AGNICO-EAGLE MEADOWBANK
555 Burrard Street, Suite 375
Box 209, Two Bentall Centre
Vancouver, British Columbia V7X 1M8
Tel. 604.608.2557 Fax. 604.608.2559

agnico-eagle.com

November 7, 2008

Via email and Xpresspost

Mr. Richard Dwyer
Licensing Administrator
Nunavut Water Board
PO Box 119
Gjoa Haven, NU X0B 1J0
Phone: (867) 360-6338

Dear Mr. Dwyer,

Re: Meadowbank Water License 2AM-MEA0815: Document Submission

As per water license 2AM-MEA0815 Part D, Item 19 and water license 8BC-TEH0809 Part D, Item 10, please find the document entitled, '*Sewage Treatment Plant – Operation & Maintenance Manual'* enclosed with this letter.

Should you have any questions regarding this submission, please contact me directly at 604-622-6527 or via email at rgould@agnico-eagle.com.

Regards,

RL Gould

Rachel Lee Gould, M.Sc.
Project Manager, Environmental Permitting and Compliance Monitoring

Encl (1)

MEADOWBANK GOLD PROJECT

Operation & Maintenance Manual
Sewage Treatment Plant

In Accordance with Water License 2AM-MEA0815 & 8BC-TEH0809

Prepared by:
Agnico-Eagle Mines Limited – Meadowbank Division

Version 1
November 2008

EXECUTIVE SUMMARY

The Nunavut Water Board (NWB) has issued Type A Water License 2AM-MEA0815 to Agnico-Eagle Mines Limited (AEM) for the Meadowbank Gold Project site authorizing the use of water and the disposal of waste required by mining and milling and associated uses.

AEM has prepared the following document which summarizes the operational and maintenance procedures to be followed at the sewage treatment plant.

This report documents the stand alone Operation & Maintenance Manual – Sewage Treatment Plant, as specified under Water License 2AM-MEA0815 Part D, Item 19 and includes the following requirements:

- The manual was prepared in accordance with the "Guidelines for the Preparation of an Operation and Maintenance Manual for Sewage and Solid Waste Disposal Facilities in the Northwest Territories, 1996", and adapted for the use of a mechanical sewage treatment facility;
- The manual includes contingency measures in the event of a plant malfunction;
- The manual includes sludge management procedures; and
- The manual incorporates the Operation and Maintenance Manual requirements of 8BC-TEH0809, Part D, Item 10.

IMPLEMENTATION SCHEDULE

As required by Water License 2AM-MEA0815, Part B, Item 16, the proposed implementation schedule for this Plan is outlined below.

This Plan will be immediately implemented (November 2008) subject to any modifications proposed by the NWB as a result of the review and approval process**.**

DISTRIBUTION LIST

AEM Internal:

- Operations Manager
- Mine Superintendent
- Environmental Superintendent
- Environmental Coordinator
- STP Operator

DOCUMENT CONTROL

Version	Date (YMD)	Section	Page	Revision
1	08/11/07			Operation and Maintenance manual

Prepared By: _____
Rachel Lee Gould, M.Sc.
Project Manager: Environmental Permitting & Compliance Monitoring

Approved by: _____
Larry Connell, P.Eng.
Regional Manager: Environment, Social and Government Affairs

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SECTION 1 • INTRODUCTION

1.1 PURPOSE

This sewage treatment plant (STP) operation and maintenance (O&M) manual for the Meadowbank Gold Project has been prepared in accordance with the Nunavut Water Board Type A Water License 2AM-MEA0815, Part D, Item 19, and is based on the "*Guidelines for the Preparation of an Operation and Maintenance Manual for Sewage and Solid Waste Disposal Facilities in the Northwest Territories, 1996, prepared by the Department of Municipal and Community Affairs, NWT*". The manual has been adapted for the use of a mechanical sewage treatment facility.

This manual is a component of the Meadowbank Environmental Management System. The objectives of this plan are summarized as follows:

1. To define the location, design and operating procedures to be used in the treatment of sewage generated at the Meadowbank Mine; and
2. To define monitoring requirements for the STP.

Many facilities for the Meadowbank Gold Project are under construction, or have yet to be built. As of October 2008, the STP is still under construction. As additional components of the STP are installed and additional sources of sewage from the various facilities are brought online, the procedures set forth in this manual will be revised accordingly.

1.2 BRIEF DESCRIPTION OF THE PROJECT

The Meadowbank Gold Project, operated by Agnico-Eagle Mines Ltd. (AEM), is located approximately 70 kilometres north of the Hamlet of Baker Lake, in the Kivalliq Region of Nunavut. The center of operations is situated at 65^{o} 01' 9.12''N latitude and 96^{o} 04' 1.91''W longitude on NTS map sheet 66H/1. The site is currently under construction; mining operations are scheduled to begin in January 2010.

As of October 2008, the Meadowbank Gold project hosts estimated combined proven and probable open pit mining reserves containing 3.5 million oz of gold. This gold will be extracted during the roughly 8- to 10-year operational lifespan of the open pit mine. Access to the site is via an airstrip at Meadowbank and via an all-weather access road from the Hamlet of Baker Lake. On-site facilities will include (once construction is complete) a mill, power plant, maintenance facilities, tank farm for fuel storage, water treatment plant, sewage treatment plant, and accommodation and kitchen facilities for 340 people.

The freshwater supply for the mine and camp is pumped from Third Portage Lake; mine process water will be primarily reclaimed from the tailings and attenuation ponds. Treated sewage will be discharged to the stormwater management pond (referred to as Tear Drop Lake in other plans) during the construction phase, and then to the tailings pond during the operations phase of the project (co-disposed with the mill tailings).

1.3 CONTACT INFORMATION

The individuals responsible for the operation of the sewage treatment plant for the Meadowbank Gold Project are the following:

Mine Superintendent	867-796-4610
STP Operator	867-796-4610
Environmental coordinator	867-796-4610 ext 6728

SECTION 2 • BACKGROUND

2.1 GENERAL SEWAGE TREATMENT AND DISPOSAL

Sewage, liquid waste from toilets, baths, showers and kitchen, is treated for removal of contaminants including organic and inorganic compounds as well as bacteria. Treatment of sewage produces:

- a clean waste stream (or treated effluent) suitable for reuse or discharge back into the environment; and
- a solid waste (or sludge) also suitable for proper disposal.

Contaminants that require treatment may include organic constituents (measured using biochemical oxygen demand (BOD)), ammonium (NH^{-4}), phosphorus, oil and grease, grits and suspended solids (TSS)). Sewage treatment incorporates physical, chemical and/or biological methods requiring various levels of treatment processes, which define the operations and processes that occur to complete the treatment. The stages of treatment processes are typically referred to as:

- Preliminary (or mechanical) treatment: physical removal of large objects such as floatables, sticks, grit and grease;
- Primary treatment: physical removal of suspended and faecal solids and sand and grit by pre-precipitation;
- Secondary treatment: removal of organic matter via biological/chemical processes; and
- Tertiary treatment: physical removal of residual suspended solids (after secondary treatment).

Package sewage treatment plants often combine all or at least two stages of the three main treatment stages (i.e., primary to tertiary treatment processes) into one combined stage. They are often employed to serve small populations, deal with intermittent flows and/or reduce the need for large footprints to achieve higher environmental standards. A tank (e.g., septic tank, equalization pond) is usually installed upstream of the package treatment system to collect sewage and provide inflow to the treatment system. This tank can also act as a primary treatment tank where solids can settle and homogeneous liquid is produced for further treatment. The secondary treatment stage offers the main treatment processes where the biological content of the sewage containing human waste, food waste, soaps and detergents will degrade with the help of bacterial activities. The majority of sewage treatment systems are based on aerobic biological processes where organic compounds (such as carbonaceous BOD) and soluble organic contaminants (e.g., sugars, fats, short organic chain carbon particles) are degraded. Ammonia is also converted to nitrate with the help of microorganisms under the aerated conditions (i.e., nitrification). Combination of decaying bacteria resulting from the biological processes (or “biomass”) and flocculent particles form sludge that require separation and disposal. In order for the microorganisms to perform effectively, the environment within the treatment system must be well-aerated (to provide oxygen), and must include suitable nutrients (i.e., substrate) for the microorganisms. After these reactions are complete, the treated wastewater (effluent) is removed from the system for disposal or reuse.

2.2 HISTORY OF SEWAGE TREATMENT AT MEADOWBANK

The sewage treatment plant (STP) at Meadowbank first went into operation on May 15, 2008. However, as mentioned previously, the STP at Meadowbank is still under construction. Additional components of the STP (including an emergency overflow tank) are, as of October 2008, still to be installed or brought into operation. Consequently, this manual is a work-in-progress, and will be updated as the plant at site is updated.

The STP at Meadowbank is located on the northern end of the mine site in a prefabricated structure adjacent to the accommodations camp (see Figure 1). The proximity of the system to the camp optimizes the wastewater inputs. During the construction phase of the project, before construction of the tailing impoundment, treated wastewater is discharged into Tear Drop Lake, a small, shallow (less than 2m deep) and fishless, water body. This water body is located between the proposed plant site and Portage Pit, within the mine footprint and is being used as a stormwater management pond for the Meadowbank site. During the construction phase (2008 and 2009) sludge from the STP will be withdrawn from the RBC through drain ports under the primary clarifier tank and partially dewatered in a filter press (not yet installed). The filtered sludge will then be bagged and either incinerated within the site incinerator or stored in suitable containment pending later co-disposal with the mill tailings in 2010. During mine operations, the treated water and sludge will be co-disposed with the mill tailings into the tailings pond.

Prior to the installation of the STP at Meadowbank, outhouses or Pacto toilets (waterless toilets) were in use at the site; waste from these toilets was incinerated. The Pacto toilets are still being used in some of the less-inhabited buildings at site, such as the old kitchen building, coverall building, and remote work trailers. As before, the waste from these toilets is incinerated.

2.3 SEWAGE GENERATION AND COMPOSITION

Approximately 45,000 L to 65,000 L of sewage and grey water is generated at site each day. The estimate is dependent on the number of people in camp each day and their travel schedules. Meadowbank has noticed a trend that people tend to use more water (and consequently generate more wastewater) 1-2 days before they leave camp and 1-2 days after arriving at camp. Daily records are maintained of the amount of sewage and grey water generated per day.

The STP at Meadowbank is capable of handling the wastewater generated by up to 550 people, or 112.5 m^3 per day. As described in Section 3 below, the STP is comprised of 3 units: the Seprotech L333 and two Biodisk LJ100s. With a biological oxygen demand (BOD) of approximately 350 mg/L, the L333 has a capacity up to 400 people, and the two Biodisks, operating in a series, another 150 people.

The composition of the sewage and grey water entering the plant is monitored weekly. Results for early July 2008 are presented in Table 2.1 below.

SEAWAGE TREATMENT PLANT

MEADOWBANK COMPLEX

BUILDING SERVICE

HEAT TRACED INSULATED PIPELINE

LAYDOWN

LAYDOWN

MILL

POWER HOUSE

ASSAY LAB

TEARDROP LAKE

CONTRACTOR AREA

CRUSHING PLAN AGNICO-EAGLE

INCINERATOR

FUEL TANK

DESSINS EN RÉFÉRENCE / REFERENCE DRAWINGS		REVISIONS			

AGNICO-EAGLE
DIVISION MEADOWBANK

DESSINÉ PAR / DRAWN BY	JG	DATE 05/11/08
VÉRIFIÉ PAR / CHECKED BY	SD	
APPROUVÉ PAR / APPROVED BY		
No. PROJET / PROJECT NO.		
DATE	05/11/08	

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SITE LAYOUT

ÉCHELLE/ SCALE	NONE	FICHIER FILE	
No. DESSIN/ DRAWING NO.	FIGURE 1	REVISION —	FEUILLE/SHT 1 / 1

AE-CART-ANSI B

N:\ACAD\Surface Layout\SITE LAYOUT ENVIRO.dwg, 06 Nov 2008

Table 2.1: Untreated Water Quality Entering the STP (Influent) - July 2008

Parameter	July 2008 Results (mg/L)
BOD5	289
COD	1583
Total Suspended Solids – TSS	208
Faecal Coliforms	5600

SECTION 3 • OPERATION AND MAINTENANCE OF SEWAGE TREATMENT PLANT

3.1 DESCRIPTION OF TREATMENT PLANT

A Rotary Biological Contactor (RBC) sewage treatment system has been installed at Meadowbank. Three RBC units have been purchased and installed at site; the Seprotech L333 Rotordisk model, and two Biodisk LJ100 units. These units are designed to remove organic material and nutrients from the wastewater (sewage and greywater).

The main unit, the Seprotech L333, was originally purchased by Voisey's Bay Nickel Company for use at their construction camp in July of 2003. The two Biodisk LJ100 units, run in a parallel series, were purchased to increase the wastewater treatment capacity of the Meadowbank system. A 65 m^3 capacity equalization tank was purchased to attenuate the expected peak flows of influent both in the morning and evening as crews prepare and/or return from their respective worksites. The Seprotech L333 and two parallel Biodisk units are fed from this equalization tank; the treated effluent from both systems is transferred to a common lifting station (station 3) prior to discharge.

To supplement the main RBC unit, AEM purchased a plate and frame filter press as an add-on package to allow sludge to be drawn as needed from the bottom of the primary clarifier and then filtered into storage bags. An emergency overflow tank was also purchased for the STP; this tank (once installed) will be connected to the Seprotech L333, both Biodisks, equalization tank and lift stations 2 and 3; in the event of an issue at the plant or lift stations, this overflow tank would be capable of accepting overflow from the system for up to 24 hours.

The operation of an RBC system is based on a continuous flow of wastewater through a series of stages. The number of stages required is dependent on the treatment goal, temperature and proximity to influent input. As wastewater flows through the RBC system, each successive RBC stage receives influent with lower contaminant concentrations than the previous. In general, treatment of wastewater by an RBC system includes the following processes:

- Aeration and mixing via rotating disks;
- Biological reactions on disk surfaces; and
- Sloughing of solids from rotating disks.

Prior to entering the RBC, untreated wastewater requires some form of pretreatment of either primary clarification or passing through fine screens for liquid/solid separation. Wastewater can then flow into an RBC unit, where it comes in contact with disks attached to a rotating shaft. The disks can be configured and corrugated in various patterns to provide increased surface area and enhanced structural stability as they rotate through the wastewater. Aeration and mixing occurs as the shaft and associated disks rotate through the wastewater. The disks provide surfaces on which microorganisms can react with ambient air and wastewater to convert ammonia to nitrate (termed nitrification) and reduce the Biological Oxygen Demand (BOD). As wastewater flows through the disks, sloughing of solids accumulated on the disks occurs by displacement and gravity. After the treatment process within the RBC is complete, the resulting wastewater is directed to settling tanks. These tanks are

necessary for secondary clarification, such that solids within the treated wastewater can be separated from the liquid to form sludge.

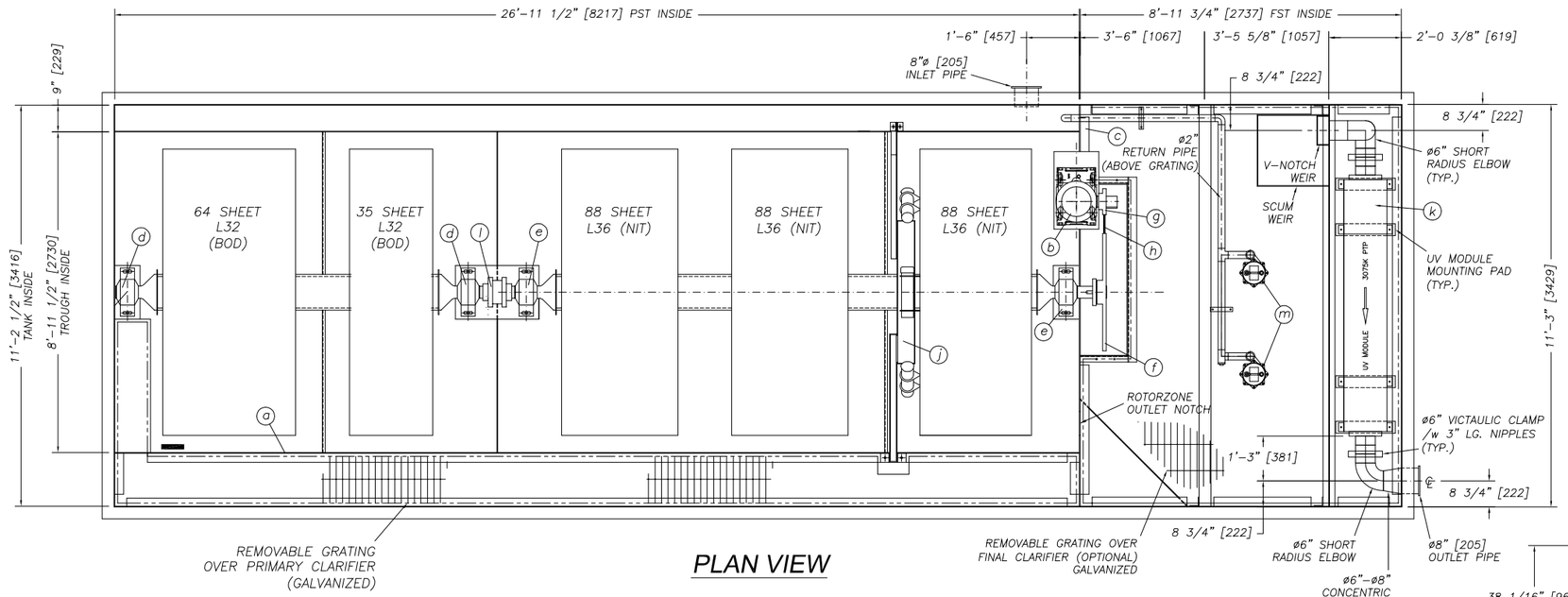
Schematics of the RBC and flow through system are presented in Figures 2 and 3 below.

The following pictures show similar RBC units during assembly so that the internal structure is visible. The Meadowbank RBC units are housed within an insulated tank with an insulated cover and are equipped with immersion heaters to ensure efficient operation under Northern temperature conditions.

