NEWMONT
NORTH AMERICA

Hope Bay Mining Ltd.

Waste Water Treatment Management Plan

HB-WM-OPS-MP-004

October 2012 (Rev 3)

Prepared by:

Hope Bay Mining Ltd.
North Vancouver, BC

Prepared for:

Nunavut Water Board
Gjoa Haven, NU

Doris North Project

Wastewater Treatment

Management Plan

Revision 3

Hope Bay Mining Ltd.

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October 2012

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List of Acronymns and Units

BOD_5 – biological oxygen demand

°C – degrees celsius

CFU – colony forming units

CIP – clean-in-place

ERT – Emergency Response Team

ESR – Environment and Social Responsibility

HBML – Hope Bay Mining Ltd

Km - kilometer

kPa – kilopascal

L – litres

m – meters

mg – milligram

m^3 – meters cubed

MBR - Membrane Biological Reactor

MLSS - Mixed Liquor Suspended Solids

MSDS - Material Safety Data Sheets

NWB – Nunavut Water Board

PLC - Programmable Logic Controller

PPE – Personal Protective Equipment

psi – Pound Per Square Inch

QA/QC – Quality Assurance/Quality Control

s – second

TIA – tailings impoundment area

TSS – total suspended solids

WWTP - wastewater treatment tlant

wt% - weight percent

1 Introduction

1.1 Project Location

The Hope Bay Project, located on Inuit owned land in the West Kitikmeot region of Nunavut, is approximately 125 km southwest from Cambridge Bay and 75 km northeast from Umingmaktok. The various elements of Hope Bay Project are centered at approximately 68°09'N and 106°40'W and extend from the head of Roberts Bay (an extension of Melville Sound) in the north to the Boston Camp located approximately 80 km to the south.

The water intake for the Doris North Project is located in the north end of Doris Lake at station ST-7. The wastewater effluent discharge point is a diffuser system located at station ST-8 on a rock outcrop approximately 1 km northwest from Doris Camp (Figures 1 and 2). The sampling station for the wastewater effluent is located inside the wastewater treatment plant (WWTP) at a valve located on the discharge line that goes to the permitted station ST-8 discharge point northwest of camp.

1.2 Purpose

This wastewater management plan has been prepared to fulfill the requirements of the Nunavut Water Board (NWB) Type A Water Licence 2AM-DOH0712 (Parts D, G and J). Note that 'wastewater treatment plant' is the industry standard name for sewage treatment plant, therefore, Hope Bay Mining Ltd. (HBML) uses WWTP throughout this document, with the exception of the licence wording presented in section 1.2.

The water licence permits the co-disposal of wastewater effluent and mine tailings waste into the Tail Lake Tailings Impoundment Area (TIA), and discharge to the tundra during construction prior to completion and operation of the mine processing plant and TIA. The plan presented in this document relates specifically to the following sections of the Type A Water Licence 2AM-DOH0713:

Part D: Conditions Applying to Construction:

20. The Licensee shall ensure that the Sewage Treatment Plant is operated in accordance with conditions provided in Part G, Item 3 with compliance at monitoring station ST-8 during construction.

Part G: Conditions Applying to Waste Management and Waste Management Plans

3. The Licensee shall operate the Sewage Treatment Plant in accordance with the following:

a. All sewage and grey water shall be collected and treated in the Sewage Treatment Plant.

b. During the construction phase, all effluent from the Sewage Treatment Plant at monitoring station ST-8 shall not exceed the following effluent quality limits (Table 1):

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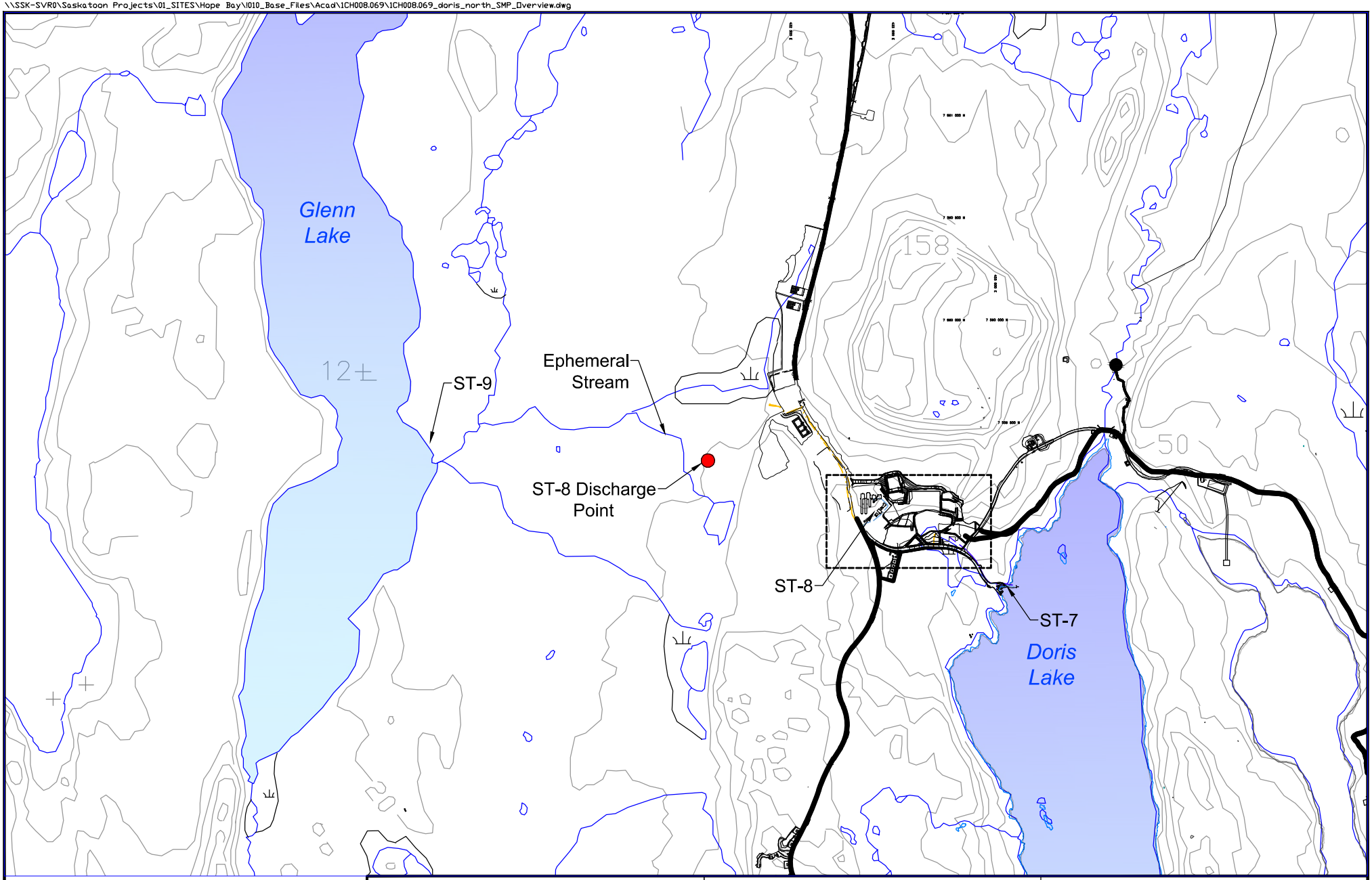


