing housing is displaced with the grease.

Recycle Bucket Mounting

The recycle buckets and the recycle trough are to be mounted to the Rotorzone tank on the last stage of the disk bank shaft assembly. The bucket opening and recycle trough discharge should point in the direction of the disk rotation. The disk bank assembly rotates toward the inlet opening on one side of the Rotorzone tank trough.

Drive Mechanism

1. Mount the bushing onto the large sprocket and install the ROTORDISK™ shaft drive end.
2. Mount the small sprocket onto the reducer output shaft.
3. Mount the reducer onto the Rotorzone tank reducer pad. Allow for some play in the reducer mounting bolt tightness.
4. Align the large and small sprocket faces with straight edge. Fix the sprockets into position. Install the cottered chain over the sprockets. Tighten the reducer mounting bolts. Recheck the axial alignment.
5. Mount the motor on the reducer flange.

ROUTINE MECHANICAL MAINTENANCE OF ROTORDISK™ SEWAGE TREATMENT PLANTS

1 - MOTOR:

If motor is equipped with grease fittings and relief plugs, it should be re-lubricated using a low-pressure gun once a year with Shell Alvenia R2" grease (DO NOT OVER-LUBRICATE).

There is no lubrication required for motors without grease fittings and relief plugs

2 - REDUCER:

Reduction gear on **ROTORDISK™** units are filled with synthetic long life lubricant. No inspection or maintenance outside of periodic visual inspection is normally required. If there are no evidence of oil leaks on the seals, the synthetic lubricant must be changed every five (5) years for **ROTORDISK™** units running 24 hours a day.

Reduction Gear on medium and large **ROTORDISK™** size units are filled with Shell Tivela 75 oil and does not require oil changes (permanent lubrication). Periodic visual inspection is required. Check oil level and top up to required level with same oil, if necessary.

3 - BEARINGS:

Bearings are lubricated with NLGI Grade 2 Molyslip Multipurpose grease or SKF LGEP2 lithium grease. Lubricant will deteriorate in time and rate of deterioration is a function of the operating conditions encountered. Lubrication cycle can be determined by analyzing the samples taken near the bearing. Reapplication of new grease once a month is usually adequate or at least every three (3) months.

4 - SPROCKETS AND CHAIN:

(Applicable to non-direct drive **ROTORDISK™** units)

Chain drive should be inspected every six (6) months for following points:

-If Chain is covered with grit or chips, it should be cleaned in kerosene and re-lubricated.

-Inspect oil for contamination, such as chips, dirt or grit. Replace oil if necessary (Oil with viscosity of SAE30 at ambient temperature 40° to 100° F is recommended).

- Milky white color of the oil is indicative of flooding. Replace oil and determine the cause of the flood.

-Check Chain tension and adjust if required.

5 - COUPLING:

(Applicable for direct drive **ROTORDISK™** units and 'L' models)

Coupling should be checked for lubricant level. Lubricant is to be added if required. Re-lubrication with NLGI#2 or LTG Grease once a year is usually adequate.