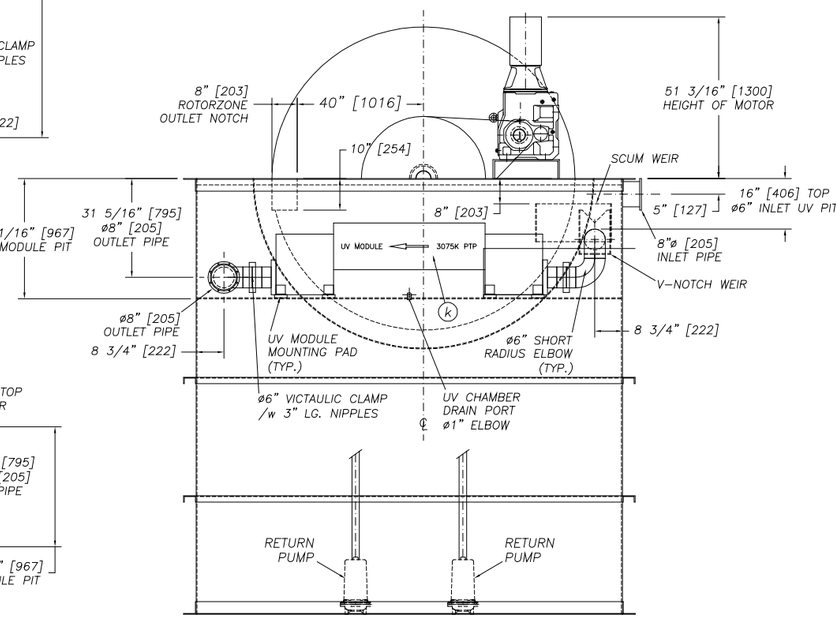



SHIPPING DETAILS		L 333
OVERALL LENGTH		36'-10" [11225]
OVERALL WIDTH		12'-1" [3685]
OVERALL HEIGHT		15'-6" [4275]
SHIPPING WEIGHT	(LBS)	42,000
	(KG)	19,000

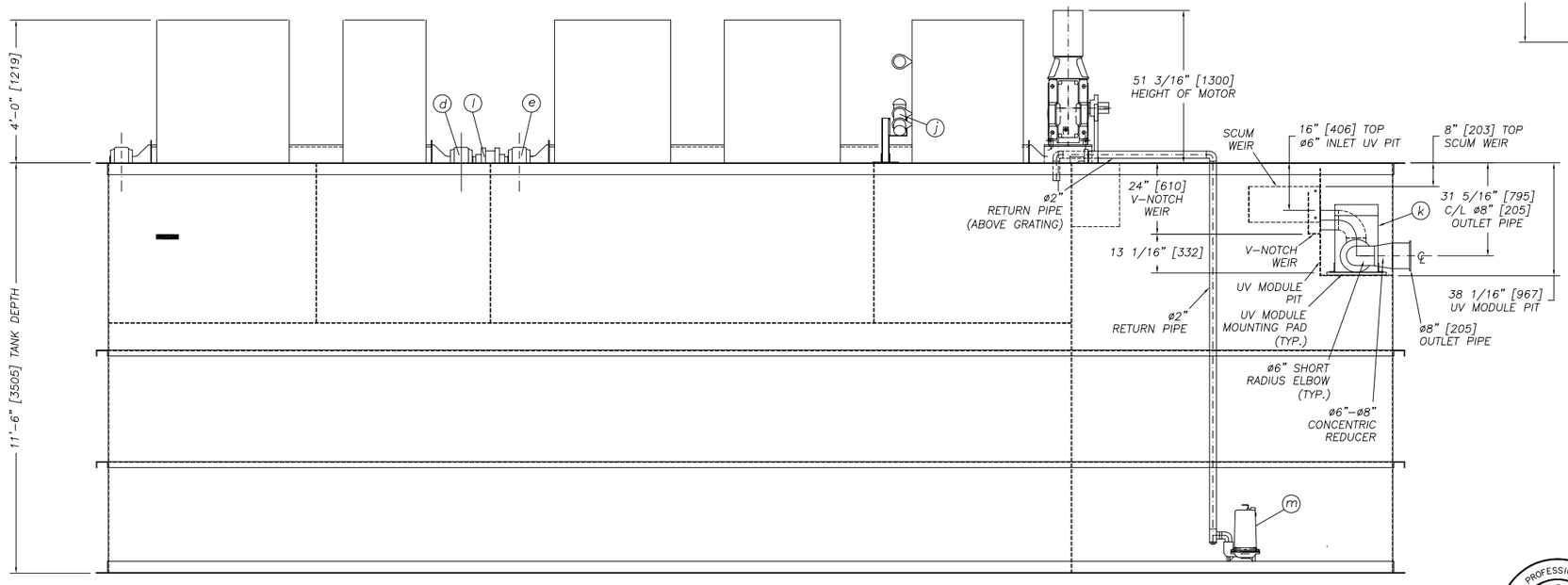
PROCESS DETAILS		L 333
HYDRAULIC LOADING	(USGPD)	27,738
	(L/DAY)	105,000
BIO SUPPORT MEDIA AREA	(SQ.FT)	36,490
	(SQ.M)	3,390
BIO SUPPORT MEDIA DIAMETER	(FT)	8
	(M)	2.44
PRIMARY CLARIFIER CAPACITY	(CU.FT)	2,581
	(CU.M)	73.09
FINAL CLARIFIER CAPACITY	(CU.FT)	873
	(CU.M)	24.72
ROTORZONE CAPACITY	(CU.FT)	640
	(CU.M)	18.12
SLUDGE STORAGE IN PRIMARY CLARIFIER	(CU.FT)	1,588
	(CU.M)	44.97
SLUDGE STORAGE IN FINAL CLARIFIER	(CU.FT)	233
	(CU.M)	6.60
T.W.L IN PRIMARY CLARIFIER	(FT)	10.58
	(M)	3.23
T.W.L IN FINAL CLARIFIER	(FT)	9.75
	(M)	2.97



PLAN VIEW



SIDE VIEW



ELEVATION VIEW

ITEM	DETAILS	MAT'L	QUANT
a	"ROTORZONE" TANK	M.S	1
b	REDUCER NORD GEAR, MODEL SK9062V-185TC		1
c	MOTOR TEFC 185TC FRAME, 3HP, 575V, 3PH, 60HZ		1
d	BEARING SKF, SNH22524, 4 3/16" DIA.		2
e	BEARING SKF, SNH22526, 4 7/16" DIA.		2
f	LARGE SPROCKET # 160 M60T c/w TAPER LOCK BUSHING		1
g	SMALL SPROCKET # 160 B12T		1
h	CHAIN # 160 COTTERED		1
j	D.O. RECIRCULATION DEVICE	M.S	1 SET
k	UV MODULE 3075K PTP		1
l	COUPLING		1
m	RETURN PUMP		2

P.O. # 334366-41-0005

AS BUILT DRAWING
RELEASED FOR FABRICATION

LICENSED PROFESSIONAL ENGINEER
B. KHORAL
PROVINCE OF ONTARIO
03/21/03

NOTES:

1. UNIT TO BE PLACED LEVEL ON CONCRETE PAD OR WELL COMPACTED GRAVEL.
2. ALL DIMENSIONS IN BRACKET ARE IN MILLIMETERS.
3. ALL STEEL SANDBLASTED AND PAINTED WITH DEVTAR 5A FINISH.
4. 3" THICK FOAM INSULATION ON OUTSIDE OF TANK AND INSIDE COVER (IF APPLICABLE).
5. TANK INTERIOR, FULLY WELDED SEAMS. EXTERIOR, STICH WELDED.

NOTES:

6. THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION PURPOSES WITHOUT PRIOR APPROVAL OF SEPROTECH SYSTEMS INC.

REV	DESCRIPTION	DATE	BY
6	AS BUILT REVISIONS, SLUDGE PUMPS ADDED, NOTES REVISED	11MAR04	D.C.
5	STAMPED FOR CONSTRUCTION	21AUG03	B.K.
4	SNC LAVALIN REVIEW REVISIONS	20AUG03	D.C.
3	REVISED TITLEBLOCK & NOTE	17JUL03	D.C.
2	UV MODULE AND PIT ADDED, REDUCER ROTATED VERTICAL ORIENTATION	08JUL03	D.C.
1	DIMENSION ADDED, REDUCER MOTOR HEIGHT ABOVE TANK	26JUN03	D.C.
0	ISSUED FOR APPROVAL	20JUN03	D.C.

PROPRIETARY INFORMATION MAY NOT BE REPRODUCED OR DIVULGED WITHOUT PRIOR WRITTEN CONSENT OF SEPROTECH SYSTEMS INC. DO NOT SCALE. IF IN DOUBT, ASK

SEPROTECH SYSTEMS INC.
2378 HOLLY LANE OTTAWA, ONTARIO, CANADA K1V 7P1
TEL: (613) 523-1641 FAX: (613) 731-0851
Email: contact@seprotech.com Web: http://www.seprotech.com

DESCRIPTION
GENERAL ARRANGEMENT OF L333
ROTORDISK IN FULL STEEL TANKAGE

DRAWN	CHECKED	SIZE	SCALE	JOB NO.	DWG NO.	REV
D.C.	J.T.	D	N.T.S	60012	L333-163	6

PROJECT NAME: SNC LAVALIN (VOISEY'S BAY, NFLD) DATE 20JUNE03 SHEET 1 OF 1

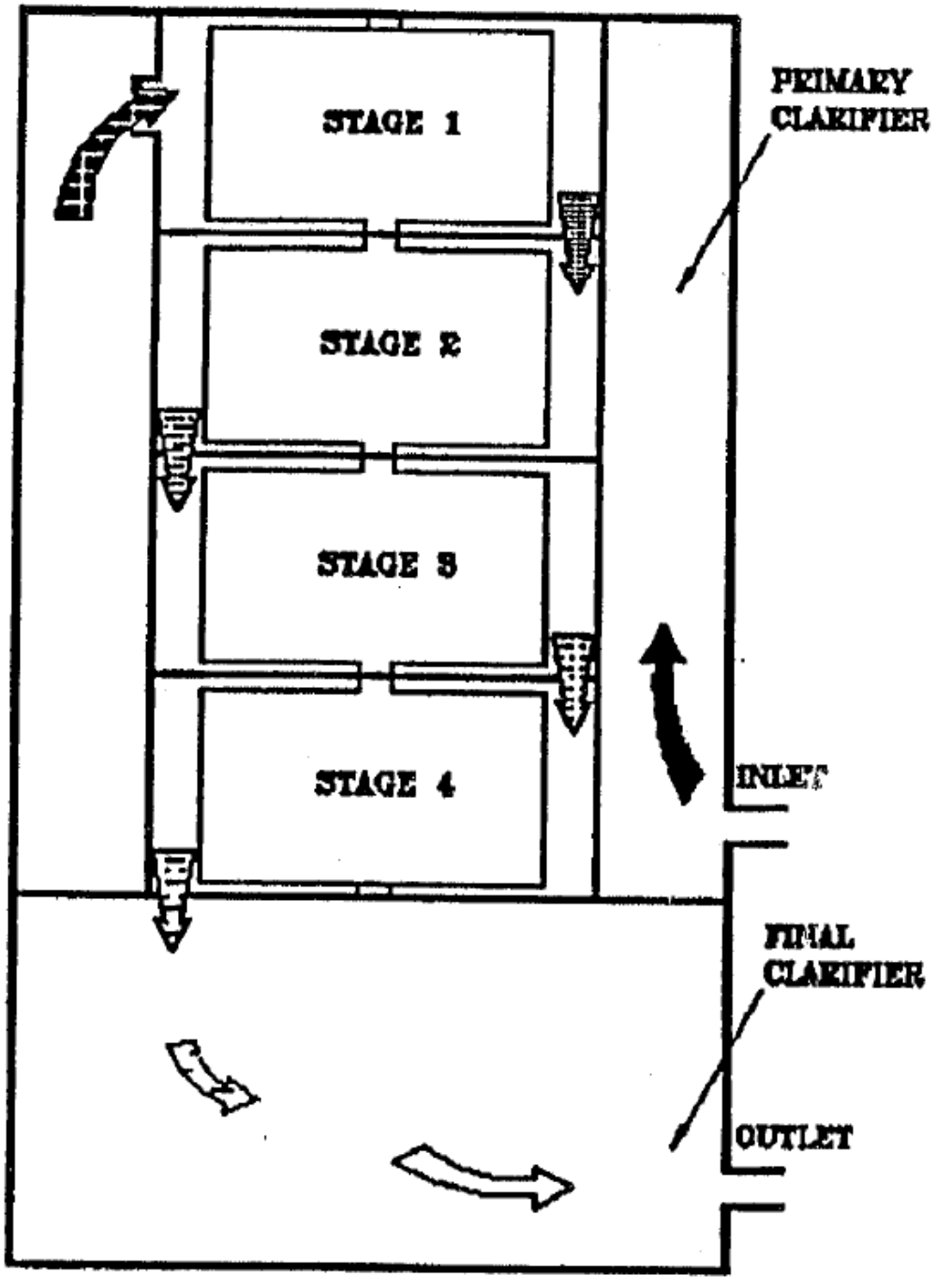


Figure 3: RBC Flow-Through System

3.2 WASTEWATER COLLECTION

All sewage and greywater generated at Meadowbank is drained by gravity pipelines to a specific lifting station, then pumped through a heat traced insulated pipeline to the STP equalization tank. The number of lifting stations, and the building they service, is provided below.

- Lifting station 1 services the greywater generated from the kitchen grease trap, laundry room, old kitchen building and shower/laundry tents; this is strictly a greywater line that connects to lifting station 3
- Lifting station 2 services the dormitory accommodations in trailer units # 1 to 11; this is the main sewage line
- Lifting station 3 services the discharge line to the stormwater management pond
- Lifting station 4 services the dormitory accommodation in trailer unit # 12; this line connects to the main line
- Lifting station 5 will service the assay laboratory once construction of the facility is completed; this line connects to the main line
- Lifting station 6 services the construction office; this line connects to the main line

As of October 2008, no lifting stations or water/sewage facilities had been constructed for the mill, power plant or service buildings. As these buildings are brought online, normal operating procedures for the STP system will be revised.

In addition to the sewage generated from the buildings above, a sewage truck picks up sewage daily from a 10,000 gallon storage tank at the exploration camp, 2 – 1000 gallon tanks and 1 – 500 gallon tank from the Nahanni office and rebar shop, and 2 – 250 gallon tanks from the NUNA trailers.

3.3 SLUDGE MANAGEMENT

As of October 2008, sludge from the STP was being transferred monthly, or as required, to the sewage lagoon in Baker Lake, with the written permission of the Hamlet of Baker Lake. The sludge is removed from the following pieces of equipment:

- Lifting station # 2
- Equalization tank
- Seprotech L333 RBC
- Both Biodisk LJ100s RBC
- Final clarifying tank

Once the installation of the plate filter press is completed, the sewage sludge will be drawn through sludge ports on the bottom of the primary settling tank on an as needed basis and pressed into solid “hockey pucks”. These pucks will be incinerated or co-disposed of in the tailings pond.

3.4 STORMWATER MANAGEMENT POND

Tear Drop Lake is a small non-fish bearing pond located south-east of the main camp facilities. It is a shallow pond that freezes to its bottom each winter. AEM has built up the depth of this pond through construction of low permeability roadways around the perimeter of the pond; these roadways operate as dikes to allow the pond to act as a stormwater management pond. During the construction phase of the project the treated sewage from the STP is pumped through a heat traced insulated pipeline to lifting station # 3 and then into this stormwater management pond. In the operational phase of the Meadowbank project all treated STP effluent and sludge will be co-disposed with the mill tailings in the Tailings Storage Facility.

The treated effluent is pumped from the STP intermittently, approximate every 10 minutes. However, the discharge at the end of the pipe is a continuous flow.

Overflow from the stormwater management pond will be pumped into the northwest arm of Second Portage Lake, if necessary, only after it meets the discharge criteria stipulated in the NWB Type A Water License 2AM-MEA0815. Details of the monitoring requirements and discharge criteria are presented in detail in the “Water Quality and Flow Monitoring Plan” prepared by AEM in August 2008.

3.5 NORMAL OPERATIONAL AND MAINTENANCE PROCEDURES

Normal operating procedures for the STP at Meadowbank are currently in development, as components of the plant and sewage collection system are still under construction. The sections below outline the general operational and maintenance procedures at the plant; further details are available in the manufacturers’ operating manuals in Appendix A (Seprotech) and B (Biodisk).

AEM recognizes that in order to keep a properly functioning STP, particular items must not be allowed to enter, or at least be minimized, in the STP influent. Two such products, and the process AEM uses to prevent or reduce these items in the STP influent, are described below.

- The kitchen at Meadowbank is equipped with a grease trap to separate and collect grease from the kitchen greywater. The grease trap is manually cleaned to keep this material out of the sewage treatment plant influent and the recovered grease incinerated.
- The camp rules and purchasing practices prohibit anti-bacterial soap products from being used on site to protect the biological activity in the RBC units.

3.5.1 Chemicals used in the Treatment Process

The dry bacteria product, BEC105, is used in the treatment process to stimulate biological activity.

3.5.2 General O&M and Sampling Procedures and Frequency

The STP at Meadowbank went into operation in May 2008. The following are the general O&M and sampling procedures that have been employed since the plant's activation; further details of the O&M procedures are provided in the operator's manuals in Appendix A and B.

Daily

A daily inspection of the sewage collection system, heat traced pipelines, and treatment plant is conducted to ensure there are no spills or incidents to report.

Inspection and sampling sheets are completed daily for each of the RBC units; these forms include:

- Daily weather observations;
- Discharge volumes;
- Dissolved Oxygen and pH measurements in the final discharge and RBC units; and
- Visual observations of the final discharge.

Example daily sample sheets are provided in Appendix C.

Weekly

Maintenance inspections and repairs, if necessary, of bearings, pumps and hoses in the STP are conducted weekly.

The dry bacteria product Bec105 is added to the equalization tank and lifting stations weekly to stimulate biological activity.

Water quality sampling of the input and final discharges from the Seprotech and Biodisk RBC units is conducted weekly. Water samples are tested for:

- Ammonia
- Biological Oxygen Demand (BOD_5)
- Faecal Coliforms
- pH
- Total Suspended Solids
- Total Phosphate

Monthly

Regular monthly maintenance of the RBC units includes applying grease to all of the bearings.

Every 6 Months

An inspection of the chain linkage in the RBC units will be conducted every 6 months and the gear oil is changed.

Annually

On an annual basis, each of the tanks will be pumped out for maintenance and cleaning purposes.

3.6 RECORD KEEPING

Records of the operational and maintenance and sampling procedures are kept daily in order to assist in the evaluation of the effectiveness of the sewage treatment plant.

The sampling sheets record, on a daily basis, the following information:

- Volume of any effluent discharged to environment;
- Sewage volume collected; and
- Details of any maintenance undertaken at site.

The record sheets are stored securely in the Sewage Treatment Plant office.

3.7 SAFETY PROCEDURES FOR OPERATORS

Employees working in the STP facility must be trained prior to commencement of work so that they are aware of the health and safety risks associated with the STP. The following two absolute points of compliance are part of that training:

- No person is to drink the water in the plant or the water that is discharged from it; and
- Working with sewage requires adequate protection for operators. This includes wearing steel toed boots, hard hat, safety vest, protective goggles and protective gloves.

All authorized personnel working in the STP must have received their Twinex Hepatitis A/B vaccine.

Regular hand washing stations and an emergency eye wash station have been installed in the plant for use in the event of accidental contact with unprotected hands or face due to splashing or other cause.

3.8 CONTROLLING ACCESS TO STP

Access to the STP at Meadowbank is restricted to authorized personnel only. All doors to the plant are locked, with only authorized persons having keys. Signs are posted on the STP entrance doors notifying all people that the entrance to the STP is for authorized personnel only. Failing to comply with this restriction is grounds for termination.

No fencing is used to control access to the STP. Due to the remote nature of Meadowbank, there is no concern of non-mine personnel attempting to access the site.

SECTION 4 • EMERGENCY RESPONSE

4.1 FIRE

In case of fire at the STP, the on-site emergency response team would be notified as per AEM protocol. Instructions from the on-site emergency response team would be followed by all personnel at the STP. Further details of fire response are provided in the "*Emergency Response Plan*" prepared by AEM in October 2008.