0 200 400 600 800 1000

Scale in Metres

srk consulting

SRK JOB NO.: 1CH008.069

FILE NAME: 1CH008.069_doris_north_SMP_Overview.dwg

NEWMONT The Gold Company

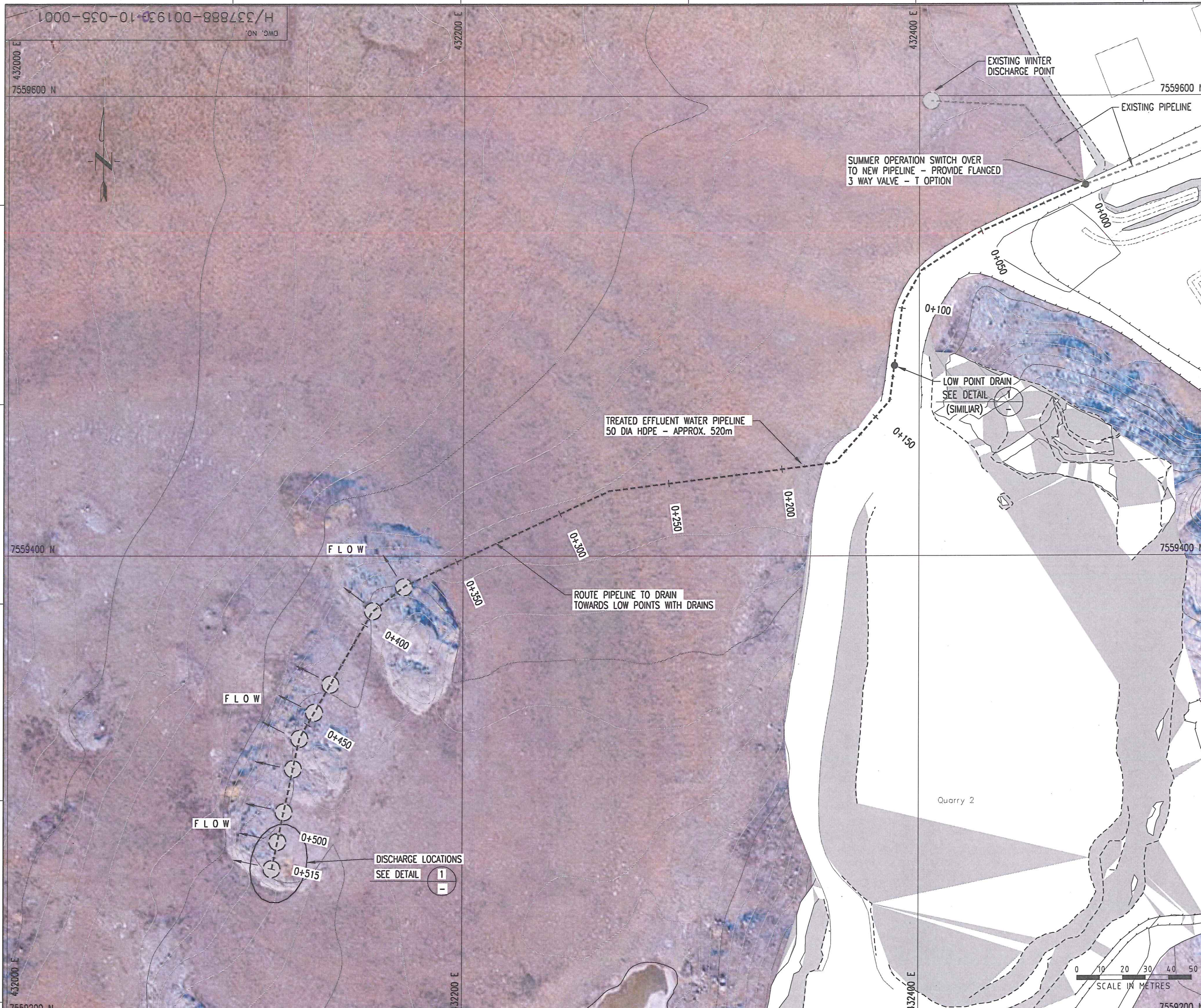
Hope Bay Project

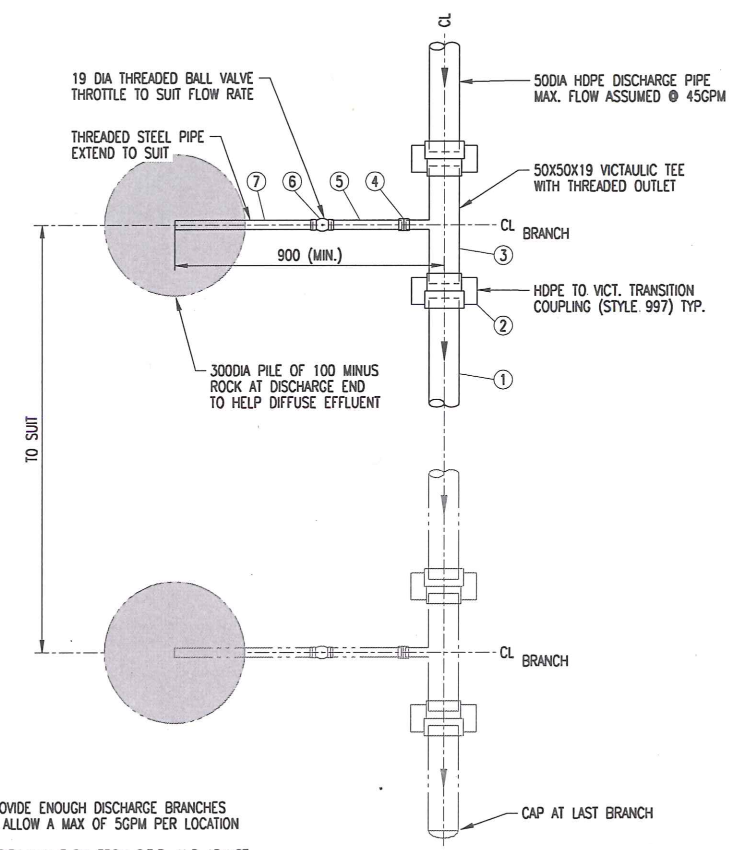
Doris North Project Wastewater Treatment Management Plan

Station Locations

DATE:	APPROVED:	FIGURE:
March 2012	MP/ML	1

ITEM	DESCRIPTION	QUANTITY
1	50 DIA SDR17 HDPE PIPE	520m
2	GROOVE TO FLANGE TRANSITION CPLG (VICTAULIC OR EQUIV.)	20
3	50x50x19 GROOVED TEE (VICTAULIC OR EQUIV.)	10
4	19 DIA THREADED CPLG	10
5	150 LONG THREADED NIPPLE	10
6	19DIA THREADED BALL VALVE	10
7	300 LONG THREADED NIPPLE	9
8	50 DIA HDPE CAP	1
9	50 DIA FLANGE ADAPTER – STUB END WITH FLANGE	3
10	50 DIA 3 WAY FLANGED VALVE – FULL PORT – T OPTION	1





NOTE:

- PROVIDE ENOUGH DISCHARGE BRANCHES TO ALLOW A MAX OF 5GPM PER LOCATION
- VERIFY MAX FLOW FROM S.T.P. AND ADJUST NUMBER OF EFFLUENT DISCHARGE POINT TO SUIT

SUMMER DISCHARGE ARRANGEMENT

DETAIL 1 – N.T.S.

Figure 2

INTERNAL/CLIENT REVIEW

APRIL 05/2011

REFERENCE DRAWINGS: DRAWING NO. | DRAWING TITLE

NO.	DESCRIPTION	BY	CHK'D	APP'D	DATE
A	ORIGINAL DRAWING	DN			05/04/2011

REVISIONS

REV.	ISSUE FOR	AUTH.	BY	DATE
A	INTERNAL/CLIENT REVIEW			05/04/2011

ISSUE AUTHORIZATION

HATCH

DESIGNED BY DN · DATE 04/2011 · DRAWN BY DN · DATE 04/2011 · CHECKED BY · DISCIP. ENGR. · PROJ. DES. COORD. · PROJ. ENGR. · PROJ. MGR. · CLIENT

NEWMONT. The Gold Company

HOPE BAY MINING LTD.

SEWAGE DISPOSAL DIFFUSER SUMMER DISCHARGE LAYOUT PLAN AND DETAIL

SCALE 1:1000 OR AS NOTED · DWG. NO. H/337888-D0193-10-035-0001 · REV. A

Table 1: 2AM-DOH0712 Wastewater (Sewage) Treatment Plant Effluent Discharge Criteria

Parameter	Maximum Average (mg/L)	Maximum Allowable in a Grab Sample (mg/L)
pH	6-9	9
Total Suspended Solids (TSS)	100	100
BOD_5	80	80
Fecal Coliform	10,000 CFU/100 mL	10,000 CFU/100 mL
Total Oil and Grease	5 and no visible sheen	10 and no visible sheen

c. During site construction, treated effluent from the Sewage Treatment Plant shall be discharged approximately 400 metres north of the camp pad.

d. Once the Tailings Impoundment Area is operational, all treated effluent from the Sewage Treatment Plant shall be discharged to the Tailings Impoundment Area.

e. The Licensee shall notify an Inspector at least ten (10) days prior to start-up of the Sewage Treatment Plant and subsequent discharge from the facility.

4. The Licensee shall submit a Sewage Management Plan, to the Board for review sixty (60) days prior to commissioning the Sewage Treatment Plant that takes into consideration operation, maintenance and sludge management.

19. The Licensee shall operate the Sewage Treatment Plant, Landfill, Landfarm, Fuel Storage and Containment Facilities, Sedimentation Pond, and Pollution Control Pond to the satisfaction of the Inspector.

Part J: Conditions Applying to General and Aquatic Effects Monitoring

12 f. The volume of sewage sludge removed from the Sewage Treatment Plant and the locations or method of sewage sludge disposal during construction, operation and closure;

20. The Licensee shall visually monitor and record observations on a daily basis during periods of discharge, all discharge onto the tundra from the:

f. Sewage Treatment Plant (during the construction phase).

All effluent discharged from the WWTP must be monitored during the construction and operation phases of the operation. During construction, a sampling station has been identified at the edge of Glenn Lake (ST-9) just prior to where the effluent would enter the lake if the effluent flows reached the lake (Figure 1).

This wastewater treatment management plan is also based on the following regulations:

- *Guidelines for the Preparation of an Operation and Maintenance Manual for Sewage and Solid Waste Disposal Facilities in the Northwest Territories*, prepared by the NWT Municipal and Community Affairs - Community Development (Duong and Kent 1996);
- *Consolidation of Environmental Protection Act* (RSNWT 1988c E.7);
- *Consolidation of the Environmental Rights Act* (RSNWT 1988 c83 2nd Supplement);
- *Consolidation of Camp Sanitation Regulations*; and
- *Environmental Guideline for General Management of Hazardous Waste*.

1.3 Responsibility

The HBML General Manager of Operations has overall responsibility for this management plan and will provide the resources to operate and maintain the WWTP.