4.2 SPILL

In the event of a spill at the STP, the on-site emergency response team would be notified as per AEM protocol. Instructions from the on-site emergency response team would be followed by all personnel at the STP. Further details of spill response are provided in the "*Spill Contingency Plan*" prepared by AEM in August 2008.

4.3 PLANT MALFUNCTION

An overflow tank will be installed in the fall of 2008. This overflow tank would be connected to the Seprotech L333, both Biodisks, equalization tank and lift stations 2 and 3; in the event of an issue at the plant, this overflow tank would be capable of accepting overflow from the system for up to 24 hours.

The following contingent measures can be applied by AEM in the event of an RBC malfunction at the Meadowbank Sewage Treatment Plant for more than 24 hours:

- Cut back on allowable camp water until the malfunction is corrected and use the equalization tank to retard the peak flow to the remaining RBC unit;
- Shut down the malfunctioning RBC unit until the malfunction is repaired and use only one of the two parallel units until repairs are completed; and
- Shut down all water use in the camp until the repairs are complete.

By passing untreated STP influent around the malfunctioning RBC unit and holding this untreated influent in a holding tank or lined pond on site until the repairs are complete is another contingent measure that could be applied. The untreated sewage would then be pumped back to the STP when the unit is repaired. This will require the coincidental restriction of water use to minimize the volume of untreated influent being bypassed.

No untreated sewage will be trucked to the Hamlet of Baker Lake for disposal in the Hamlet's sewage treatment lagoon without the written consent of the Hamlet Council. It is assumed that such consent would not be given without due consultation with the Hamlet and its elected representatives. Under winter conditions this is an unlikely option due to the 2 hour road distance between the Meadowbank site and the Hamlet of Baker Lake.

Appendix A

Seprotech Operation and Maintenance Manual

Seprotech Systems Incorporated
2378 Holly Lane, K1V 7P1
Ottawa, Ontario, Canada
Telephone (613) 523-1641
Fax (613) 731-0851

INSTALLATION, OPERATION AND MAINTENANCE

MANUAL

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IMPORTANT: READ THIS INSTALLATION PROCEDURE PRIOR TO START-UP.

1.0 SITE INSTALLATION OF ROTORDISK® SEWAGE TREATMENT PLANTS:

IMPORTANT: READ THIS INSTALLATION PROCEDURE PRIOR TO START-UP.

1.1 - Concrete Tankage for ROTORDISK®

If the ROTORDISK® unit supplied is to be encased in concrete tankage, the site preparation is as follows:

The unit is lowered into the concrete tankage, the pipe at the end of the unit is placed into the opening of the intermediate wall between the primary and final settlement chambers and lowered onto the anchor bolts (contractors supply).

Unit is to be lifted only at lifting points by use of hooks and spreader bars.

All anchor bolts (contractors supply) should be correctly located in concrete in a vertical position. In addition, all bolts should include a levelling nut.

All anchoring and levelling of ROTORDISK® unit on site is to be done by customer/contractor. When the unit is set onto the anchor bolts in the concrete tank, it must be levelled to a slope of no more than 3/4" in 20' along the length. The unit is then centred in the tank and completely bolted down.

After the unit has been bolted down, check alignment of shaft and sprockets and clearances of couplings where applicable prior to start-up, failure to do so may void manufacturer's warranty. Refer to this ROTORDISK® manual for details. If required, the contractor must perform levelling.

All hydraulic piping, to and from the unit, is to be supplied and installed by customer/contractor.

All input electric and hydro hook-ups to be done by customer/contractor to local governing regulations and a signed approval sent to SEPROTECH SYSTEMS INCORPORATED. Under no circumstances must electrical connections, junction boxes or equipment pertaining to the electrical function of the unit be installed in the ROTORDISK® tank.

SEPROTECH SYSTEMS INCORPORATED will supply a man on-site to assist customer/contractor at a specified rate and at customer/contractor discretion.

If unit is not shipped completely assembled assembly instructions and drawings will be supplied. (As shown)

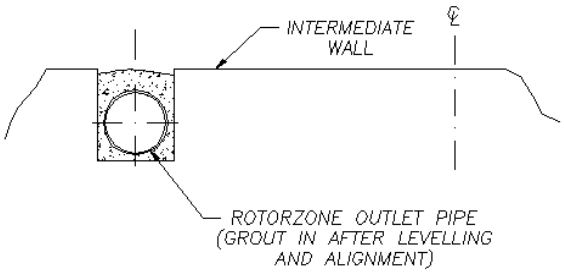


Figure a - **ROTORDISK®** tank outlet through intermediate wall between settlement tank chambers.

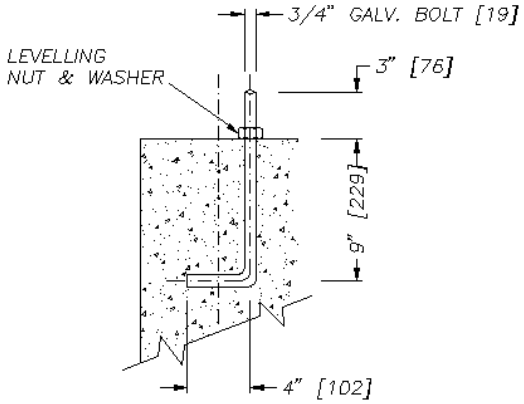
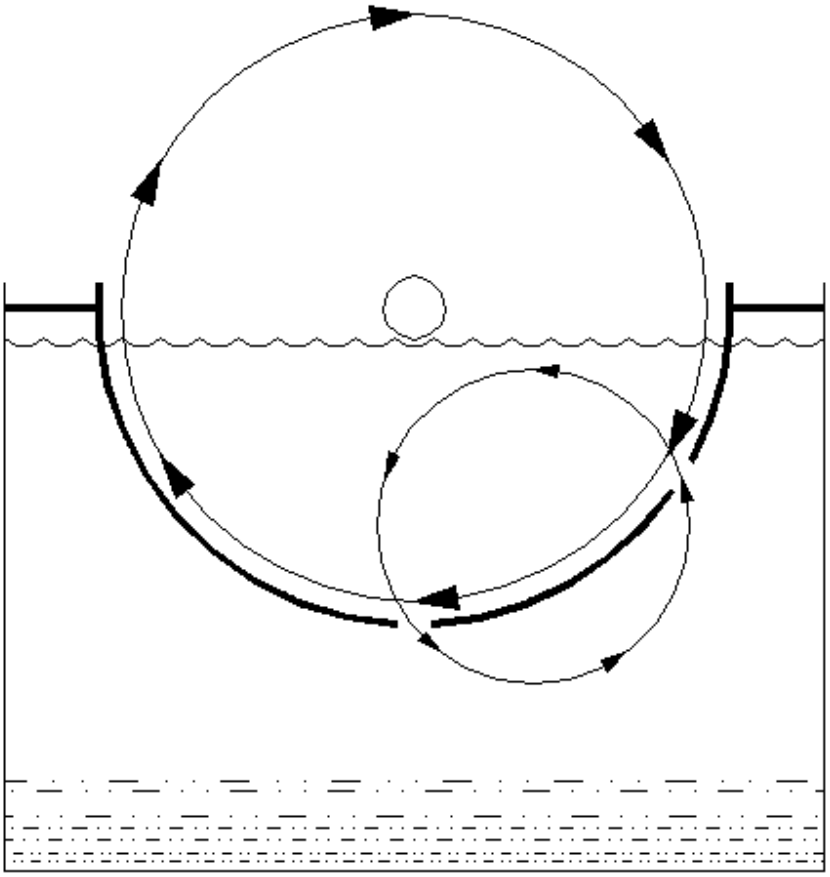


Figure b - anchor bolt detail for **ROTORDISK®** tank.

1.2 - DIRECTION OF SHAFT ROTATION



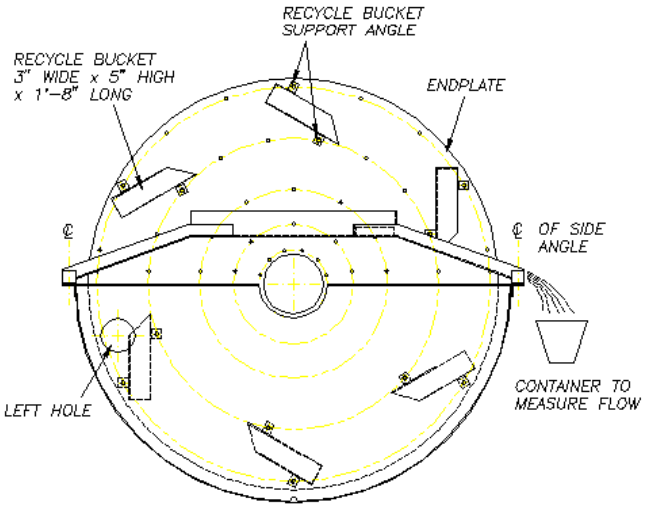
The direction of shaft rotation should be such that disks mounted on shaft will enter water on the side where inlet to "Rotorzone" is located. The electric motor driving the shaft should be wired accordingly.

1.3 - RECYCLE for ROTORDISK®

1.4.1 Recycle buckets are mounted on the last stage of the ROTORDISK®. These buckets rotate at the same speed as the disks. See the attached elevation view of the recycle buckets and trough on the Rotorzone tank.

1.4.2 As the disks rotate, the buckets scoop-up treated wastewater. As this wastewater falls into the recycle trough, it is exposed to the atmosphere, where it absorbs fresh oxygen. The wastewater then cascades on one side of the trough through a narrow steel channel and mixes back with the contents of the Primary Clarifier, thereby introducing fresh dissolved oxygen in the Primary Clarifier. See the section of diskbank assembly showing buckets and recycle trough.

1.4.3 The set-up described above is comprised of the recycle buckets and recycle trough, is what we term as our D.O. re-circulation device. This is especially advantageous to preventing septic conditions from occurring in the Primary Clarifier in small flow or low flow situations.



SECTION OF DISKBANK ASSEMBLY SHOWING 6 BUCKETS AND RECYCLE TROUGH

1.4 - SUMMARY OF OPERATION

(ROTORDISK® systems designed for BOD/SS/Ammonia/Nitrate removal)

The sewage plant (as supplied by SEPROTECH SYSTEMS INCORPORATED) is comprised of three (3) main components: the primary settling tank, the RBC tank, and the secondary settling tank.

Raw sewage is pumped and/or gravity flows into the primary settling tank (PST). When the sewage is pumped into the plant, pumping must simulate conditions encountered in gravity fed systems. Indeed, over a 24-hour period, the plant is designed to handle a flow rate corresponding to the Average Daily Flow (ADF) and can accommodate for two Peak Daily Flow (PDF) periods of two (2) hours per day. Each PDF event can be at a maximum of three times ADF.

In the PST, sedimentation separates heavy solids from the bulk of the liquid and the supernatant enters the aerobic section through the inlet slot located at the front section of the RBC tank.

The aerobic section is made up of four stages. The 1st stage is mounted on one common shaft. This 1st stage is comprised of one (1) to three (3) disk banks. The normal colour of the bacteria in the 1st stage is dark brown. This is the stage where most of the BOD removal by biological oxidation occurs. The succeeding 2nd, 3rd, and 4th stages are mounted on the rest of the shaft or another common shaft. Each stage has one (1) to three (3) disk banks. It is in the 2nd stage that further BOD is removed, and if the BOD is removed to approximately 30 mg/l, nitrification will follow. As such, in the 3rd stage, nitrifying bacteria (those which convert ammonia (NH_3) in the form of ammonium ions (NH_4^+) into nitrite (NO_2^-) and, ultimately, nitrate (NO_3^-) predominate in the 3rd and 4th stages. The 4th and last aerobic stage has recycle buckets that introduce both fresh dissolved oxygen into the primary settling tank and nitrifying bacteria present in the recycled water.

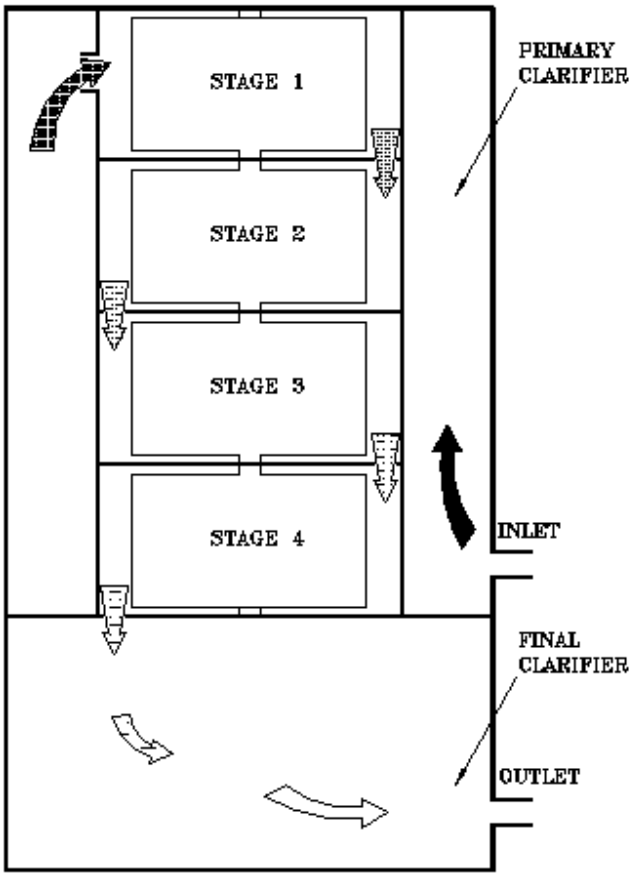
The rotation of the disks in and out of the water provides a mean of air and heat transfer from the ambient air to the water. The transfer of air to the water is important for aerobic bacteria to remove BOD and ammonia. The transfer of heat to the water is important to maintain the water at an optimum temperature of 15 °C and above such that BOD and ammonia removal rates by the bacteria are maximized (removal rates are a function of the water temperature). Because maintaining a temperature that provides acceptable removal rates is important to the process, RBC's are installed indoors and ambient air is maintained at 15 °C and above.

In the secondary settling tank, remaining suspended solids as well as sloughed off biomass from the disks settles and is pumped to the primary settling tank via sludge return pumps.

Chemical dosing of alum facilitates the coagulation and flocculation of aluminium phosphate resulting in the removal of phosphorus. Sodium bicarbonate can be used to maintain the pH balance throughout the process.

2.0 - ROUTINE VISUAL CHECKS ON PHYSICAL AND BIOLOGICAL FUNCTIONING OF ROTORDISK® & DESCRIPTION OF TREATMENT PROCESS

ROTORDISK® sewage treatment plants have three major steps in the purification process. In the primary settling tank, gross solids separate from the flow by either sinking or floating. In the Rotorzone, dissolved pollutants are broken down to simple, non-pollutant compounds by the bacteria ("biomass"), which grows on the rotating disks. The final settling tank permits gravity separation of spent biological growth, which continually sloughs off the disks in the Rotorzone preceding it.



2.1 - PRIMARY SETTLING TANK (PST OR PRIMARY "CLARIFIER")

The accumulation of floating scum on the surface of the primary clarifier is normal. It is proportional to the accumulation of settleable solids at the bottom of the tank. Periodic (9-12 months) removal of sludge at the bottom of the tank is required for proper operation of the Unit.

If no sludge, measuring device is available; the accumulation of 9"-12" depth of scum on the surface is a good indication that it is time to remove the accumulated deposits of sludge from the bottom of the tank(s).

2.2 - ROTORZONE

The Rotorzone is subdivided into four sections, with disk banks in each. The wastewater first enters the Rotorzone in the section marked "1" in the sketch (furthest away from the inlet to the plant). The flow then proceeds through sections 2, 3, and 4 before entering the final settling tank.

The accumulation of biological growth will be greatest in section 1, and gradually decrease through subsequent sections. Generally, the growth will be thick, and often filamentous ("stringy"), in section 1, becoming thinner and more compact through sections 2-4.

The colour of the growth will typically be dark brown to black in Section 1. Some grey growth may also be noticed, depending on the relative load and type of wastewater being treated. Growth in sections 2-4 will typically vary from medium brown to a light brown or tan growth in section 4.

In a well-functioning unit with the appropriate feed of wastewater, there will be an earthy, humus-like ("musty") smell inside the unit. A substantial sour, "sewage" smell may be an indication of sub-optimal conditions in the treatment process.

2.3 - 'BATHTUB RING'

The wastewater flows by gravity within a ROTORDISK® Plant thus the water level is relatively constant. Changes in water level of 1" to 2" are not unusual due to surge flows entering the unit. The evidence of this is a 'bathtub ring' 1" - 2" above the normal level. A 'bathtub ring' higher than this, suggests partial or complete flooding of the unit has occurred since the last check. If so, the (gravity or pump) discharge system should be checked for blockages or mechanical malfunction. Another condition, which can lead to the level of water rising to levels greater than 1" – 2"; is if the plant is fed by pumps, which exceed, the design limits of the plant (i.e., ADF over a period of 24 hours including a maximum of two (2) PDF events no longer than 2 hours each).

2.4 - FINAL SETTLING TANK (FST OR FINAL "CLARIFIER")

The effluent near the outlet at the backside of the final clarifier should be relatively clear and colourless and relatively free of suspended matter. Clarity can best be judged by scooping a small volume of the final effluent into a clear glass container. This is particularly true of larger units where the depth and dark colour of the tank walls may make clarity hard to determine. (Note: Although the risk of infection is very small, the wearing of rubber gloves is a rational safety precaution when hand-scooping the effluent for a clarity check. This is particularly true if there are open cuts on the hands.)

Although the final effluent itself should be relatively clear, some floating matter may accumulate on the surface of the final clarifier. This is normal, and will typically be much less than the accumulation of floating scum in the primary clarifier.

2.5 - MONITORING OF DISCHARGE FLOW RATE

The plant is equipped with a flow meter located on the influent pipe. This instrument is equipped with a counter that allows tracking of the total volume of clean effluent discharged by the plant.

2.6 - OPERATING PARAMETERS ADJUSTABLE ON THE CONTROL PANEL

Sludge pumps should be set to operate for 15s every 3h. Making changes and adjustments to the default plant's operating parameters requires a good understanding of the wastewater treatment process and should therefore only be performed by qualified and trained staff. Please contact SEPROTECH SYSTEMS INCORPORATED if assistance is needed to optimise the operation of the plant.

2.7 - FREQUENCY OF INSPECTION

Visual checks every week should be sufficient. However, for better preventative maintenance of the wastewater treatment plant and thus the capital investment, a daily walk through is often the preferred frequency of visit. Many owners prefer the visual and audible (look and listen) walk through. A standard operator checklist should be prepared and used by the person responsible for periodic maintenance of the plant at every visit. SEPROTECH SYSTEMS INCORPORATED can assist in preparing such checklist upon request.

3.0 - STANDARD RECOMMENDATIONS AND PROCEDURES FOR SLUDGE REMOVAL

3.1 - STORAGE CAPACITIES

A design feature of ROTORDISK®, which contributes greatly to overall simplicity of the process, is the sizing of clarifiers to accommodate static internal sludge storage for extended periods. Depending on such factors as raw wastewater solids concentrations, and design organic loading in a given application, maximum sludge storage levels will typically be reached in 6-9 months of operation.