The Facilities Manager will have site responsibility at the Doris North Camp to:

- Implement this management plan;
- Provide the on-site resources to operate, manage and maintain the WWTP in accordance with this management plan and the WWTP operation manual;
- Conduct regular inspections of the WWTP and audits of the maintenance records;
- Provide input on modifications to design and operational procedures to improve operational performance of the facilities.

The Environment and Social Responsibility Site Manager has responsibility to:

- Review and update this management plan;
- Sample the treated wastewater, reporting on the performance of the wastewater treatment facilities and assessment of whether the treated wastewater has met applicable regulatory standards; and
- Provide operational personnel with direction as to where WWTP sludge should be moved.

The Wastewater Treatment Plant Operator has responsibility to:

- Provide input on modifications to design and operational procedures to improve operational performance of the facilities;
- Provide technical expertise for the operation and maintenance of the WWTP; and
- Maintain the WWTP maintenance records.

2 Wastewater Treatment and Disposal

2.1 Background

The WWTP is used to treat wastewater from toilets, showers, sinks and kitchen for removal of contaminants including organic and inorganic compounds and bacteria. Treatment of wastewater 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. Wastewater 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. There are four stages of treatment processes are typically referred to as:

- Mechanical treatment: physical removal of large objects such as floatables and grease;
- Primary treatment: physical removal of suspended and faecal solids by precipitation;
- Secondary treatment: removal of organic matter via biological/chemical processes; and

- Tertiary treatment: physical removal of residual suspended solids (after secondary treatment)

Two or more of the treatment stages may be combined in most packaged wastewater treatment plants designed for small populations. Often, a tank (e.g., primary settling tank, equalization tank) is installed to collect wastewater prior to entering the package treatment system. This tank may also be the primary treatment tank where solids are settled and the liquid is transferred for further treatment. The secondary treatment stage is where bacterial activity is used to break down the biological content of the wastewater. After the biological content is broken down, the liquid is pressed through a membrane or filter to remove residual suspended solids (TSS) prior to removal from the system to the discharge location (tertiary treatment).

The majority of WWTPs are based on aerobic biological processes where organic compounds are degraded and ammonia is also converted to nitrate. The treatment system must be well-aerated and include suitable nutrients for the bacteria to perform effectively. Sludge is produced from a combination of decaying bacteria from the biological processes and settled particles; this sludge must be separated for proper disposal.

The efficiency of treatment of organic compounds in the wastewater treatment plant are measured by biochemical oxygen demand (BOD_5), ammonium (NH_4-N), phosphorus, oil and grease, and TSS.

2.2 Doris Camp Sanitherm® Membrane Biological Reactor Wastewater Treatment Plant

There are two Sanitherm® Membrane Biological Reactor (MBR) WWTPs, housed in seven 40 foot-long containers, located at the Doris Camp. Each of the Sanitherm® plants has a capacity for wastewater from 180 people and capacity to accept raw wastewater and sludge from other WWTPs into its surge/conditioning tanks. The Doris North camp is currently permitted to accommodate 180 people, which is below the maximum design capacity of 360 people for the two Sanitherm® plants.

The treatment process operates both aerobically and anoxically and will treat the carbon fraction of the wastewater (the BOD_5) and address ammonia and other nitrogen containing compounds to some extent. Ammonia reductions exceeding 95% are possible with this type of plant.

A regular cleaning process is necessary to maintain the membrane filter. Under continual operation (i.e., 24 hours/day and 7 days/week) the Sanitherm® filter has a life of between 3 to 5 years before requiring replacement. With cleaning and extremely good wastewater preparation and screening, 7 years of life may be possible.

2.3 Description of the Sanitherm® Membrane Biological Reactor Wastewater Treatment Plant Process

The system consists of the following major processes:

- Pre-Treatment:
  - Primary settling; and
  - Equalization.
- Biological treatment and effluent separation:
  - Anoxic treatment;
  - Aeration; and

  - Membrane reactor.
- Treated effluent discharge;
- Sludge de-watering (membrane press); and
- Clean In-Place (CIP) system.

The general layout of the plant and the process diagram are provided in Figures 3 and 4. The full operation and maintenance manual for the system is included in Appendix A. The operation and maintenance manual also describes the critical operating limits as well as potential operational failures and alternatives.

2.3.1 Pre-treatment – Primary Settling/Screening

There are separate methods of pre-treatment used for each of WWTP system #1 and 2. In system #1, wastewater enters the WWTP flowing into the primary settling tank, which is divided by a bulkhead into two sections. Settling occurs in the first section while aeration for odour control and some mixing is provided by coarse bubble diffusers in the second section. Wastewater then flows from the primary settling tank into the equalization tank through a basket screen. In system #2, wastewater enters the WWTP flowing through a travelling screen inside of a primary screened tank. Wastewater then flows from the primary screening tank into the equalization tank through a basket screen. Materials removed by the basket screens are dewatered and disposed of as necessary.

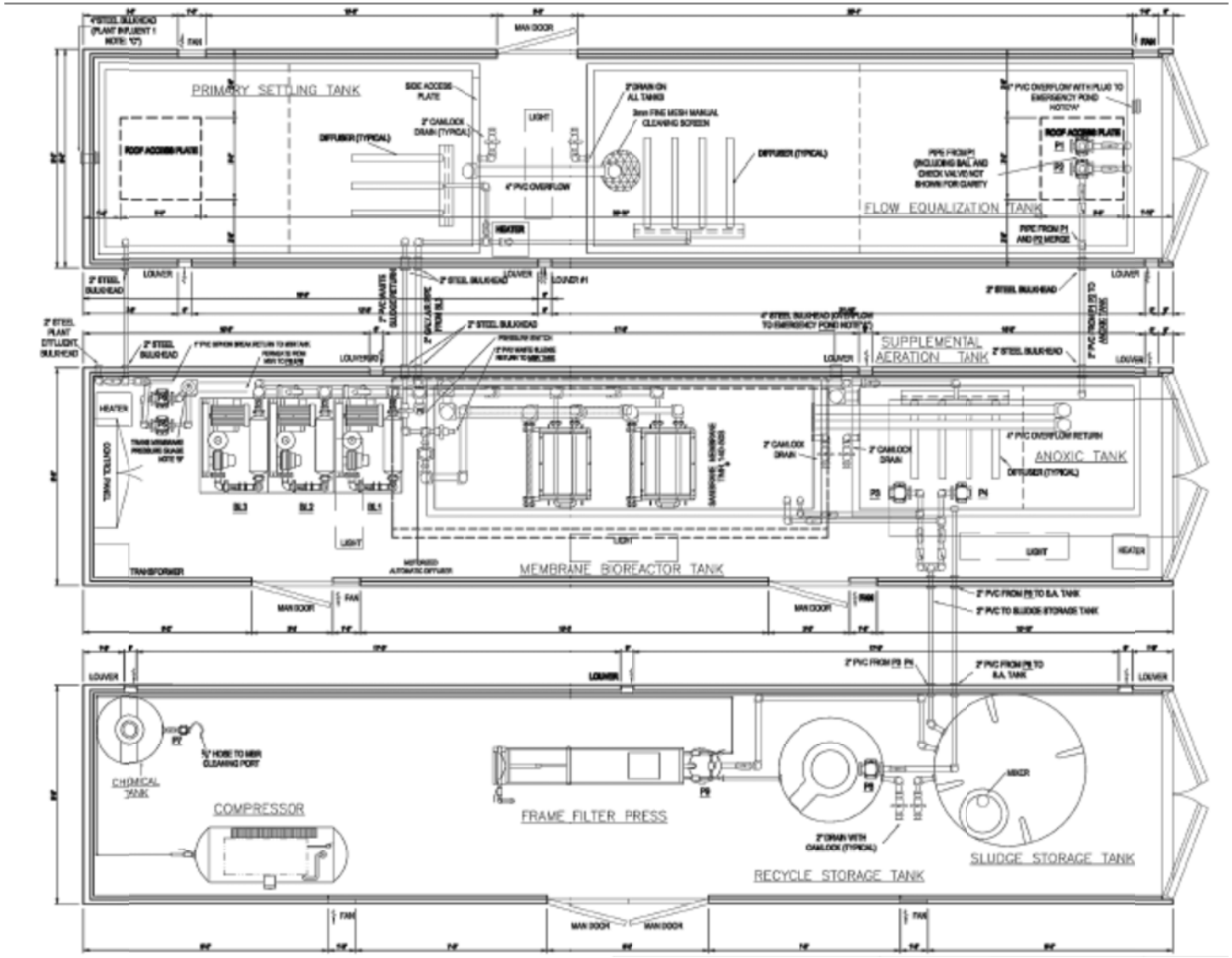
Wastewater enters the wastewater treatment plant in two ways:

- piped directly from Doris Camp through a heat traced line; and
- transferred with a wastewater truck from washcars placed around the project site into the Doris wastewater stream through one of the lift stations.

2.3.2 Pre-Treatment – Equalization

The equalization tanks provide a reservoir to smooth the fluctuating wastewater feed, allowing the downstream biological process to be fed at a constant rate. The equalization tank is divided into two sections by a bulkhead. The equalization tank is designed to hold a volume up to 3,880 L with an average flow of approximately 0.95 L/s. The tank is provided with coarse bubble aeration for mixing and freshening to reduce odours.

Two submersible equalization pumps are located in the tank and provide the forward flow at the controlled rate of 0.95 L/s. The pumps will operate with one primary duty pump running at design flow and one in standby. The standby pump automatically responds if the primary duty pump fails, as the system is controlled by a Programmable Logic Controller (PLC). The tanks are equipped with level switches and alarms. The flow to the anoxic tank is set by throttling ball valves. By the end of equalization, actual removal of any organic compounds is minimal and incidental. Aeration in the equalization tank may remove 5% of the BOD_5 and some organics may have been collected by screening.



Note: WWTP #2 at Doris Camp shares the primary settling tank and the sludge tank and filter press with WWTP #1..