This period is based on calculated rates of initial decomposition of raw and biological solids, and, upon operating experience, indicating the degree of auto-digestion/compacting, which proceeds during the storage period. The 6-9 month period will be shortened to the extent that design hydraulic and waste loads are exceeded. It will be lengthened to the extent that flows and waste load are less than those designed for.

3.2 - DETERMINATION OF ACCUMULATED SLUDGE VOLUMES

The accumulation of maximum storage capacities can be indirectly monitored through visual observation of the thickness of the scum blanket on the surface of the primary clarifier. When the scum blanket has matured to a height of approximately 7"-10", this is a good indication that sludge accumulations at the bottom of both clarifiers are at or near maximum levels, and that sludge withdrawal is indicated.

A more accurate procedure of determining sludge levels is to directly measure actual accumulations, and compare these to the maximum storage capacities listed on the "Details" section of the general arrangement drawing for the ROTORDISK® model in question.

A variety of sludge measuring devices is commercially available. The two most common are the weighted hollow tube type, and, the (electronic) turbidity-change detector type. The former is less

costly, relatively easy to use, and more appropriate because of the low frequency with which measurements need to be made in a ROTORDISK® unit.

Whatever means of measuring the sludge may be selected; it must be kept in mind that the sludge is not a firm solids substance. Domestic wastewater sludge is mostly trapped water and other liquids. Only to determine sludge levels by "feeling" for a solid layer with a stick or pole. The settled sludge is far more liquid than the surface scum, which is perhaps 30-40% solids, by volume.

Irrespective of the type of device used, sludge levels should be measured at several locations in each settlement tank to ensure a reasonably accurate calculation of accumulated volumes. This is required since sludge accumulation levels are not uniform; being highest at the inlet ends of both clarifiers, and, below the slot at the bottom of the first section of the Rotorzone trough.

Once an average sludge height has been determined, multiply by the surface area of the clarifier in question to determine the existing volume of stored sludge. Compare to maximum design capacity listed on the general arrangement drawing. If the accumulated levels equal or exceed design values, it is time to remove the sludge from the unit.

3.3 - SLUDGE REMOVAL

A pump-out truck of the same type that pumps out septic tanks normally does the sludge removal. For smaller ROTORDISK® units, the entire liquid contents of the treatment plant can be withdrawn. For larger installations, the haulage contractor should be instructed to get the suction hose directly to the bottom of the tanks and withdraw the sludge only, while taking as little of the supernatant as possible. Once the primary sludge is withdrawn from the primary settlement tank, the supernatant of the secondary clarifier can be transferred to the primary settlement tank to expose the secondary sludge. The suction hose should be placed down at a multiple number of points to help ensure complete removal of accumulated sludge deposits. Floating surface scum should also be removed. Haulage contractors should be given a brief description of the unit and its operation if they are not already familiar with it. A particular point to emphasise is that the biological growth on the disks should not be washed off, but should be left in place. The exception to this is if the disks have accumulated excess biomass due to sludge pump out being delayed past the indicated intervals.

Sludge removed from the unit is normally hauled away by the pumping truck and disposed of at municipal facilities, or, by controlled spreading on farmland. On-site disposal in shallow trenches and/or some form of on-site volume reduction (prior to export) may be feasible or desirable depending on the specific opportunities and limitations afforded by the site of a given installation.

3.4 - POTENTIAL CONSEQUENCES OF OPERATING ROTORDISK® UNITS PAST DESIGNATED MAXIMUM SLUDGE STORAGE LEVELS

Sludge accumulations should be removed once they reach indicated maximum storage levels, because failure to do so could result in lowered treatment efficiency, and possibly cause serious damage to the structure of the Rotating Assembly and drive unit. The potential for problems is as described below and depicted in the attached sketches.

Figure (c) shows a unit operating with sludge build-ups at or near maximum storage levels. This will cause no problem since the storage heights are designated so that flows through the primary clarifier will not disturb the sludge layer. Characteristics of wastewater reaching the Rotorzone at this time (and since start-up) will be in the range of 180-200 mg BOD/1 and 50-250 mg SS/1. The

supporting structure of the rotating assembly is over designed for the amount of biological build-up which will occur on the disks under this operating condition, and the shear force of the rotation through the trough water will limit the thickness of growth.

However, if sludge is allowed to accumulate past designated storage heights, flow through the primary clarifier will begin to disturb the sludge blanket, and thus carry loads of solids and dissolved organic matter into the Rotorzone which are not anticipated in the design of the unit (Figure d). The pollutant load reaching the biomass on the first stage of disks will overload that biomass (in terms of F:M ratio), and force a change in its activity and growth. The biomass becomes more gelatinous, and does not shear off as well with disk rotation. Additionally, the biomass will readily adsorb and entrap the extra solids with the sum effect being an increase in weight on the rotating assembly that considerably exceeds that which its design is based on.

This tendency reaches its extreme if sludge is allowed to accumulate to the point where it will be disturbed by-, and caught up in -, the re-circulation pattern created by the two slots in the trough on the first section of the Rotorzone (see Figure e).

The sludge will have characteristics in the order of 20,000 mg TSS/1 and 10,000 mg BOD/1, so it is obvious that even a minor amount of this material caught up in the re-circulation flow will significantly increase the concentration of the waste stream entering the Rotorzone. If, for example, the sludge was caught up in the recycle flow at a ratio of as little as 1:10 or 1:15, the resulting concentration would be sufficient to produce a considerable first-stage overload on an amount of disk area selected based on normal concentrations.

The resulting build-up of poorly-shearing gelatinous biomass and trapped solids would pose a serious potential for strain on the drive unit, and for structural damage to disk bank assemblies and shaft, in spite of them being considerably over designed for loads anticipated in normal operation.

Clearly, these potential problems should be avoided by the removal of sludge once it reaches the level specified as maximum for the ROTORDISK® unit in question.

3.5 - FRONT VIEW SCHEMATIC OF ROTORDISK®

UNIT OPERATING AT-, AND ABOVE-,
RECOMMENDED MAXIMUM SLUDGE STORAGE LEVELS

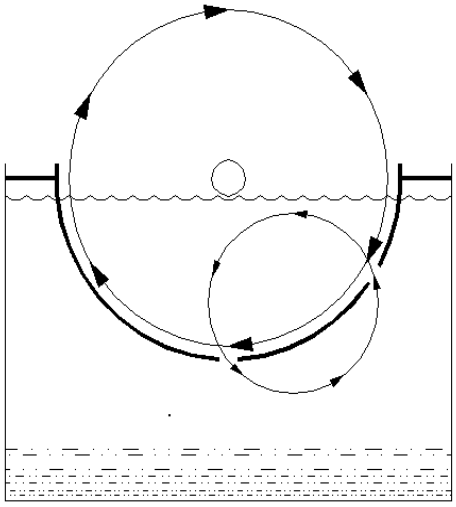


Figure c-unit operating at maximum sludge storage levels. Neither influent flows, nor re-circulating flows, disturb sludge blanket.

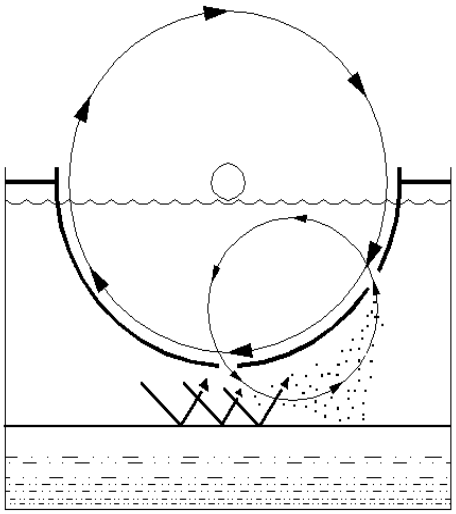


Figure d- unit operating with excess accumulations. Influent flows may disturb sludge blanket and increase BOD and solids loads to Rotorzone to levels above treatment design.

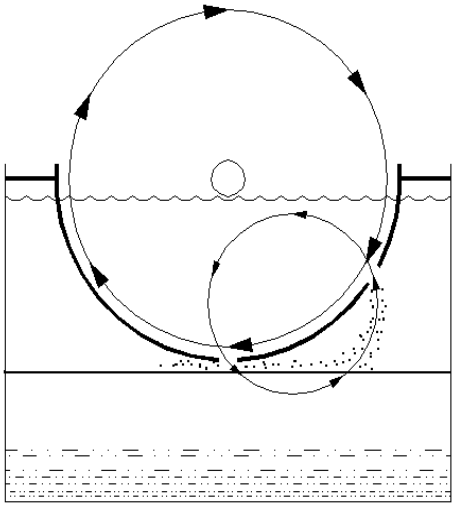


Figure e-Unit operating with excess sludge accumulated to base of Rotorzone. Both influent flows and re-circulation flows will disturb and carry sludge solids. Increase in BOD and solids loads entering Rotorzone will be substantially above design treatment levels, increase accumulated masses on rotating assembly, produce potential for damage to structure and drive unit.

3.6 - PUMPOUT PROCEDURES FOR ROTORDISK® TREATMENT SYSTEMS (summary)

Using suction hose, floating or surface scum should be removed first. Place the suction hose directly to the bottom of the tank and withdraw sludge only, while taking as little as possible of the volume of waste liquid above the sludge blanket (supernatant).

Move the hose at a multiple number of points along the bottom of the settlement tanks. Do not wash off biological growth (biomass) on the disks. The exception to this is excess accumulated biomass on the disks due to an overdue sludge pump-out. Excess accumulated biomass is when a disk bank is 100% fully covered with biomass and the colour is grey with a slight odour.

Keep a record of all pump-outs to arrive at an actual normal operating interval for sludge pump-outs. For systems with several flow meters, it is also beneficial to note the total flow generated between pump-outs.

3.7 - START-UP PROCEDURES OF ROTORDISK®

WARNING: A VALVE LOCATED AT THE BOTTOM OF THE DENITRIFICATION TANK AND EQUIPPED WITH A REMOTE ACTUATION MECHANISM WAS PROVIDED WITH YOUR UNIT. THIS VALVE:

- Needs to be OPEN: when the plant is first filled with water, during draining if the plant ever requires such operation and during subsequent refilling operations. FAILURE TO OPEN THIS VALVE DURING FILLING AND DRAINING WILL RESULT IN SERIOUS DAMAGE TO THE PLANT. This is because, during a filling operation, the water rising in the PST would push the denitrification tank upwards while it is empty (this tank wouldn't have had a chance to fill with water until the water level reaches the inlet slot between the PST and the aerobic ROTORDISK®. Th open valves provide a mean of filling the PST and the through (denitrification tank included) at the same time.

- Needs to be CLOSED: during normal operation of the plant. Indeed, the denitrification section contains water already partly treatment thus this water and that contained in the PST shouldn't mix. FAILURE TO CLOSING THIS VALVE DURING NORMAL OPERATION OF THE PLANT WILL RESULT IN A POOR QUALITY EFFLUENT.

The ROTORDISK® sewage treatment plant is based on a fixed film treatment process referred to as the Rotating Biological Contactor (RBC). In this process, micro-organisms or bugs are attached and grown on the surface of a media, the quantity of bugs being directly proportional to the amount of food in the wastewater. When starting up a new system, it will normally take about two weeks to get organic removal from the wastewater and three to four weeks to establish the nitrification process at normal domestic sewage temperatures. The method of and effluent discharge during system start-up should be discussed and thoroughly communicated with the environmental authority. The primary sedimentation tank and RBC of the system should, preferably, be filled with fresh water before admitting wastewater to the system. A flow less than design is not a problem. The biomass will develop themselves on the media. If there is a small flow only a portion of the disk will have biomass. As the flow increases the amount of biomass will increase.

Seeding a ROTORDISK® with activated sludge, although not required, can be accomplished. The activated sludge should be at the same temperature as the influent. Sudden changes in wastewater temperature cause biomass sloughing. In most cases, the use of domestic waste as a seed culture has provided the required biomass for continuous operation. When seeding the ROTORDISK® with activated sludge is decided, the primary sedimentation tank and RBC of the system should first be filled with fresh water (preferably) and the activated sludge added to the RBC. The RBC should be rotating at all times. The wastewater introduced to the tank needs to have only 20% of the disks covered with waste. This can already provide the needed wetting and still provide some time to reach normal operating levels when source flow is introduced. The final clarifier does not need to be filled with anything.

Alternately, seeding can be accomplished using dry bacteria and a source of organic carbon such as raw molasses or sugar. This can be done, for example, in situations where wastewater or activated sludge are not available and the plant needs to be ready to treat wastewater very shortly after it begins receiving it. By simulating the conditions encountered in wastewater (where large amounts of organic carbon and bacteria are present), biomass will establish on the ROTORDISK® and the plant can thus be prepared to work under actual conditions before these are actually encountered. SEPROTECH SYSTEMS INCORPORATED can help find appropriate supplies of both dry bacteria and raw molasses.

The preferred start up is the introduction of source wastewater at design or less than design loading. The disks need to be rotating at all times. When the disks are rotating and wastewater is introduced the biomass will develop and the pollutants will be removed.

The practice of starting up a sewage plant with a charge of septage or activated sludge may be appropriate for suspended growth systems where sludge return is an essential and necessary part of the process. However, start-up with septage is not an appropriate practice for fixed film systems such as the Rotating Biological Contactor process and is not recommended. This is especially true of the ROTORDISK® process and its static, internal storage of sludge.

Studies have shown that the natural start-up time for a ROTORDISK® is 2 1/2 – 3 weeks (normal temperatures and BOD reduction only), and that it has already developed sufficient biomass for 50% removals in only 1 week. These are time frames significantly shorter than respective ones for suspended growth systems. Thus there is little rationale for “pre-starting” a ROTORDISK® unit with septage.

Further, septage contains solids that are already well digested, and therefore not subject to further digestion-compaction in the storage zones. This contrasts to the fresh solids, which will undergo considerable digestion-compaction in the 6 – 9 months after initial settlement. Therefore, a charge of septage would contribute disproportionately to the accumulation of sludge levels, and necessitate a shorter interval to the first pump-out of the unit.

The ROTORDISK® concept of static sludge storage contributes greatly to its overall operation and maintenance simplicity. Following the above guidelines and recommendations will help ensure that the trouble-free simplicity of ROTORDISK® is maintained.

4.0 - STORAGE OF ROTORDISK® SEWAGE TREATMENT EQUIPMENT

If the unit is not to be operated for an extended period, then the motor-reducer assembly (drive unit) should be removed from its mound and stored at room temperature in a reasonably dry area (unless the whole unit is being stored in such an area).

Additionally:

1. Reducer: The input shaft should be given several turns once a month to re-lubricate the upper bearings.

NOTE: Some reducers are shipped to site filled with synthetic lubrication. Otherwise, fill the reducer with the lubricant (see reducer section of installation & maintenance instructions).

2. Motor: The motor has a tendency to take on moisture when not in operation. It requires no attention during storage, but before it goes into operation the insulation should be measured using a Meger. It should be at least 1.0 mega-ohm. If below 1.0 mega-ohm, it has taken on excessive condensation, and must be dried out before being operated. (Note: any electrical contractor or repair shop commonly understands these terms and procedures).

3. Support bearings on main ROTORDISK® shaft(s) should be re-lubricated prior to start-up.

4. The system should not be installed and operated in water. In the absence of sewage inputs and normal biological activity, freezing and consequent mechanical damage would be a distinct possibility. Water level in the primary settlement tank to be dropped to below the bottom of the Rotorzone tank level, if freezing of the tank contents is possible.

5.0 - ASSEMBLY PROCEDURE OF ROTORDISK® COMPONENTS SUPPLIED BY SEPROTECH SYSTEMS INCORPORATED

1. Upon receipt of mechanical components:

   a. Check packing list for any missing items on delivery.

   b. Motor/Reducer is shipped loose, for assembly on the reducer flange. The reducer is shipped completely filled with synthetic lubricant.

   c. Bearing components are shipped as a set. Open only when ready for assembly to avoid moisture contamination.

   d. Chain and sprockets are shipped as a set. Check for the following:

   -Large sprocket bushing (O.D.) fits into the large sprocket bore.
   -Large sprocket bushing bore (I.D.) fits the Rotordisk® shaft drive end.
   -Small sprocket bore (I.D.) fits on the reducer output shaft.
   -Cottered chain fits or matches the teeth on the sprockets.

   e. Coupling (applicable only to split-shaft ROTORDISK® is shipped as a set. Check the coupling hubs to ensure they fit the center stub ends of the ROTORDISK®shafts.

f. Disk banks are shipped pre-assembled on the shaft by SEPROTECH SYSTEMS INCORPORATED and are shipped on A-frames. Handle with care, as the Fiberglass of the disk banks is brittle.

g. Hardware (bolts, nuts, washers) for mounting the following items are provided:

-Bearings
-Reducer
-Recycle trough

2. If, for any reason, the diskbanks must be removed from the shaft, the procedure for remounting them is as follows:

If disk banks are 5 ft. in diameter or larger (supplied in semicircular sections)

Mount them on shaft(s) as shown on Dwg.# GL-28D, with 1/2-20NFX1-1/2 Bolts. Connect two half sections with two connecting plates (see sketch of typical mounting details) Remove outer nuts on required tie rods, fit connecting plate on tie rods over the end plates, then fasten them together with nuts and washers.

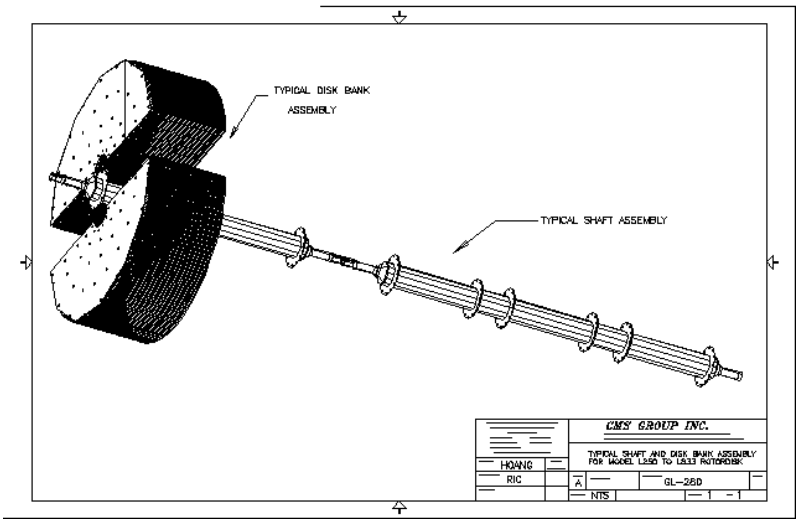


Figure f - typical mounting of disk banks on the shaft(s).

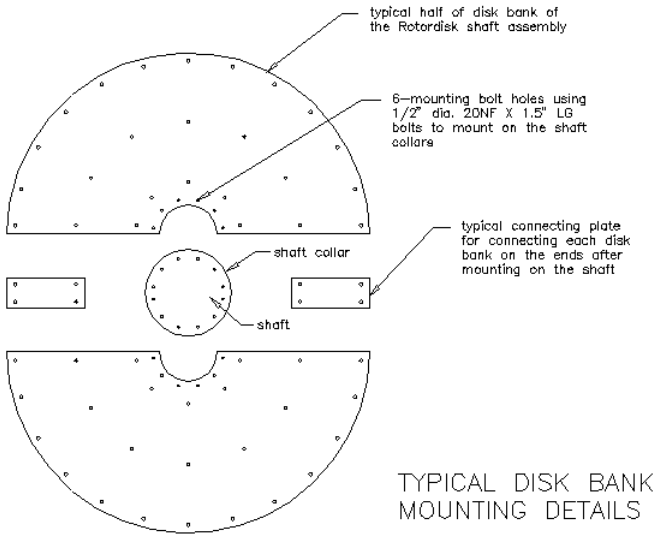


Figure g - exploded view of disk bank mounting parts.