Figure 3: Sanitherm® Wastewater Treatment Plant #1, General Layout

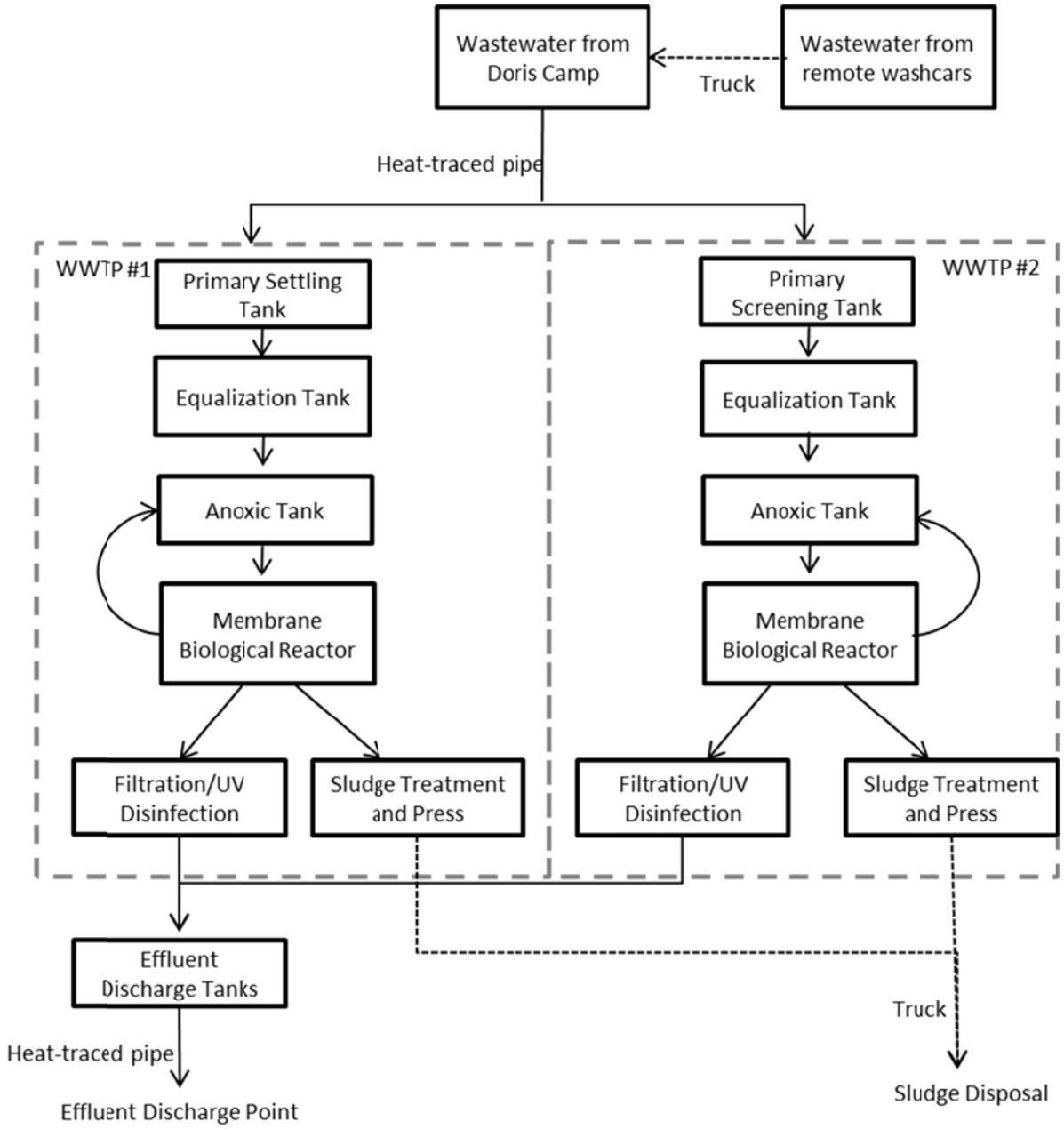


Figure 4: Wastewater Treatment Process Flow Diagram

2.3.3 Biological Treatment and Effluent Separation – Anoxic Tank

The anoxic tank is divided into two by a bulkhead to form an anoxic and supplemental aeration tank. The flow into this tank is received from the equalization tank and a recycle flow from the membrane reactor tank. The mixing of streams forms a mixed liquor suspended solids (MLSS) concentration ranging from 10,000 to 20,000 mg/L. The recycle flow contains high levels of nitrates (NO_3-N), the end products of nitrification (ammonia removal). Under anoxic conditions (zero dissolved oxygen), the nitrates will be removed and, in the conversion, will remove a portion of the BOD_5. To achieve anoxic conditions, the tank is generally not aerated, but mixing is provided by bubble diffusers, using a manual ball valve on the air line.

The process switches, pumps and alarms are controlled by a PLC. In the event of high flows, the equalization tank pumps are stopped. In the event that low levels of effluent liquid are available for processing, timers are activated and the process enters into a sleep mode. Sleep mode involves periodically turning on blowers for scouring in the membrane modules and provides minimal mixing to the equalization tank. Until the equalization tank has been reactivated and raised levels in the anoxic tank, the entire system stays in sleep mode. Transfer pumps forward the partially treated liquid to the membrane reactor.

2.3.4 Membrane Biological Reactor

The MBR step in the process provides the same aeration purpose as the previous step with the added purpose of separating the biological solids from the flow stream and thereby creating a highly treated, acceptable effluent for disposal (Figure 5). Also, like the previous tank, the MLSS will range from 10,000 to 20,000 mg/L.

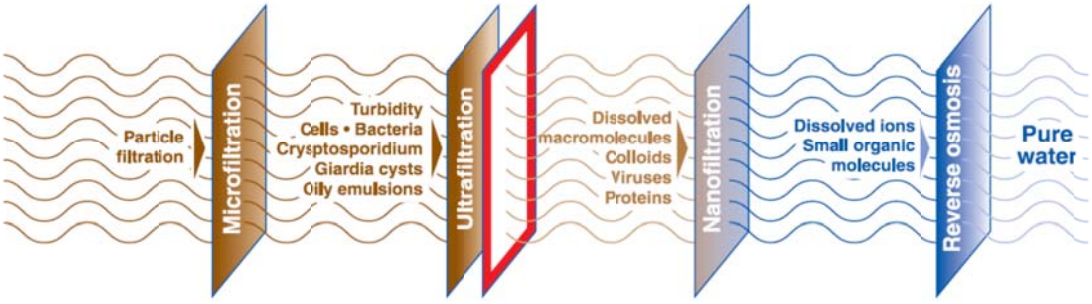


Figure 5: The 0.08 Micron Pore Size of the Sanitherm® Membrane Shown in Red and the Quality of the Water that is Produced with Different Types of Filtration

The aluminum MBR tank houses one membrane module that acts as both the aeration and the separation device. Air is provided to the unit from the membrane blower, serving primarily as a cleaning or scouring mechanism, but simultaneously providing air for mixing and process oxygenation. Two blowers are used, a primary duty blower and a standby blower. Two effluent pumps are associated with the membrane reactor tank. One operates as a primary duty pump with the other as a standby unit and is responsible for removing treated effluent from the module at a rate of 0.95 L/s.

This module is protected by level switches, alarms and the PLC. The float switches in the membrane tank prevent the water level above the membrane module from falling to a level where the unit can be affected. On low level alarms, the permeate pumps are deactivated. In addition, the permeate

pumps cannot be operated if scouring air is cut off; therefore, the blower pressure supply is monitored. Failure to supply air because of motor failure or failure to pressurize the line, possibly due to blockage or V-belt failure, prevents the effluent pumps from operating. This prevents poor quality effluent from leaving the Sanitherm® unit. Failure of the main membrane blower will trigger an alarm, and will result in a start-up of the standby unit. Recycle liquid flow continues regardless of equalization pump or effluent pump operation. The effluent removed by the permeate pump is discharged (to the tundra), while overflow from the MBR tank is recycled back to the anoxic tank

After the MBR, the treated effluent is pumped through the UV disinfection modules (there are separate modules in each WWTP) and then into the Effluent Discharge Trailer (Trailer #5).

2.4 Care and Maintenance Treatment Options

During care and maintenance, or any other period where the camp population is low, it may be necessary to shut down the existing WWTP at Doris Camp. The manufacturer indicates that the existing system can operate with low wastewater inputs; however, HBML may, depending upon the camp head count during care and maintenance in 2013 going forward, bring in a smaller Rotating Biological Contactor or MBR plant that would potentially be more efficient with a small camp population. A smaller plant would meet all licence discharge criteria and appropriate legislation and regulation. If the camp population is sufficiently small, HBML may choose to switch to alternate toilet systems (e.g., Pacto, composting) and will manage waste according to appropriate legislation and regulations.