3. Mount Bearings on Shaft(s).

   a) Bearing should be mounted at the centre of stub end. Follow bearing manufacturer's installation instructions.
   b) Use of the bearing fixing rings: one bearing of each pair is "fixed", the other "floating". Install the fixed bearing on the drive end of the shaft and the floating bearing on the non-drive end.

NOTE: All bearings mounted on tapered sleeves have to be driven up the taper to the tolerances given in the manual, using a bearing locking tool or equal. See installation, operation and maintenance instructions section of this manual regarding bearings.

4. Mount coupling hubs on their respective shafts (if applicable) so that hub face is flush with the end of its shaft (for direct drive and 'L' models). See installation, operation and maintenance instructions section of this manual regarding couplings.

5. Install shaft(s) in ROTORDISK® tank.

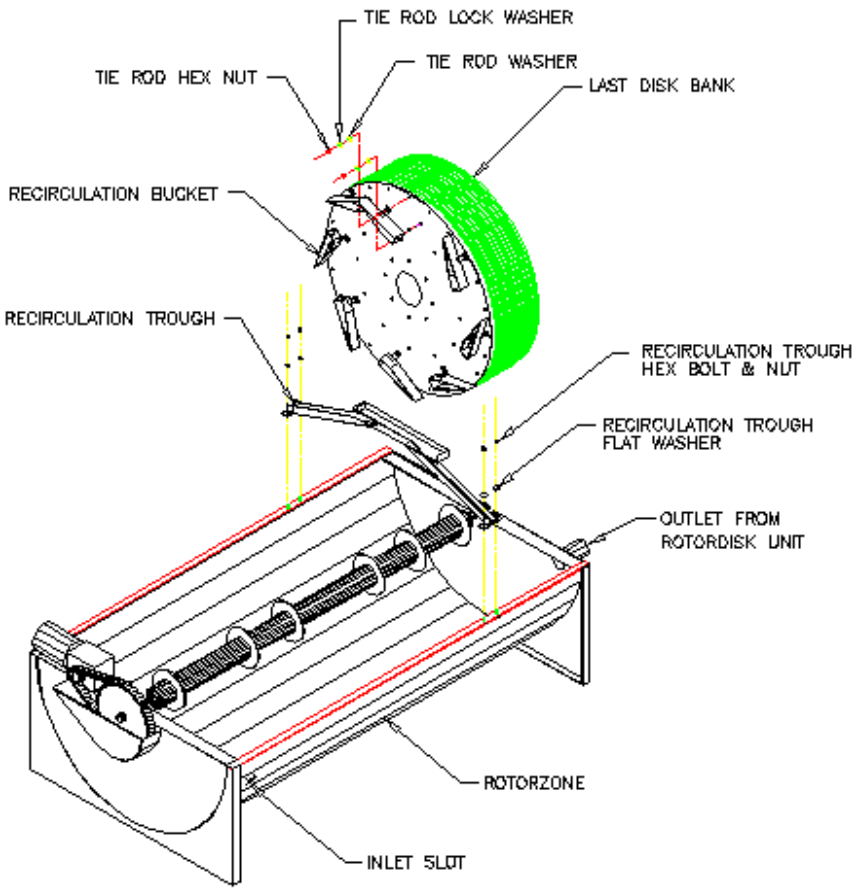
6. Mount small sprocket/coupling hubs on reducer output shaft (whichever is applicable).

7. Install Reducer-Motor Assembly in place. The reducer comes completely filled with synthetic lubricant. Ensure that the breather plug (mounted on top of one of the reducer oil intake ports) is installed on the reducer, after it is mounted on the ROTORDISK®. It is recommended that the motor be mounted into the reducer prior to assembly into the ROTORDISK® tank. Allow for some play in the reducer mounting bolt tightness so the chain tightness can be adjusted later.

8. Connect sprockets with chain. Check the axial alignment of the sprockets while tightening the chain. Tighten the previously loosened reducer mounting bolts after the sprockets are aligned and set in place. See installation, operation and maintenance instructions section of this manual regarding roller chain drives.

9. Connect two coupling hubs, grease, and fit coupling cover (if applicable). Before mounting, check bore on both hubs to match the shaft diameter. See installation, operation and maintenance instructions section of this manual regarding couplings.

10. Mount the stainless steel recycle trough on the ROTORDISK® tank with the bucket opening points to the proper rotation of the shaft.



NOTES:

1. Follow manufacturers instructions in the "Installation, Operation & Maintenance Manuals" included by SEPROTECH SYSTEMS INCORPORATED for mounting bearings, couplings (if applicable), reducer, sprockets and chain (if applicable).

2. Make sure all setscrews on sprockets and coupling hubs; bolts on reducer and bearings, are all well tightened before machine goes into operation.

6.0 - ROUTINE MECHANICAL MAINTENANCE OF ROTORDISK® SEWAGE TREATMENT PLANTS

6.1 - 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

6.2 - REDUCER:

Reduction gear on ROTORDISK® units is 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.

6.3 - BEARINGS:

Lubricant will deteriorate in time and rate of deterioration is a function of the operating conditions encountered. Lubrication cycle can be determined by analysing the samples taken near the bearing. See bearing manufacturer's maintenance instructions.

6.4 - 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^{o} to 100^{o} F is recommended).
- Milky white colour of the oil is indicative of flooding. Replace oil and determine the cause of the flood.
-Check Chain tension and adjust if required.

6.5 - COUPLING:

(Applicable for direct drive ROTORDISK®)

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.

7.0 - TROUBLE SHOOTING

7.1 - MECHANICAL HARDWARE

TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Noisy chain	1. Loose chain 2. Faulty lubrication 3. Misalignment 4. Worn Parts 5. Moving parts rubbing stationary parts	1. Tighten chain 2. Lubricate properly 3. Correct sprocket alignment 4. Replace worn chain 5. Align & tighten chain to clear oil bath
Rapid wear on chain	1. Faulty lubrication 2. Loose or misalign parts	1. Lubricate properly 2. Align & tighten entire drive
Chain climbing sprockets	1. Worn out chain and sprockets 2. Loose chain	1. Replace worn out parts 2. Tighten chain
Stiff chain	1. Misalignment 2. Worn out chain or sprockets 3. Faulty lubrication 4. Rust corrosion	1. Correct alignment 2. Replace worn out parts 3. Lubricate properly 4. Clean and lubricate
Noisy Bearing	Rollers or bearings damaged	Replace bearing cartridge
Bearing grease discoloured or mixed with water	Insufficient grease in the bearings	Purge bearing with grease and increase lubrication interval
Hot bearing	1. Improper lubrication 2. Rollers or bearing race damaged	1. Purge bearing with grease and decrease lubrication interval 2. Replace bearing cartridge
Reducer temperature rises above 200 degrees Fahrenheit.	Oil level too high or too low	Maintain proper oil level
Oil leakage from reducer	1. Oil seals need to be replaced 2. Ventilators/breather plugged causing pressure build-up inside the reducer. 3. Oil level too high	1. Replace oil seals 2. Clean Ventilators 3. Correct oil level
Noisy reducer	1. Bearing failure 2. Misalignment in worm gear inside 3. Coupling between motor and reducer worn out and misalign	1. Check bearings and replace if necessary 2. Align worm gear shafts. 3. Replace coupling between motor and reducer. Align coupling hub vertically
Noisy Motor	Bearing damage	Replace damaged bearings
Motor overheating	1. Reducer overheating 2. Cooling fins on motor are clogged 3. Overload 4. Rotor rubbing on stator 5. Over greasing or lubrication	1. Check reducer 2. Clean fins 3. Check for excess friction or imbalance 4. Replace bearings 5. Avoid packing grease too tightly
Motor won't start	1. Power trouble 2. Single phasing at station 3. Fuse blown	1. Check source of power supply 2. Do not try to make it go and "fry" motor. Check starter windings 3. Replace fuse
Knocking/rumbling on motor bearings	1. Bearing worn due to lack of lubrication or excessive mechanical overload 2. Bearings slack in housing	1. Replace bearing and put new grease of recommended grade. 2. Fir new end shields
Rotordisk® shaft doesn't turn	1. Power failure 2. Motor failure 3. Reducer failure 4. Chain drive failure	1. Check power supply 2. Check and replace motor and bearings. 3. Check teeth worn gears and bearings. Replace necessary parts 4. Replace chain

7.2 - ROTORDISK® PROCESS

ROTORDISK® TROUBLESHOOTING GUIDE

Problem	Cause	Corrective Action
1. Slime on media appears shaggy with a brown colour	PROPER OPERATION	NO PROBLEM, NORMAL CONDITION
2. Black slime growing on disks	Solids and/or BOD overloading	a. Pre-aerate RBC influent b. For severe organic overloads, increase recycle rate c. De-sludge unit d. Place another RBC unit in parallel
3. Rotten egg or other obnoxious odors	Solids or BOD overloading	See Problem 2, solutions a, b, c and d, above
4. Development of odors and white biomass over most of the media surface	1. Septic influent wastewater or high hydrogen sulfide or sulfate concentration	a. Determine the cause of the problem and correct it at source. For example, aerate equalization tank b. Pre-aerate influent wastewater c. Determine the cause of the problem, possibly with the addition of chlorine or hydrogen peroxide; potassium permanganate has also been used
	2. Overload first stage	a. Check dissolved oxygen levels to confirm overload problem b. Increase number of recycle buckets
5. White slime	1. Bacteria that feed on sulfur compounds. Also, industrial discharges containing sulfur compounds may cause an overload	▪ See Problem 2, solutions a and b above
	2. Grease on the disks	a. Remove grease at source b. Install grease traps
6. Sloughing or loss of slime (biomass)	1. Toxic or inhibitory substances in influent, including abrupt pH changes	a. Eliminate source of toxic or inhibitory substances b. Reduce peaks of toxic or inhibitory substances by carefully regulating inflow to plant c. Dilute influent using plant effluent or any other source of water d. See Problem 7.4
	2. Variation in flow or organic loading	a. During low flow or loading periods, pump from secondary clarifier or 4th stage RBC unit effluent to recycle water with food and dissolved oxygen through the RBC unit b. During high flow or loading conditions, attempt to throttle plant inflow during peak periods c. For severe organic under loads, add a cheap source of soluble carbon in the PST such as molasses

ROTORDISK® TROUBLESHOOTING GUIDE

Problem	Cause	Corrective Action
7. Decrease in process efficiency	1. Reduced wastewater temperature	a. Decrease air opening in RBC building b. Heat air inside RBC unit cover or building
	2. Unusual variations in flow or organic loading	▪ See Problem 6, cause 2, solutions a and b above
	3. Sustained flows or loads above design levels	▪ Install additional treatment units
	4. High or low pH values	▪ Adjust pH to near neutral
	5. Improper rotation of media	▪ Inspect chain tension and adjust
8. Accumulation of solids and clogging in the RBC system	Solids removal in pre-treatment steps is not adequate	a. Improve pre-treatment efficiencies b. Provide supplemental aeration to help prevent solids from settling c. De-sludge primary tank
9. Floating or rising sludge in the secondary clarifier	Removal of sludge from the clarifier is inadequate	a. Increase the duration of pumping sludge from the clarifier b. Remove sludge from the clarifier more often
10. Excess shaft weight or biomass thickness	1. Organic loading too high	▪ Decrease organic loading
	2. Stage loading too high	a. Increase number of recycle buckets
	3. Inorganic solids accumulation because of inadequate pre-treatment	▪ Check primary treatment and grit removal equipment for proper operation
	4. Accumulation of minerals	▪ Use chemical pre-treatment to eliminate minerals
	5. Digester supernatant adding excessive BOD or sulfides	▪ Modify supernatant pumping frequency
11. Shaft rotation non-uniform or “jerky”	1. Normal variations in balance	▪ Time rotation by quarters. A difference of less than 3 seconds in quarter rotation time is normal
	2. Uneven biomass weight due to power outage	a. If severe, shut unit down and wash down disks b. Turn off the unit temporarily and rotate manually to uniformly wet biomass growth before restarting c. Decrease or stop flow of wastewater to affected units d. Contact manufacturer for assistance

ROTORDISK® TROUBLESHOOTING GUIDE

Problem	Cause	Corrective Action
12. Effluent quality apparently below requirements	1. Organic loading too high	a. Add additional operating RBC's b. Identify cause of additional loading and eliminate at source c. Add supplemental air to RBC trough
	2. Sampling or testing procedures inaccurate	a. If nitrification is occurring, analyze for carbon BOD only by using nitrification inhibitor b. Check for contaminated dilution water, sampler lines, or improper sampling storage
	3. Inadequate secondary clarifier operation	a. Clean and de-sludge clarifier b. Modify sludge removal procedures to eliminate BOD kickback c. Install filters after clarifier d. Increase alum dose to enhance flocculation
	4. Anaerobic solids in the RBC tanks producing BOD kickback	▪ Flush or drain tanks
13. Snails or other nuisance organisms in RBC tanks	Nutritional and conducive environment for reproduction of hard-bodied shell snails ($^1/_8$" - $^1/_2$" in size)	a. Addition of controlled dosages of chlorine. Physical removal may be required with taking units out of service temporarily b. Contact manufacturer

Contact SEPROTECH SYSTEMS INCORPORATED for advice on how to resolve problems related to the process before making changes to the process or equipment.

Adapted from Water Pollution Control Federation "Manual of Practice OM-10", 1988.

8.0 - MAINTENANCE PROGRAM – Do's and Don'ts

8.1 - DO'S

1. Do use biodegradable soap if at all possible. The system will, however, handle a certain amount of normal soap. When laundering clothes, please follow manufacturer's instructions regarding quantity of detergent. Excessive use of detergent can cause odour in the system.

2. Do put large amounts of grease in a container and dump in garbage. The system will handle a certain amount of fat and grease. If a tile bed is used and if fats and grease get into it, they may plug the pores of the soil and seal up the bed. Never put large amounts of grease (i.e. old grease from deep fryer) into the sewer lines.

3. Have your system pumped out a minimum of once a year to remove sludge and scum to maintain top operating treatment in your system and filter bed.

4. For small systems equipped with a service hatch, keep the service hatch above the ground. Do not let run-off water enter system, as this will cause hydraulic overload.

5. If a tile bed is used, do keep traffic such as cars, snowmobiles, etc., away from the system bed areas as they will break pipes and seal the soil over the bed.

6. If a tile bed is used, do leave the raised filter in place without disturbing it. The filter is specifically designed to provide maximum dispersal of the water. Altering it by adding fill, covering it up or changing in any way may destroy its water dispersal characteristics and result in bed failure.

7. If a tile bed is used, do encourage a growth of ground cover over the filter bed as it helps disperse water by evaporation and transpiration.

8.2 - DON'Ts

1. Do not put non-biodegradable materials downs the drain, put them in the garbage, these include any plastics, rubber, disposable diapers, sanitary napkins, rubber goods, cigarettes, children's toys, cellophane, etc. They will plug the system, and a pump out will be needed.

2. Do not put harsh chemicals down the drain. They will kill the bacteria necessary for efficient treatment. These include acid or caustic cleaners, gasoline, oil, turpentine, photographic chemicals, etc. Disinfectant and chlorine bleaches should be kept to domestic uses.

3. Do not leave taps running or faulty toilets. The excess water may overload the system and, if used, tile field causing breakout and poor treatment.

4. If you do not have access to workers with appropriate training, do not attempt to fix the mechanical parts yourself. Your dealer is trained to repair your plant and work safely with electrical and mechanical components. Call him if you have a problem or concerns.

5. Do not connect any other electrical load to the fuse or breaker feeding the plant as it will cause damage to the controls.

6. Never put large amounts of grease (i.e. old grease from deep fryer) into the sewer lines.

YOUR CO-OPERATION WITH RESPECT TO THE ABOVE POINTS SHOULD ENSURE TROUBLE-FREE OPERATION OF YOUR TREATMENT PLANT AND WILL BE GREATLY APPRECIATED.

9.0 - INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS FOR VARIOUS MECHANICAL PARTS OF THE ROTORDISK® AND OTHER EQUIPMENT SUPPLIED

9.1 - INSTALLATION & MAINTENANCE DETAILS FOR ROLLER CHAIN DRIVES

CHAIN TENSIONING:

The proper fit of a chain may be obtained by adjusting the sprocket centres. When a chain is correctly tensioned, the total mid-span movement (double amplitude) in the slack span should be 4-6% of the span length for normal drives.

Where there is no adjustment means, adjustment may be made by removing links to compensate for elongation due to wear (Drives with fixed centres). Proper lubrication and proper drive maintenance may minimize chain wear.

LUBRICATION:

Although many slow-speed drives operate successfully with little or no lubrication beyond the initial factory lubrication, proper lubrication will greatly extend the useful life of every chain drive.

A good grade of clean petroleum oil without additives, free from flowing at the prevailing temperatures should be used.

Chain drives should be protected from abrasive and corrosive conditions, and the oil supply kept free of contamination. Periodic oil change is desirable. The lubricant viscosity recommended for ambient temperature 40^{o} - 100^{o}F is SAE 30.

OIL BATH:

With bath lubrication, the lower strand of chain runs through a sump of oil in the drive housing. The oil level should reach the pitch line of the chain at its lowest point while operating. Only a short length of chain should run through oil.

INSTALLATION RECOMMENDATIONS:

Shafting, bearings and foundations should be supported rigidly to maintain the initial alignment. Roller chain should be free of grit and dirt. Wash the chain in kerosene when required. Re-lubricate!

Misalignment results in uneven loading across the width of the chain and may cause roller link-plate and sprocket tooth wear. Drive alignment involves two things:

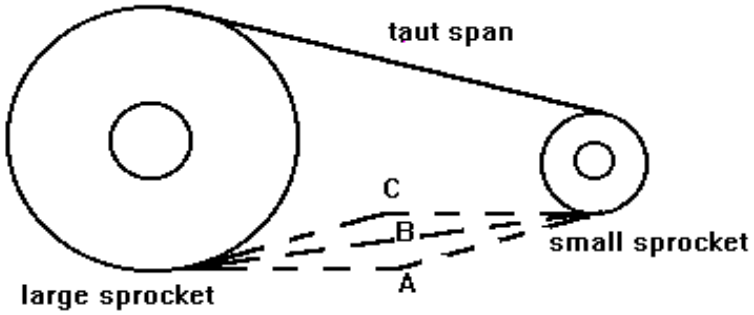
a) Parallel shaft alignment: Shafts should be parallel and level.
b) Axial sprocket alignment: Sprocket axial alignment can be checked with a straight edge, which will extend across the finished sides of the two sprockets.

Normally, it is good practice to align sprockets as close to the shaft bearings as possible.

Installing the Chain: Recheck all preceding adjustments for alignment and make sure all setscrews, bolts and nuts are tight. Fit chain around both sprockets and bring free ends together around one sprocket for connection.