2.5 Waste Disposal

2.5.1 Effluent Discharge

Effluent discharge occurs via pipeline from the Doris Camp WWTP to the discharge point (UTM 432125E 7559324N) located on a rock outcrop, nearly 1 km to the northwest of the Doris Camp. A three-inch diameter HDPE pipeline has been laid from the WWTP to the tundra discharge point northwest of Quarry 2. The effluent is fed into the discharge pipeline by pumps in effluent discharge station (Trailer #5). The discharge is directed to the tundra through a diffuser which will drain west towards Glenn Lake (UTM 430285E 7560303N), which is over 1 km from the discharge point. The wastewater discharge diffuser has been designed to reduce the discharge energy, disperse the effluent and to minimize erosion or vegetation damage from ice build-up. Erosion protection needs are monitored routinely at the discharge point and the down slope area to ensure that erosion management is effective. Occasionally, HBML may be required to discharge to the old tundra discharge point, which is located next to the batch plant pad. This location required less heat trace to thaw the pipeline for spring start-up and fall shut-down activities, and can be used with lower flows and pump rates.

After completion of the TIA and processing plant, HBML will switch the discharge location to the TIA as permitted in the water licence. HBML may choose to transfer treated effluent to the TIA before construction of the processing plant.

2.5.2 Sludge Dewatering, Destruction and Use

Sludge dewatering is a manual process. The operator directs some of the flow from the anoxic and supplemental aeration tank via pumps to the sludge holding tank. Polymers can be added for

thickening in the sludge mixing tank, using the mixer for agitation. The solution is pumped to a plate and frame press with filtrate directed to the sump from where it is periodically pumped back to the anoxic and supplemental aeration tank by a submersible pump. Dewatered sludge is collected in a sludge hopper and is removed for disposal.

Sludge has a typical solids content of 25-30% after the frame press. This gives it the consistency of top soil. This material can be further composted or it can be incinerated. Currently, the sludge is being incinerated in the Doris CY-100-FA-D double chamber incinerator as per the Incinerator Waste Management Plan (HBML 2012b, or latest revision).

HBML may replace incineration, with one or more of the following alternative options for dewatered sludge, which could then be used as organic matter for future reclamation activities. The alternatives identified by HBML include:

- placement in covered pits in the overburden dump;
- composting; or
- placement at isolated reclamation sites.

With any option chosen, HBML will ensure that there is not a potential risk of runoff entering a waterbody. The locations, and volumes placed, will be reported in the monthly and annual water licence reports.

2.5.3 Care and Maintenance Waste Disposal Options

In care and maintenance, the treated effluent and sludge disposal options will remain the same as described in sections 2.5.1 and 2.5.2. The disposal locations and volumes of effluent and sludge will continue to be reported in the monthly and annual water licence reports.

During seasonal shut-down activities, HBML may separate the greywater from the blackwater to reduce the quantity of wastewater that needs to be held in the storage tanks over winter. As per discussions with Andrew Keim, AANDC, if the greywater can be separated from the blackwater, the greywater will be discharged onto the overburden pile by Quarry 2 during the shutdown period.

2.6 Sanitherm® Membrane Cleaning and Critical Operating Limits

2.6.1 Sanitherm® Clean-In-Place (CIP) System – Organic Cleaning

A mild solution of sodium hypochlorite (0.5 %) is added to the membrane modules for cleaning as needed. The need for this cleaning process is determined from monitoring of the trans membrane pressure. This involves daily monitoring of the pressure reading between the discharge headers in the MBR Tank and the discharge pressure on the effluent pump. A reading indicating an increase of 3 psi (20 kPa) from the initial recorded reading requires a planned cleaning. A chemical feed pump introduces the sodium hypochlorite solution to the module. After adding 500 L to the module, the system will be allowed to soak for several hours. If an inorganic cleaning is required, a solution of oxalic acid or citric acid would be used instead of sodium hypochlorite.

The cleaning agents will generally be consumed and their oxidizing potential reduced during the cleaning process. Under normal circumstances the water from the plant would be discharged as part of the effluent stream. Under the temporary operating procedures the effluent stream is being discharged to the tundra, in this case the water from the cleaning process will be collected and

returned to the front end of the wastewater treatment plant. This will ensure that any oxidizing potential is completely consumed and that the water is subjected further normal dilution and treatment with new raw wastewater.

2.6.2 Critical Operating Limits

The following points are noted amongst others by the manufacturer as critical operational limits that must be met to ensure proper system operation, maximum lifespan and good effluent quality. For a complete list of installation, operation and maintenance requirements refer to the manufacturer's manual, parts of which are presented in Appendix A.

- The Sanitherm® WWTP is designed to treat normal human domestic waste from toilets, showers, laundry and kitchens.
- It is not designed to treat industrial wastes, chemical cleaning agents, bactericides or any product that is toxic to the bacteria.
- Only biodegradable detergents and products should be used in effluent feeds.
- Kitchen grease traps must be well serviced to prevent overloading the Sanitherm® system with oils and grease.
- Plastic, rubber and other non-biodegradable items must be kept out of the wastewater flow.
- The Sanitherm® unit must be protected from freezing. Maintain the temperature from 5º to 40° C (41° to 104° F).
- The effluent discharge from the Sanitherm® unit must not be used for drinking water.
- Sanitherm® effluent water should be tested for suitability before it is used again.
- To protect the membranes and prevent clogging, design the peripheral equipment in such a way that the raw water is supplied to the membrane submerged basin via a screen with openings 3 mm or less.
- Avoid applying pressure to the permeate side.
- Large amounts of iron, manganese, calcium and/or silica may cause clogging in the membrane.

2.7 Wastewater Treatment Plant Operator Training

Thorough knowledge of the operation and maintenance of the wastewater treatment plant is required to properly operate the plant and achieve compliant effluent discharge. HBML has a dedicated wastewater treatment plant operator who manages all aspects of the plant and performs the routine maintenance as specified by the manufacturer in the Operation and Maintenance Manual (Appendix A). New WWTP Operators are provided with mentoring and on-the-job training by an experienced operator.

2.8 Record Keeping

Records of operation and maintenance are required to evaluate the effectiveness of the wastewater treatment plant operation.