Chain Tension: Check chain tension to be sure that the slack span has 4-6% mid-span movement in horizontal drives.

Recommended Possible Mid-Span Movement AC									
Drive	Tangent Length Between Sprockets								
Center-Line									
	5”	10”	15”	20”	30”	40”	60”	80”	100”
Horizontal to 45	.25”	.5”	.75”	1”	1.5”	2”	3”	4”	5”
Vertical to 45	.12”	.25”	.38”	.5”	.75”	1”	1.5”	2”	2.5”



AC = Total Possible Mid-Span Movement
Depth of Free Sag = .866 AB, approximately

MAINTENANCE RECOMMENDATIONS:

Regular maintenance schedules should be followed for all chain drives. Each drive should be inspected every six months. At each inspection period the following points should be checked:

a) Check Lubrication: If chain is covered with grit or chips, it should be cleaned in kerosene and re-lubricated before reinstalling. With bath lubrication, oil should be maintained at the proper level, as shown in lubrication instructions. Add oil if necessary. At each inspection, oil should be checked for contamination, such as chips, dirt or grit.

b) Check sprocket alignment: If the chain is properly aligned, no wear will show on the inner surfaces of the chain roller link-plates. If wear is apparent, this is evidence that sprockets are misalign and should be realigned as outlined in the installation instructions to prevent further chain and sprocket wear.

c) Check sprocket tooth wear: If sprocket shows evidence of wear high on the sprocket teeth, this is evidence of excessive wear in the chain and the chain should be replaced. If the sprocket teeth are severely worn, the sprocket should be replaced. Do not run new chain on worn sprockets.

d) Check chain tension: At each inspection period, the chain tension should be adjusted. If excessive slack has accumulated which cannot be removed by available shaft centre adjustment (i.e. by moving reducer away from large sprocket using chain tensioning bolts), two or more pitches of chain should be removed and chain reconnected.

9.2 - PROCEDURE FOR ASSEMBLING BEARINGS AND PILLOW BLOCKS

Shaft Preparation
Clean shaft and remove any burrs or sharp edges. Check the shaft diameter to given specifications.

Seal Installation
Place seal, which consists of: Double lip 'G' type seal

9.2.1 - MOUNTING OF BEARING ON SHAFT

Adapter Sleeve Mounting
Position adapter sleeve on the shaft to correct location with respect to required bearing centerline. A smear of lubricating oil (SAE 10 or 20) applied to the sleeve outside diameter surface results in easier bearing mounting and removal. (For pillow blocks mounted close to a pulley hub or similar obstruction, mount the adapter sleeve with threads inboard for easy removal. Remember to slide lock-nut, lock-washer and bearing onto the shaft before positioning the sleeve.)

NOTE: All bearings mounted on tapered sleeves have to be driven up the taper to the tolerances given in SKF tables, to ensure correct fits. Spherical roller bearings can be measured between the unloaded rollers and the outer ring sphere surface.

Un-mounted Clearance, Spherical Roller Bearings
Measure the un-mounted internal clearance in the bearing by inserting and sliding progressively larger feeler blades the full length of the roller between the most vertical unloaded rollers and the outer ring sphere. Never run the rollers over the feeler blade, as the wrong value will be obtained. Record the measurement of the largest size blade that will slide through. This is the un-mounted internal clearance.

Bearing
Mount the bearing hand tight on the adapter sleeve. Be sure the large end of the bore of the inner ring matches the taper of the adapter. To avoid damage to the bearing it is most important during this and subsequent operation that the shaft is blocked up so the bearing is unloaded. Do not apply lock-washer. Drive up procedure may damage it.

Bearing Drive Up, Spherical Roller Bearings
Lubricate the face and thread of the lock nut and apply to sleeve with chamfered face toward the bearing. Tighten the lock nut. Do not attempt to tighten the lock nut with a hammer and drift (use proper wrenches), the lock nut can be damaged and chips can enter the bearing. Further tighten the lock nut and measure the internal clearance until the internal clearance is less than the un-mounted clearance figure by the amount shown in the attached table (see last page). Finally, remove lock nut, position lock washer with outer tangs facing away from the bearing, and inner tang properly seated in the slot provided in the adapter. Replace lock nut and tighten until firmly seated.

9.2.2 - PREPARATION OF PILLOW BLOCK HOUSING

Check to be sure all pillow block parts are free of burrs and are completely clean. Internal surfaces should be removed. Apply a thin coat of grease to the bearing seat in the base. Fit the bearing and seal inserts into the pillow block base, being careful not to damage to O-rings. For assembling larger sizes where hoists must be used, it may be convenient to seat both bearings into their housing bases simultaneously.

FIXING RINGS

On each shaft one bearing is generally "Held" and other bearings are "Free", to permit shaft expansion. For "Held" bearing housings, use two fixing rings. Place one on each side of bearing.

CAPPING THE PILLOW BLOCK

Place the cap on the base so that the dowel pins in the base align with the holes in the cap, being careful not to damage the O-rings. Caps and bases are not manufactured for interchangeable assembly. They must be kept together. Install cap-bolts with lock washers and tighten securely.

GREASE LUBRICATED BLOCKS

Lubrication Notes

Grease Lubrication

If grease is used as a lubricant, it should be smeared between the rolling elements and worked in. The lower half of the housing should be packaged $^{1}/_{2}$ to $^{3}/_{4}$ full.

9.2.3 - PROCEDURE FOR APPLYING LUBRICANT TO BEARINGS AND PILLOW BLOCKS

Pack each bearing as completely full of the specified grease as possible by swiveling the outer ring open and rotating it as necessary to inject the grease. Then, swivel the outer ring closed being careful not to use force in the event a roller end catch the corner of the outer ring sphere.

B) Before assembling the pillow block cap to the base, and after completing bearing and base assembly, fill $^{1}/_{2}$ to $^{3}/_{4}$ of the pillow block base with the same lubricant that was used to pack the bearing.

9.2.3.1 - LUBRICATION PROCEDURE TO BE USED AT START-UP

A) All pillow block assemblies that have not been prepared for stage are ready for use, assuming the installation procedures have been correctly followed.

B) While shaft is rotating, lubricate each seal through the outside lubricant fittings until grease is seen emerging from the labyrinth areas. Make sure the outside of the lubricant fitting is clean before applying grease.

9.2.3.2 - RE LUBRICATION

Lubricants deteriorate in time, and the rate of deterioration is a function of the lubricant used at the operating conditions encountered. Determining the re-lubrication cycle depends on sampling the grease and analysis of the samples. Provisions must be made to adequately evaluate the contamination by solids. Samples for grease evaluation should be taken from near the bearing, and evaluation of the samples should dictate the re-lubrication cycle.

Remove caps once a-year and re-apply new grease.

Each seal assembly should be lubricated once a month, while the bearing is rotating, with the same grease that is used in the bearing.

9.3 - GREASE CLASSIFICATION

		Oil Viscosity Saybolt Second (approx. SSU)		
Class	Type of Base (1)	@ 100 F	@ 210 F	NLGI (2) Grade
A	Lithium or Equal	200 - 500	48 – 55	0
B	Lithium or Equal	400 - 600	58 – 68	1
C	Lithium or Equal	800 - 1,000	75 – 82	1
D	Lithium only	800 - 1,000	75 – 82	2

	Grease requirement from above			
Operating temperature of bearing (4)	Low (5)	Medium	High	Suggested Re-lube cycle
0 – 70	A or B			6 – 12 months
70 – 120	B or C			6 – 12 months
120 – 160	B or C	C or D (6)	D (7)	2 - 3 weeks
160 – 200	C	C or D (6)	D (7)	1 - 4 weeks

1) Calcium Complex Greases NOT recommended for spherical roller bearings.

2) National Lubricating Grease Institute Consistency Code.

3) Definition of speed categories:
Low: up to 1/4 of catalog speed limit for static oil lubrication.
Medium: 1/4 to 1/2 catalog speed limit for static oil lubrication.
High: 1/2 to full catalog speed limit for static oil lubrication.

4) Consult SKF Engineering if temperature is below 0^{o} or above 200^{o}F.

5) Extremely slow speed will require special consideration if loads are high.

* Under all conditions, application should be checked using the SKF lubricant film parameter found in the Engineer Data Catalog.

6) Use type "C" where load is heavy, 15,000 hours-rating life or less and/or speed are less than RPM.

7) Consult SKF Engineering - Grease lube not normally recommended under this combination of operating conditions.

8) Dry clean applications only. For moderate conditions of dirt and/or moisture, use cycle of 1 to 2 months. For extreme conditions of dirt and/or moisture, use cycle of 1 week. Vertical applications normally require shorter than normal re-lube cycle.

9) Never mix greases with unlike bases.

10) Remove old grease at least once a year.

10 - LIMITED WARRANTY

SEPROTECH SYSTEMS INCORPORATED warrants the parts in each treatment plant to be free from defects in material and workmanship; for a period of 15 months from shipment or 12 months from start-up, whichever occurs first, in the treatment of domestic wastewater. Sole obligation under this warranty is as follows:

SEPROTECH SYSTEMS INCORPORATED shall fulfil this warranty by repairing or exchanging any component part, F.O.B. our factory, that in SEPROTECH SYSTEMS' judgement, shows evidence of defects, provided said component part has been paid for and is returned through an authorized dealer, transportation prepaid. The warranty must also specify the nature of the defect to the manufacturer. New placed parts are under warranty for one year.

The warranty does not cover treatment plants that have been flooded, by external means, or that have been disassembled by unauthorized persons, improperly installed, subjected to external damage or damage due to altered or improper wiring or overload protection.

This warranty applies only to the treatment plant and does not include any other electrical wiring, plumbing, drainage, or disposal system. SEPROTECH SYSTEMS INCORPORATED is not responsible for any delay or damages caused by defective components or material, or for loss incurred because of interruption of service, or for any other special or consequential damages or incidental expenses arising from the manufacture, sale, or use of this plant.

SEPROTECH SYSTEMS INCORPORATED reserves the right to revise, change, or modify the construction and design of the treatment plant for domestic wastewater or any component part or parts thereof without incurring any obligation to make such changes for modifications in previously sold equipment. SEPROTECH SYSTEMS INCORPORATED also reserves the right, in making replacements of component parts under this warranty, to furnish a component part, which, in its judgement is equivalent to the Company part replaced.

Under no circumstance will SEPROTECH SYSTEMS INCORPORATED, be responsible to the warrantee for any other direct or consequential damages. Including but not limited to; lost profits, lost income, labour charges, delays in production, and/or idle production, which damages are caused by a defect in material and/or workmanship in its parts.

This warranty is expressly in lieu of any other expressed or implied warranty, excluding any warranty of merchantability or fitness, and of any other obligation on the part of SEPROTECH SYSTEMS INCORPORATED.

Appendix B

Biodisk Big John Operation Manual

www.BIODISK.ca
BIODISK Corporation
21 Cliveden Avenue
Toronto, Ontario
M8Z 3M7
Canada
Office (416) 237-0214
Fax (416) 239-7880
email: rbcguy@BIODISK.ca

BIODISK
Natural Purification of Wastewater

BIG JOHN

OPERATION

MANUAL

TABLE OF CONTENTS

IMPORTANT: READ THIS INSTALLATION PROCEDURE PRIOR TO START-UP.

1.0 **SUMMARY OF OPERATION**

A). The Big John wastewater treatment plant as supplied by BIODISK Corporation is a tertiary treatment plant designed to remove organic material and nutrients. It is comprised of the primary clarifier, the RBC tank, and the final clarifier.

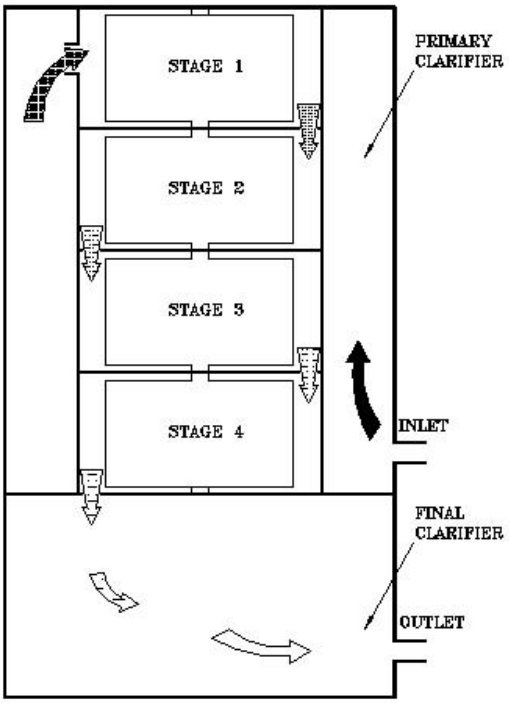
B). Raw sewage is pumped into the primary clarifier. Settling separates heavy solids and the clarified water enters the aeration section through the inlet slot located at the bottom of the non drive end section of the biozone. This is the first section of four and contains two rotating assemblies. The second third and fourth stages each have one rotating assembly

The normal colour of the bacteria in the 1st stage is dark brown. This is the stage where most of the BOD reduction occurs. The succeeding 2nd, 3rd, and 4th stages are mounted on the second shaft. It is in the 2nd stage that further BOD is reduced, and that nitrifying bacteria start to predominate. The 3rd and 4th stages are just for nitrification.. The 4th disk bank has recycle buckets. Recycled water has many operational benefits. See www.Biodisk.ca for additional information.

C). Partially treated water from the RBC now enters the final clarifier. Spent biomass and flocculated phosperous particulate settled in this chamber. Sludge is returned to the primary clarifier

2.0 - ROUTINE VISUAL CHECKS ON PHYSICAL AND BIOLOGICAL FUNCTIONING OF BIG JOHN & DESCRIPTION OF TREATMENT PROCESS

BIG JOHN sewage treatment plants have three major steps in the purification process. In the primary settlement tank, gross solids separate from the flow by either sinking or floating. In the Biozone, dissolved pollutants are broken down to simple, non-pollutant compounds by the biological growth ("biomass") which grows on the rotating disks. The final settlement tank permits gravity separation of spent biological growth, which continually sloughs off the disks in the Biozone preceding it.



2.1 - PRIMARY SETTLEMENT TANK (PRIMARY "CLARIFIER")

The accumulation of floating scum on the surface of the primary clarifier is normal. It is proportional to the accumulation of settle-able solids at the bottom of the tank. Periodic removal of sludge at the bottom of the tank is required for proper operation of the Unit. Sludge management can effect the efficiency of the process. Sludge is a source of heat. Only partial sludge removal is recommended in cold climates. Spring is a good time for sludge removal. Sludge removal on a fully loaded system may be required every 6 to 9 month. Lightly loaded system or system with upstream holding tanks may experience long term sludge storage.

Sludge storage volumes can be measured with equipment like a Sludge Judge or by visual inspection of the disk and scum layer. The accumulation of 9"-12" depth of scum on the surface of the primary clarifier is a good indication that it is time to remove the accumulated deposits of sludge from the bottom of the tank. The first disk bank will show signs of grey and black spotting if excessive organics (sludge) are being introduced.

2.2 - BIOZONE

The Biozone is subdivided into four sections,. The wastewater first enters the Biozone in the section marked "1" in the sketch (furthest away from the inlet to the plant). The flow then proceeds through sections 2, 3, and 4 before entering the final settlement chamber.

The accumulation of biological growth will be greatest in section 1, and gradually decrease through subsequent sections. Generally, the growth will be thick, and often filamentous

("stringy"), in section 1, becoming thinner and more compact through sections 2-4.

The colour of the growth will typically be dark brown in the first stage1. Some grey growth may also be noticed, depending on the relative load and type of wastewater being treated. Grey and black growth spotting can lead to poor effluent quality. Growth in sections 2-4 will typically vary from medium brown to a light brown or tan growth in section 4.

A properly operating Biodisk will have an earthy, humus-like ("musty") smell inside the unit. If the Biodisk is overloaded biologically or has experienced an upset form grease or toxic material introduction it will have an unpleasant odour. Grey and black biomass is often accompanied by odour and poor effluent quality. The toxic material, FOG or other sources must be removed from the flow stream.

The use of antibacterial soap must be limited or preferably non existent.

2.3 - FINAL SETTLEMENT TANK (FINAL "CLARIFIER")

The effluent from the sample tap should be clear, free of colour and free of suspended matter.

Although the final effluent itself should be relatively clear, some floating matter may accumulate on the surface of the final clarifier. This is normal, and will typically be much less than the floating scum in the primary clarifier.

2.4 - 'BATHTUB RING'

The flow of wastewater within a BIG JOHN Plant is strictly by gravity and the water level relatively constant. Changes in water level of 1" to 2" are not unusual due to surge flows entering the unit. The evidence of this is a 'bathtub ring' 1" - 2" above the normal level. A 'bathtub ring' higher than this suggests that partial or complete flooding of the unit has occurred since the last check. If so, the (gravity or pump) discharge system should be checked for blockages or mechanical malfunction.

2.5 - FREQUENCY OF INSPECTION

Visual checks at 3-4 month intervals should be sufficient. However, for better preventative maintenance of the wastewater treatment plant and thus the capital investment, a daily walk through is often the preferred frequency of visit. Many owners prefer the visual and audible (look and listen) walk through.

The frequency of required testing may govern the operator frequency.

2.6 – CHEMICAL PHOSPHORUS REMOVAL SYSTEM

The removal of phosphorus from the water is achieved by injecting alum (an hydrated aluminum sulphate or Al2(SO4)3 •nH2O where n typically ranges from 14 to 18 mg/l.

The system provided consists of a chemical feed pump that receives a 4 – 20 mA signal from the flow meter. The alum shipping container will function as the chemical feed tank. The injection point for the alum is the 3rd stage of the RBC.

The flow meter provided with the system is of magnetic type. It features a volume tantalizer (the total volume of effluent produced by the plant from start-up is always kept in memory). It can display daily flow and total flow.

2.7 – UV-LIGHTS DISINFECTION UNIT

At sufficient dosage levels, ultraviolet light renders micro-organisms inactive by destroying their DNA such that they can no longer replicate. Ultraviolet intensity is measured in $W.s/cm^2$. Typically, wastewater effluent criteria require Fecal Coliform, such as *E. Coli*, not to exceed a given concentration (for example, < 100 counts / 100 ml). A dose of UV-light in the order of 16,666 $\mu W.s/cm^2$ provides an approximate 5-log reduction (or a 99.999% decrease) of the microorganisms concentration which is usually sufficient to meet wastewater discharge criteria. The UV-lights unit installed with this plant was designed to provide a dose of about 40,000 $\mu W.s/cm^2$ at flow rate 30 USgpm.

2.8 – MONITORING OF DISCHARGE FLOW RATE AND TOTAL EFFLUENT VOLUME

The plant is equipped with a magnetic flow meter located on the clean effluent's discharge pipe. This instrument is equipped with a counter that allows tracking of the total volume of clean effluent discharged by the plant. As mentioned in paragraph 2.7, the flow meter is also used to control the injection rate of alum.

3.0 - STANDARD RECOMMENDATIONS AND PROCEDURES FOR SLUDGE REMOVAL

3.1 - STORAGE CAPACITIES

A design feature of BIG JOHN, which contributes greatly to overall simplicity of the process, is the sizing of clarifiers to accommodate static internal sludge storage for extended periods. Depending on such factors as raw wastewater solids concentrations, and design organic loading in a given application, maximum sludge storage levels will typically be reached in 6-9 months of operation or longer.

This period is based on calculated rates of initial decomposition of raw and biological solids, and, upon operating experience, indicating the degree of auto-digestion/compacting, which proceeds during the storage period. The 6-9 month period will be shortened to the extent that design hydraulic and waste loads are exceeded. It will be lengthened to the extent that flows and waste load are less than those designed for.

3.2 - DETERMINATION OF ACCUMULATED SLUDGE VOLUMES

The accumulation of maximum storage capacities can be indirectly monitored through visual observation of the thickness of the scum blanket on the surface of the primary clarifier. When the scum blanket has matured to a height of approximately 7"-10", this is a good indication that sludge accumulations at the bottom of both clarifiers are at or near maximum levels, and that sludge withdrawal is indicated.

3.3 - SLUDGE REMOVAL

A pump-out truck of the same type that pumps out septic tanks normally does the sludge removal. Sludge settles to the bottom of the primary clarifier. More sludge will be present near the inlet. Sludge depth will less at the non drive end of the shaft. When removing sludge the hose end must be moved across the bottom of the tank. If the nozel of the hose does not go into the corners the sludge removal will not be effective. Removal of sludge is like vacuuming under the bed. You have to move the suction end around to cover all the tank bottom. It is not necessary to remove all the water. If the climate is cold only remove some of the sludge. Stored sludge is a source of heat.

3.4 - POTENTIAL CONSEQUENCES OF OPERATING BIG JOHN UNITS PAST DESIGNATED MAXIMUM SLUDGE STORAGE LEVELS

Sludge accumulations should be removed once they reach indicated maximum storage levels, because failure to do so could result in lowered treatment efficiency, and possibly cause serious damage to the structure of the Rotating Assembly and drive unit. The potential for problems is as described below and depicted in the attached sketches.

Figure (c) shows a unit operating with sludge build-ups at or near maximum storage levels. This will cause no problem since the storage heights are designated so that flows through the primary clarifier will not disturb the sludge layer. Characteristics of wastewater reaching the Biozone at this time (and since start-up) will be in the range of 180-200 mg BOD/1 and 50-250 mg SS/1. The supporting structure of the rotating assembly is over designed for the amount of biological build-up which will occur on the disks under this operating condition, and the shear force of the rotation through the trough water will limit the thickness of growth.

However, if sludge is allowed to accumulate past designated storage heights, flow through the primary clarifier will begin to disturb the sludge blanket, and thus carry loads of solids and dissolved organic matter into the Biozone which are not anticipated in the design of the unit (Figure d). The pollutant load reaching the biomass on the first stage of disks will overload that biomass (in terms of F:M ratio.), and force a change in its activity and growth. The biomass becomes more gelatinous, and does not shear off as well with disk rotation. Additionally, the biomass will readily adsorb and entrap the extra solids with the sum effect being an increase in weight on the rotating assembly that considerably exceeds that which its design is based on.

This tendency reaches its extreme if sludge is allowed to accumulate to the point where it will be disturbed by-, and caught up in -, the re-circulation pattern created by the two slots in the trough on the first section of the Biozone (see Figure e).

The sludge will have characteristics in the order of 20,000 mg TSS/1 and 10,000 mg BOD/1, so it is obvious that even a minor amount of this material caught up in the re-circulation flow will significantly increase the concentration of the waste stream entering the Biozone. If, for example,

the sludge was caught up in the recycle flow at a ratio of as little as 1:10 or 1:15, the resulting concentration would be sufficient to produce a considerable first-stage overload on an amount of disk area selected based on normal concentrations.

The resulting build-up of poorly-shearing gelatinous biomass and trapped solids would pose a serious potential for strain on the drive unit, and for structural damage to disk bank assemblies and shaft, in spite of them being considerably over designed for loads anticipated in normal operation.

Clearly, these potential problems should be avoided by the removal of sludge once it reaches the level specified as maximum for the BIOZONE unit in question.

3.5 - SLUDGE LEVEL SCHEMATIC DIAGRAM

UNIT OPERATING AT-, AND ABOVE-, RECOMMENDED MAXIMUM SLUDGE STORAGE LEVELS

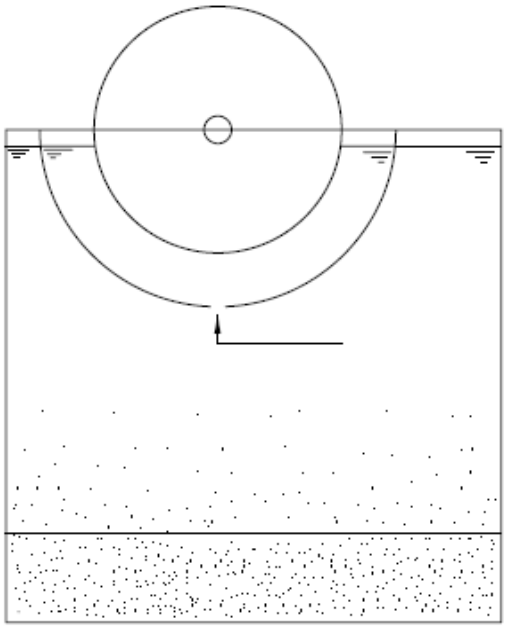


Figure A-unit operating at maximum sludge storage levels. Neither influent flows, nor re-circulating flows, disturb sludge blanket.

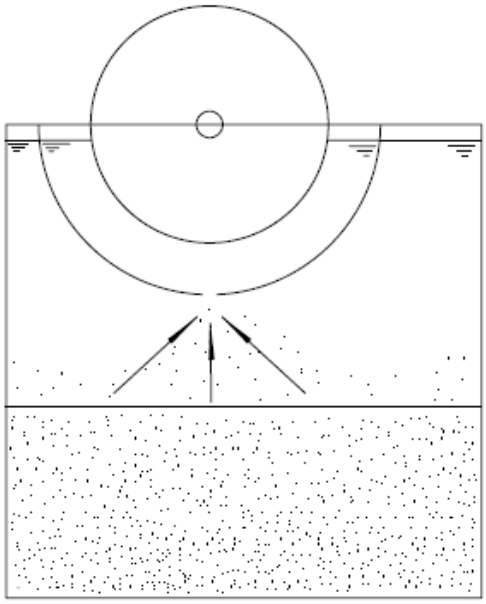


Figure B- unit operating with excess accumulations. Influent flows may disturb sludge blanket and increase BOD and solids loads to Biozone to levels above treatment design.

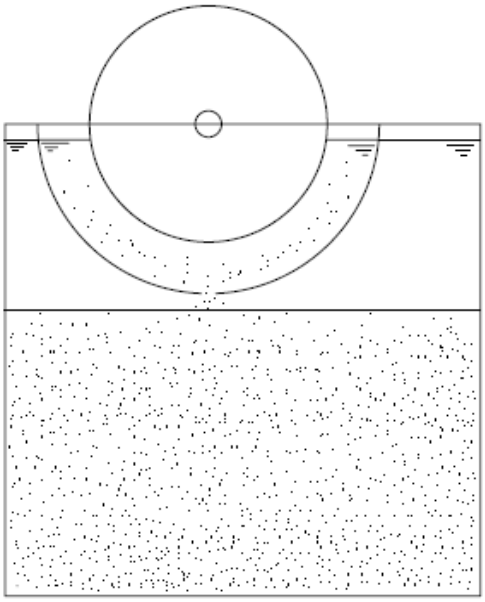


Figure C-Unit operating with excess sludge accumulated to base of Biozone. Both influent flows and re-circulation flows will disturb and carry sludge solids. Increase in BOD and solids loads entering Biozone will be substantially above design treatment levels, increase accumulated masses on rotating assembly, produce potential for damage to structure and drive unit.

3.6 - PUMPOUT PROCEDURES FOR BIG JOHN TREATMENT SYSTEMS (summary)

Using suction hose, floating or surface scum should be removed first. Place the suction hose directly to the bottom of the tank and withdraw sludge only, while taking as little as possible

of the volume of waste liquid above the sludge blanket (supernatant).

Move the hose at multiple number of points along the bottom of the settlement tanks. Do not wash off biological growth (biomass) on the disks. The exception to this is excess accumulated biomass on the disks due to an overdue sludge pump-out. Excess accumulated biomass is when a disk bank is 100% fully covered with biomass and the colour is grey with a slight odour.

Keep a record of all pump-outs to arrive at an actual normal operating interval for sludge pump-outs. For systems with several flow meters, it is also beneficial to note the total flow generated between pump-outs.

3.7 - START-UP PROCEDURES OF BIG JOHN

The BIG JOHN sewage treatment plant is based on a fixed film treatment process referred to as the Rotating Biological Contactor (RBC). In this process, micro-organisms or bugs are attached and grown on the surface of a media, the quantity of bugs being directly proportional to the amount of food in the wastewater. When starting up a new system, it will normally take about two weeks to get organic removal from the wastewater and three to four weeks to establish the nitrification process at normal domestic sewage temperatures. The method of and effluent discharge during system start-up should be discussed and thoroughly communicated with the environmental authority. The primary sedimentation tank and RBC of the system should, preferably, be filled with fresh water before admitting wastewater to the system. A flow less than design is not a problem. The biomass will develop themselves on the media. If there is a small flow only a portion of the disk will have biomass. As the flow increases the amount of biomass will increase.

Seeding a BIG JOHN with activated sludge, although not required, can be accomplished. The activated sludge should be at the same temperature as the influent. Sudden changes in wastewater temperature cause biomass sloughing. In most cases, the use of domestic waste as a seed culture has provided the required biomass for continuous operation. When seeding the BIG JOHN with activated sludge is decided, the primary sedimentation tank and RBC of the system should first be filled with fresh water (preferably) and the activated sludge added to the RBC. The RBC should be rotating at all times. The wastewater introduced to the tank needs to have only 20% of the disks covered with waste. This can already provide the needed wetting and still provide some time to reach normal operating levels when source flow is introduced. The final clarifier does not need to be filled with anything.

The preferred start up is the introduction of source wastewater at design or less than design loading. The disks need to be rotating at all times. When the disks are rotating and wastewater is introduced the biomass will develop and the pollutants will be removed.

The practice of starting up a sewage plant with a charge of septage or activated sludge may be appropriate for suspended growth systems where sludge return is an essential and necessary part of the process. However, start-up with septage is not an appropriate practice for fixed film systems such as the Rotating Biological Contactor process and is not recommended. This is especially true of the BIG JOHN process and its static, internal storage of sludge.

Studies have shown that the natural start-up time for a BIG JOHN is 2 1/2 – 3 weeks (normal temperatures and BOD reduction only), and that it has already developed sufficient biomass for 50% removals in only 1 week. These are time frames significantly shorter than respective ones for suspended growth systems. Thus there is little rationale for "pre-starting" a BIG JOHN unit with septage.

Further, septage contains solids that are already well digested, and therefore not subject to further digestion-compaction in the storage zones. This contrasts to the fresh solids, which will undergo considerable digestion-compaction in the 6 – 9 months after initial settlement. Therefore, a charge of septage would contribute disproportionately to the accumulation of sludge levels, and necessitate a shorter interval to the first pump-out of the unit.
The BIG JOHN concept of static sludge storage contributes greatly to its overall operation and maintenance simplicity. Following the above guidelines and recommendations will help ensure that the trouble-free simplicity of BIG JOHN is maintained.

4.0 - STORAGE OF BIG JOHN SEWAGE TREATMENT EQUIPMENT

If the unit is not to be operated for an extended period, then the motor-reducer assembly (drive unit) should be removed from its mound and stored at room temperature in a reasonably dry area (unless the whole unit is being stored in such an area).

Additionally:

1. Reducer: The input shaft should be given several turns once a month to re-lubricate the upper bearings.

NOTE: Some reducers are shipped to site filled with synthetic lubrication. Otherwise, fill the reducer with the lubricant (see reducer section of installation & maintenance instructions).

1 Motor: The motor has a tendency to take on moisture when not in operation. It requires no attention during storage, but before it goes into operation the insulation should be measured using a Meger. It should be at least 1.0 mega-ohm. If below 1.0 mega-ohm, it has taken on excessive condensation, and must be dried out before being operated. (Note: any electrical contractor or repair shop commonly understands these terms and procedures).
2 Support bearings on main BIG JOHN shaft(s) should be re-lubricated prior to start-up.
3 The system should not be installed and operated in water. In the absence of sewage inputs and normal biological activity, freezing and consequent mechanical damage would be a distinct possibility. Water level in the primary settlement tank to be dropped to below the bottom of the Biozone tank level, if freezing of the tank contents is possible.

5.0 - ROUTINE MECHANICAL MAINTENANCE OF BIG JOHN SEWAGE TREATMENT PLANTS

5.1 - 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

5.2 - REDUCER:

Reduction gear on BIG JOHN units is 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 BIG JOHN units running 24 hours a day.

Reduction Gear on medium and large BIG JOHN 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.

5.3 - BEARINGS:

Lubricant will deteriorate in time and rate of deterioration is a function of the operating conditions encountered. Lubrication cycle can be determined by analysing the samples taken near the bearing. See bearing manufacturer's maintenance instructions.

5.4 - COUPLING:

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.

6.0 - TROUBLE SHOOTING

6.1 - MECHANICAL HARDWARE

TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Noisy Bearing	Rollers or bearings damaged	Replace bearing cartridge
Bearing grease discoloured or mixed with water	Insufficient grease in the bearings	Purge bearing with grease and increase lubrication interval
Hot bearing	1. Improper lubrication 2. Rollers or bearing race damaged	1. Purge bearing with grease and decrease lubrication interval 2. Replace bearing cartridge
Reducer temperature rises above 200 degrees Fahrenheit.	Oil level too high or too low	Maintain proper oil level
Oil leakage from reducer	1. Oil seals need to be replaced 2. Ventilators/breather plugged causing pressure build-up inside the reducer. 3. Oil level too high	1. Replace oil seals 2. Clean Ventilators 3. Correct oil level
Noisy reducer	1. Bearing failure 2. Misalignment in worm gear inside 3. Coupling between motor and reducer worn out and	1. Check bearings and replace if necessary 2. Align worm gear shafts. 3. Replace coupling between motor

	misalign	and reducer. Align coupling hub vertically
Noisy Motor	Bearing damage	Replace damaged bearings
Motor overheating	1. Reducer overheating 2. Cooling fins on motor are clogged 3. Overload 4. Rotor rubbing on stator 5. Over greasing or lubrication	1. Check reducer 2. Clean fins 3. Check for excess friction or imbalance 4. Replace bearings 5. Avoid packing grease too tightly
Motor won't start	1. Power trouble 2. Single phasing at station 3. Fuse blown	1. Check source of power supply 2. Do not try to make it go and "fry" motor. Check starter windings 3. Replace fuse
Knocking/rumbling on motor bearings	1. Bearing worn due to lack of lubrication or excessive mechanical overload 2. bearings slack in housing	1. Replace bearing and put new grease of recommended grade. 2. Fir new end shields
BIG JOHN shaft doesn't turn	1. Power failure 2. Motor failure 3. Reducer failure 4. chain drive failure	1. Check power supply 2. Check and replace motor and bearings. 3. Check teeth worn gears and bearings. Replace necessary parts 4. Replace chain

6.2 – BIG JOHN PROCESS

BIG JOHN TROUBLESHOOTING GUIDE

Problem	Cause	Corrective Action
1. Slime on media appears shaggy with a brown colour	PROPER OPERATION	NO PROBLEM NORMAL CONDITION
2. Black slime growing on disks	Solids and/or BOD overloading	**a.** Pre-aerate RBC influent disks **b.** For severe organic overloads, increase recycle rate **c.** De-sludge unit **d.** Place another RBC unit in parallel
3. Rotten egg or other obnoxious odors	Solids or BOD overloading	See Problem 2, solutions a, b, c and d, above
4. Development of odors and white biomass over most of the media surface	1. Septic influent wastewater or high hydrogen sulfide or surface concentration	**a.** Determine the cause of the problem and correct it at source. For example, aerate equalization tank **b.** Pre-aerate influent wastewater **c.** Determine the cause of the problem, possibly with the addition of chlorine or hydrogen peroxide; potassium permanganate has also been used
	2. Overload first stage	**a.** Check dissolved oxygen levels to confirm overload problem **b.** Increase number of recycle buckets

		c. Increase number of recycle buckets
5. White slime	1. Bacteria that feed on sulfur compounds. Also, industrial discharges containing sulfur compounds may cause an overload	See Problem 2, solutions a and b above
	2. Grease on the disks	**a.** Remove grease at source **b.** Install grease traps
6. Sloughing or loss of slime (biomass)	1. Toxic or inhibitory substances) in influent, including abrupt pH changes	**a.** Eliminate source of toxic or inhibitory **b.** Reduce peaks of toxic or inhibitory substances by carefully regulating inflow to plant **c.** Dilute influent using plant effluent or any other source of water **d.** See Problem 7.4
	2. Variation in flow or organic loading	**a.** - During low flow or loading periods, pump from secondary clarifier or 4th stage RBC unit effluent to recycle water with food and dissolved oxygen through the RBC unit **b.** - During high flow or loading conditions, attempt to throttle plant inflow during peak periods **c.** -For severe organic under loads, add a cheap source of soluble carbon in the PST such as molasses
7. Decrease in process efficiency	1. Reduced wastewater temperature	**a.** Decrease air opening in RBC building **b.** Heat air inside RBC unit cover or building
	2. Unusual variations in flow or organic loading	• See Problem 6, cause 2, solutions a and b above
	3. Sustained flows or loads above design levels	• Install additional treatment units
	4. High or low pH values	• Adjust pH to near neutral
	5. Improper rotation of media	• Inspect chain tension and adjust
8. Accumulation of solids and clogging in the RBC system	Solids removal in pre-treatment steps is not adequate	**a.** Improve pre-treatment efficiencies **b.** Provide supplemental aeration to help prevent solids from settling **c.** Move baffles to change flow patterns to reduce settling (if problem is serious, the RBC wastewater tank may have to be pumped or cleaned out) **d.** De-sludge primary tank
9. Floating or rising sludge in the final clarifier	Removal of sludge from the clarifier is inadequate	**a.** Increase the duration of pumping sludge from the the secondary clarifier **b.** Remove sludge from the clarifier more often
10. Excess shaft weight or biomass thickness	1. Organic loading too high	• Decrease organic loading
	2. Stage loading too high	**a.** Remove baffles between units to increase size of treatment stages

		b. Increase number of recycle buckets
	3. Shaft speed too low	• Increase the shaft rotational speed by adjusting drive ratio
	4. Inorganic solids accumulation because of inadequate pretreatment	• Check primary treatment and grit removal equipment for proper operation treatment
	5. Accumulation of minerals	• Use chemical pre-treatment to eliminate minerals
	6. Digester supernatant adding excessive BOD or sulfides	• Modify supernatant pumping frequency
11. Shaft rotation non-uniform or "jerky"	1. Normal variations in balance	• Time rotation by quarters. A difference of less than 3 seconds in quarter rotation time is normal
	2. Uneven biomass weight due to power outage	**a.** If severe, shut unit down and wash down disks **b.** Turn off the unit temporarily and rotate manually to uniformly wet biomass growth before restarting **c.** Decrease or stop flow of wastewater to affected units **d.** Contact manufacturer for assistance
12. Effluent quality apparently below requirements	1. Organic loading too high	**a.** Add additional operating RBCs **b.** Identify cause of additional loading and eliminate at source **c.** Add supplemental air to RBC trough
	2. Sampling or testing procedures inaccurate	**a.** If nitrification is occurring, analyze for carbon BOD only by using nitrification inhibitor **b.** Check for contaminated dilution water, sampler lines, or improper sampling storage
	3. Inadequate secondary clarifier operation	**a.** Clean and de-sludge clarifier **b.** Modify sludge removal procedures to eliminate BOD kickback **c.** Install BUGS filters after clarifier **d.** Increase alum dose to enhance flocculation
	4. Anaerobic solids in the RBC tanks producing BOD kickback	• Flush or drain tanks
13. Snails or other nuisance organisms in RBC tanks	Nutritional and conducive environment for reproduction of hard-bodied shell snails (1/8" –1/2" in size)	**a.** Addition of controlled dosages of chlorine. Physical removal may be required with taking units out of service temporarily **b.** Contact manufacturer

7.0 - MAINTENANCE PROGRAM – Do's and Don'ts

DO'S

1 Do use biodegradable soap if at all possible. The system will however handle a certain amount of normal soap. When laundering clothes, please follow manufacturer's instructions regarding quantity of detergent. Excessive use of detergent can cause odour in the system.
2 Do put large amounts of grease in a container and dump in garbage. The system will handle a certain amount of fat and grease. If a tile bed is used and if fats and grease get into it, they may plug the pores of the soil and seal up the bed. Never put large amounts of grease (i.e. old grease from deep fryer) into the sewer lines.
3 Have your system pumped out a minimum of once a year to remove sludge and scum to maintain top operating treatment in your system and filter bed.
4 For small systems equipped with a service hatch, keep the service hatch above the ground. Do not let run-off water enter system, as this will cause hydraulic overload.
5 If a tile bed is used, do keep traffic such as cars, snowmobiles, etc., away from the system bed areas as they will break pipes and seal the soil over the bed.
6 If a tile bed is used, do leave the raised filter in place without disturbing it. The filter is specifically designed to provide maximum dispersal of the water. Altering it by adding fill, covering it up or changing in any way may destroy its water dispersal characteristics and result in bed failure.
7 If a tile bed is used, do encourage a growth of ground cover over the filter bed as it helps disperse water by evaporation and transpiration.

DON'Ts

1 Do not put non-biodegradable materials downs the drain, put them in the garbage, these include any plastics, rubber, disposable diapers, sanitary napkins, rubber goods, cigarettes, children's toys, cellophane, etc. They will plug the system, and a pump out will be needed.
2 Do not put harsh chemicals down the drain. They will kill the bacteria necessary for efficient treatment. These include acid or caustic cleaners, gasoline, oil, turpentine, photographic chemicals, etc. Disinfectant and chlorine bleaches should be kept to domestic uses.
3 Do not leave taps running or faulty toilets. The excess water may overload the system and, if used, tile field causing breakout and poor treatment.
4 If you do not have access to workers with appropriate training, do not attempt to fix the mechanical parts yourself. Your dealer is trained to repair your plant and work safely with electrical and mechanical components. Call him if you have a problem or concerns.
5 Do not connect any other electrical load to the fuse or breaker feeding the plant as it will cause damage to the controls.
6 Never put large amounts of grease (i.e. old grease from deep fryer) into the sewer lines.

YOUR CO-OPERATION WITH RESPECT TO THE ABOVE POINTS SHOULD ENSURE TROUBLEFREE OPERATION OF YOUR TREATMENT PLANT AND WILL BE GREATLY APPRECIATED.

8.0 -INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS FOR VARIOUS MECHANICAL PARTS OF THE BIG JOHN AND OTHER EQUIPMENT SUPPLIED

8.1 INSTALLATION & MAINTENANCE DETAILS FOR MOTOR AND REDUCER

INSTALLATION

To ensure Iong service and dependabIe performance, an encIosed gear drive must be rigidIy supported and the shafts accurateIy aIigned. The foIIowing describes the minimum precautions required to accomplish this end.

SHAFT MOUNTED UNITS
Shaft mounted drives should be mounted as close to the driven equipment bearing support as possible to minimize bearing loads due to overhung load.

BOLT STRENGTH
BoIt size, strength and quantity shouId be verified to insure proper torque reaction capacity whatever the mounting arrangement.

LUBRICATE SHAFTS
Both the hollow shaft and the driven shaft should be liberally lubricated before assembly. The unit must slide freely onto the driven shaft. Do not hammer or force the unit into place.

AXIAL RETENTION
Each drive shaft must be retained in place relative to the gear reducer. Or each gear reducer must be retained in place relative to the drive shaft. Either way NORD recommends the use of shaft shoulders, locking collars or FIXING ELEMENTS to axially retain the shaft or gear reducer in position.

SET SCREWS
If set screws are used for axial retention, they should be tightened evenly. Flats may be filed on the driven shaft and a thread-locking adhesive used for more position retention.

SNAP RING RETENTION
Placing external snap rings on drive shafts must be performed with caution. The groove, which the snap ring fits into, may weaken the drive shaft causing premature failure. NORD does not recommend this type of shaft retention.

THRUST PLATE
In applications, which are subject to high vibratory loads, a thrust plate will provide greater resistance to axial movement. Follow the manufacturer's recommendations for assembly.

COUPLING ALIGNMENT
Shaft coupIings shouId be instaIIed according to the coupIing manufacturer's recommendations for gap, anguIar and paraIIeI aIignment. In many instaIIations, it is necessary to aIIow for thermaI and mechanicaI shaft movement when determining shaft aIignment. The coupIing manufacturer's recommendations shouId be foIIowed.

AXIAL DISPLACEMENT
The gap between shaft ends shouId be the same as the specified coupIing gap unIess overhung mounting of the coupIing hub is specified. The coupIing gap and shaft gap must be sufficient to accommodate any anticipated thermaI or mechanicaI axiaI movement.

ANGULAR ALIGNMENT
Insert a spacer or shim stock equaI to the required coupIing gap between the coupIing hub faces

and measure the clearance using feeler gauges. Repeat this at the same depth at 90-degree intervals to determine the amount of angular misalignment.

PARALLEL ALIGNMENT
Mount a dial indicator to one coupling hub, and rotate this hub, sweeping the outside diameter of the other hub. The parallel misalignment is equal to one-half of the total indicator reading. Another method is to rest a straight edge squarely on the outside diameter of the hubs at 90-degree intervals and measure any gaps with feeler gauges. The maximum gap measurement is the parallel misalignment.

CHECKING ALIGNMENT
After both angular and parallel alignments are within specified limits, tighten all foundation bolts securely and repeat the above procedure to check alignment. If any of the specified limits for alignment are exceeded, realign the coupling.

OPERATION AND MAINTENANCE CHECKLIST
1 Operate the equipment as it was intended to be operated
2 Do not overload.
3 Run at correct speed.
4 Maintain lubricant in good condition and at proper level.
5 Dispose of used lubricant in accordance with applicable laws and regulations.
6 Apply proper maintenance to attached equipment at prescribed intervals recommended by the manufacturer.
7 Perform periodic maintenance of the gear drive as recommended by NORD.

MAINTENANCE
Mineral lubricant should be changed every 10,000 service hours or after two years. For synthetic oils, the lube should be changed every 20,000 service hours or after four years. In case of extreme operating (e.g. high humidity, aggressive environment or large temperature variations), shorter intervals between changes are recommended.

OIL SPECIFICATIONS
NORD supplies all reducers filled with oil from the factory. Consult the sticker adjacent to the fill plug to determine the type of lubricant installed at the factory. Standard lubricant is ISO VG220 mineral-based oil. However, some units have special lubricants designed to operate in certain environments or to extend the service life of the lubricant. If in doubt about which lubricant is needed, contact NORD Gear.

8.2 PROCEDURE FOR ASSEMBLING BEARINGS AND PILLOW BLOCKS

Shaft Preparation Clean shaft and remove any burrs or sharp edges. Check the shaft diameter to given specifications.

Seal Installation
Place seal, which consists of: Double lip ‘G’ type seal

MOUNTING OF BEARING ON SHAFT

Adapter Sleeve Mounting
Position adapter sleeve on the shaft to correct location with respect to required bearing centerline.

A smear of lubricating oil (SAE 10 or 20) applied to the sleeve outside diameter surface results in easier bearing mounting and removal. (For pillow blocks mounted close to a pulley hub or similar obstruction, mount the adapter sleeve with threads inboard for easy removal. Remember to slide lock-nut, lock-washer and bearing onto the shaft before positioning the sleeve.)

NOTE: All bearings mounted on tapered sleeves have to be driven up the taper to the tolerances given in SKF tables, to ensure correct fits. Spherical roller bearings can be measured between the unloaded rollers and the outer ring sphere surface.

Un-mounted Clearance, Spherical Roller Bearings Measure the un-mounted internal clearance in the bearing by inserting and sliding progressively larger feeler blades the full length of the roller between the most vertical unloaded rollers and the outer ring sphere. Never run the rollers over the feeler blade, as the wrong value will be obtained. Record the measurement of the largest size blade that will slide through. This is the un-mounted internal clearance.

Bearing Mount the bearing hand tight on the adapter sleeve. Be sure the large end of the bore of the inner ring matches the taper of the adapter. To avoid damage to the bearing it is most important during this and subsequent operation that the shaft is blocked up so the bearing is unloaded. Do not apply lock-washer. Drive up procedure may damage it.

Bearing Drive Up, Spherical Roller Bearings Lubricate the face and thread of the lock nut and apply to sleeve with chamfered face toward the bearing. Tighten the lock nut. Do not attempt to tighten the lock nut with a hammer and drift (use proper wrenches), the lock nut can be damaged and chips can enter the bearing. Further tighten the lock nut and measure the internal clearance until the internal clearance is less than the un-mounted clearance figure by the amount shown in the attached table (see last page). Finally, remove lock nut, position lock washer with outer tangs facing away from the bearing, and inner tang properly seated in the slot provided in the adapter. Replace lock nut and tighten until firmly seated.

PREPARATION OF PILLOW BLOCK HOUSING

Check to be sure all pillow block parts are free of burrs and are completely clean. Internal surfaces should be removed. Apply a thin coat of grease to the bearing seat in the base. Fit the bearing and seal inserts into the pillow block base, being careful not to damage to O-rings. For assembling larger sizes where hoists must be used, it may be convenient to seat both bearings into their housing bases simultaneously.

FIXING RINGS On each shaft one bearing is generally “Held” and other bearings are “Free”, to permit shaft expansion. For “Held” bearing housings, use two fixing rings. Place one on each side of bearing.

CAPPING THE PILLOW BLOCK Place the cap on the base so that the dowel pins in the base align with the holes in the cap, being careful not to damage the O-rings. Caps and bases are not manufactured for interchangeable assembly. They must be kept together. Install cap-bolts with lock washers and tighten securely.

GREASE LUBRICATED BLOCKS

Lubrication Notes

Grease Lubrication

If grease is used as a lubricant, it should be smeared between the rolling elements and worked in.

The lower half of the housing should be packaged 1/2 to 3/4 full.

PROCEDURE FOR APPLYING LUBRICANT TO BEARINGS AND PILLOW BLOCKS

Pack each bearing as completely full of the specified grease as possible by swiveling the outer ring open and rotating it as necessary to inject the grease. Then, swivel the outer ring closed being careful not to use force in the event a roller end catch the corner of the outer ring sphere.

B) Before assembling the pillow block cap to the base, and after completing bearing and base assembly, fill 1/2 to 3/4 of the pillow block base with the same lubricant that was used to pack the bearing.

LUBRICATION PROCEDURE TO BE USED AT START-UP

A) All pillow block assemblies that have not been prepared for stage are ready for use, assuming the installation procedures have been correctly followed.

B) While shaft is rotating, lubricate each seal through the outside lubricant fittings until grease is seen emerging from the labyrinth areas. Make sure the outside of the lubricant fitting is clean before applying grease.

RE LUBRICATION

Lubricants deteriorate in time, and the rate of deterioration is a function of the lubricant used at the operating conditions encountered. Determining the re-lubrication cycle depends on sampling the grease and analysis of the samples. Provisions must be made to adequately evaluate the contamination by solids. Samples for grease evaluation should be taken from near the bearing, and evaluation of the samples should dictate the re-lubrication cycle.

Remove caps once a year and re-apply new grease.

Each seal assembly should be lubricated once a month, while the bearing is rotating, with the same grease that is used in the bearing.

GREASE CLASSIFICATION

		Oil Viscosity Saybolt Second (approx. SSU)		
Class	Type of Base (1)	@ 100 F	@ 210 F	NLGI (2) Grade
A	Lithium or Equal	200 - 500	48 – 55	0
B	Lithium or Equal	400 - 600	58 – 68	1
C	Lithium or Equal	800 - 1,000	75 – 82	1
D	Lithium only	800 - 1,000	75 – 82	2

	Grease requirement from above	

Operating temperature of bearing (4)	Low (5)	Medium	High	Suggested Re-lube cycle
0 – 70	A or B			6 – 12 months
70 – 120	B or C			6 – 12 months
120 – 160	B or C	C or D (6)	D (7)	2 - 3 weeks
160 – 200	C	C or D (6)	D (7)	1 - 4 weeks

1) Calcium Complex Greases NOT recommended for spherical roller bearings.
2) National Lubricating Grease Institute Consistency Code.
3) Definition of speed categories: Low: up to 1/4 of catalog speed limit for static oil lubrication. Medium: 1/4 to 1/2 catalog speed limit for static oil lubrication. High: 1/2 to full catalog speed limit for static oil lubrication.
4) Consult SKF Engineering if temperature is below 0o or above 200oF.
5) Extremely slow speed will require special consideration if loads are high.

   * Under all conditions, application should be checked using the SKF lubricant film parameter found in the Engineer Data Catalog.
6) Use type "C" where load is heavy, 15,000 hours-rating life or less and/or speed are less than RPM.
7) Consult SKF Engineering - Grease lube not normally recommended under this combination of operating conditions.
8) Dry clean applications only. For moderate conditions of dirt and/or moisture, use cycle of 1 to 2 months. For extreme conditions of dirt and/or moisture, use cycle of 1 week. Vertical applications normally require shorter than normal re-lube cycle.
9) Never mix greases with unlike bases.
10) Remove old grease at least once a year.

9.0 -LIMITED WARRANTY

BIODIDSK Corporation warrants the parts in each treatment plant to be free from defects in material and workmanship; for a period of 15 months from shipment or 12 months from start-up, whichever occurs first, in the treatment of domestic wastewater. Sole obligation under this warranty is as follows:

BIODIDSK Corporation shall fulfill this warranty by repairing or exchanging any component part, F.O.B. our factory, that in BIODIDSK Corporation's judgment, shows evidence of defects, provided said component part has been paid for and is returned through an authorized dealer, transportation prepaid. The warranty must also specify the nature of the defect to the manufacturer. New placed parts are under warranty for one year.

The warranty does not cover treatment plants that have been flooded, by external means, or that have been disassembled by unauthorized persons, improperly installed, subjected to external damage or damage due to altered or improper wiring or overload protection.

This warranty applies only to the treatment plant and does not include any other electrical wiring, plumbing, drainage, or disposal system. BIODIDSK Corporation is not responsible for any delay or damages caused by defective components or material, or for loss incurred because of interruption of service, or for any other special or consequential damages or incidental expenses arising from the manufacture, sale, or use of this plant.

BIODIDSK Corporation reserves the right to revise, change, or modify the construction and design of the treatment plant for domestic wastewater or any component part or parts thereof without incurring any obligation to make such changes for modifications in previously sold equipment. BIODIDSK Corporation also reserves the right, in making replacements of component parts under this warranty, to furnish a component part, which, in its judgment is equivalent to the Company part replaced.

Under no circumstance will BIODIDSK Corporation, be responsible to the warrantee for any other direct or consequential damages. Including but not limited to; lost profits, lost income, labour charges, delays in production, and/or idle production, which damages are caused by a defect in material and/or workmanship in its parts.

This warranty is expressly in lieu of any other expressed or implied warranty, excluding any warranty of merchantability or fitness, and of any other obligation on the part of BIODIDSK Corporation.

Appendix C

STP Sample Sheets, September 2008

L333

DATE:_____

TODAY FLOW

OUTSIDE TEMP:_____

TIME;_____

WIND DIR:_____

TODAY'S READING:_____ _____L.
YESTERDAY'S READING_ _____L.
TOTAL:_____ _____L.

WEATHER OBSERVATIONS_____
_____
_____
_____

U.V._____

L333 FINAL DISCHARGE	TIME	KITCHEN/LAUNDRY FINAL DISCHARGE	TIME	LIFT STATION #3 FINAL DISCHARGE	TIME
D.O._____	_____	D.O._____	_____	D.O._____	_____
P.H._____	_____	P.H._____	_____	P.H._____	_____
VISUAL_____	_____	VISUAL_____	_____	VISUAL_____	_____
SMELL_____	_____	SMELL_____	_____	SMELL_____	_____

R B C

	TIME
ROOM TEMPERATURE_____	_____
R B C TANK TEMP_____	_____
R B C D.O._____	_____
R B C P.H._____	_____

E Q TANK

	TIME
D.O._____	_____
P.H._____	_____

Back Front

BIO- MASS COLOUR_____
(Black, Grey, Dark Brown, Light Brown, White)

Back Front

BIO- MASS CONDITION_____
(Full Growth, Thick, Patchy, New, Thin, Non-Existent)

Back Front

BIO-MASS SMELL_____
(Septic, Bad, Light, Trace, Mushroom, Laundry Detergent)

OBSERVATIONS:_____
_____
_____

OPERATOR:_____

LJ 100 #1

TOTAL FLOW

DATE:_____

TIME:_____

TODAYS READING_____L

YESTERDAYS READING_____L

TOTAL_____L

LJ 100 #1
FINAL DISCHARGER TIME
D.O._____ _____
P.H._____ _____
VISUAL_____ _____
SMELL_____ _____

R B C

Back Front

BIO-MASS COLOUR_____
(Black, Grey, Dark Brown, Light Brown, White)

Back Front

BIO-MASS CONDITION_____
(Full Growth, Thick, Patchy, New, Thin, Non-Existent)

Back Front

BIO-MASS SMELL_____
(Septic, Bad, Light Trace, Mushroom, Laundry Detergent)

OBSERVATION:_____
_____
_____

L J 100 #2

TOTAL FLOW

DATE:_____

TIME:_____

TODAYS READING_____L

YESTERDAYS READING_____L

TOTAL_____L

LJ 100 #2
FINAL DISCHARGER TIME
D.O._____ _____
P.H._____ _____
VISUAL_____ _____
SMELL_____ _____

R B C

Back Front

BIO-MASS COLOUR_____
(Black, Grey, Dark Brown, Light Brown, White)

Back Front

BIO-MASS CONDITION_____
(Full Growth, Thick, Patchy, New, Thin, Non-Existent)

Back Front

BIO-MASS SMELL_____
(Septic, Bad, Light Trace, Mushroom, Laundry Detergent)

OBSERVATION:_____
_____
_____ OPERATOR_____