The records are completed daily and include the following information:

- Volume of any effluent discharged to environment;
- Sludge volume pressed and removed from the plant; and
- Details of any maintenance undertaken at site.

The record sheets are stored in the On-site Office. The daily operations log is kept in the WWTP.

2.9 Discharge Monitoring

HBML has implemented a monitoring program for the WWTP as required under the Water Licence.

The objective of discharge monitoring is to measure:

- The performance of the WWTP;
- Ensure that treated water from the WWTP meets the appropriate discharge standards; and
- Assess water quality in the receiving water environment.

All treated effluent discharged from the WWTP at the Doris North Project Monitoring Stations ST-8 and ST-9 during the construction and operation phase must meet the quality standards in Part G Item 3b of the water licence (see Section 1.2).

Monthly samples are collected from station ST-8, located in the discharge line in the WWTP by the Environment and Social Responsibility Department. During open-water season, monthly samples are also collected from station ST-9, located at Glenn Lake. All samples are collected and handled following the sampling procedures and QA/QC methods outlined in the Hope Bay QA/QC Plan (HBML 2012a, or latest revision), and the applicable water sampling standard operating procedures developed by the Environment and Social Responsibility Department following instructions provided by the analytical laboratory.

The samples from ST-8 and ST-9 are analyzed for

- BOD_5;
- TSS;
- Faecal coliforms;
- pH;
- Conductivity; and
- Oil and grease (concentration and visible sheen).

Sample results from station ST-8 are reported to the WWTP operator upon receipt from the laboratory. The results are reported in the monthly and annual reports required under the Water Licence.

2.9.1 Off-Specification Effluent Quality

The potential does exist for isolated, short term discharges of treated wastewater effluent which does not meet the discharge limits due to equipment malfunction or operator error, however, the system design limits the potential for partially treated wastewater to be discharged from the plant.

In the event that analysis indicates that a monitoring sample exceeded the specified discharge limit, HBML will, as soon as possible upon receiving the analytical results:

- Re-sample the effluent and submit the sample for appropriate analysis;
- Conduct a detailed inspection of the entire WWTP and all associated facilities to identify the cause of the off specification discharge and ensure that the facility is operating within the prescribed parameters and operational limits;
- Correct the original cause; and
- If necessary, implement additional monitoring of the downstream environment to assess the level, if any, of the impact of the off specification discharge.

Due to the relatively short duration of such a condition, residual environmental effects resulting from such an event are likely to be negligible.

3 Health and Safety, and Emergency Response

3.1.1 General Health and Safety Requirements

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

- No person is to drink the water in the Sanitherm® plant or the water that is discharged from the plant.
- Furthermore, working with wastewater requires adequate protection for operators. This includes wearing steel toed boots, hard hat, safety vest, protective goggles and protective gloves. Face shields should be used if there is a risk of wastewater or sludge being splashed near the operator's face.

Operators, and workers assisting with operation or maintenance of the WWTP, must have current Hepatitis A and B vaccinations.

3.1.2 Chemical Handling

In handling chemicals, operators should wear protective goggles, protective gloves and other protectors. Before using chemicals, the details on Material Safety Data Sheets (MSDS) should be checked, and the MSDS must be available in the WWTP building. Follow the first aid and emergency response procedures described in the MSDS (Appendix B). Various oxidizing chemicals will be used on the Sanitherm® WWTP facility as indicted in Table 2.

Table 2: Details of Chemicals and Volumes Needed for Cleaning the Sanitherm® MBR WWTP

Contaminant	Chemical	Solutions Concentration	Amount Used	Hold time
Organic matter	Sodium hypochlorite	2,000 – 6,000 mg/L (effective chlorine concentration) (pH is about 12)	5 L/ element	1 to 3 hours
Inorganic matter	Oxalic acid	0.5 - 1.0 wt%	5 L/element	1 to 3 hours
Inorganic matter	Polymer	1.0 – 3.0 wt%	½ Kg/press	1 hour
Inorganic matter	Defoamer	1.0 – 3.0 wt%	Varies (~ 1 L/day)	1 to 3 hours
Inorganic matter	Citric acid	1.0 – 3.0 wt%	5 L/element	1 to 3 hours

3.1.3 Spill Response

Only small quantities of chemicals are maintained on hand for the WWTP. In the event of a minor chemical spill, the MSDS instructions for containment and clean-up will be followed and the incident must be reported to ESR and the Health, Safety, and Loss Prevention departments. In the event of a large spill of chemicals, the Emergency Response Team (ERT) will be called and clean-up crew members will follow the direction of the ERT. Spills of raw or partially treated wastewater will be managed following the same procedure. The details for the spill response procedures are included in the most recent Spill Contingency Plan (HBML 2012c, or latest revision).

Spills will be reported as per the Nunavut and Northwest Territories Spill Reporting Requirements, and will be included in the monthly and annual reports for the water licence.

3.2 Revision Record

This, the HBML Doris North Wastewater Treatment Management Plan, will be reviewed on a regular basis (at least once per calendar year) and revised as required. Each revision will be recorded in Table 3.

Table 3: History of Wastewater Treatment Management Plan Revisions

Revision Number	Review Date	Description of Revisions	Revised By
0	July 2008	Initial issuance of Wastewater Treatment Management Plan	SRK Consulting
1	March 2009	Updates as per concordance table in Appendix of this document	SRK Consulting
2	March 2012	Updated for Doris North and added the second Sanitherm© system information and removal of Matrix Camp	Angela Holzapfel, HBML
3	October 2012	Included Use of old discharge point and greywater discharge to overburden pile as per approvals from AANDC	Angela Holzapfel, HBML

3.3 References

Duong, D., and R. Kent. 1996. Guidelines for the preparation of an operation and maintenance manual for sewage and solid waste disposal facilities in the Northwest Territories. NWT Municipal and Community Affairs, Community Development Branch. October 1996.

HBML. 2012a. Quality Assurance and Quality Control Plan. Revision 6. Hope Bay Mining Ltd., Environmental and Social Responsibility. July 2012.

HBML. 2012b. Incinerator Management Plan. Hope Bay Mining Ltd., Environmental and Social Responsibility. March 2012.

HBML. 2012c. Spill Contingency Plan Revision. Revision 5. Hope Bay Mining Ltd., Environmental and Social Responsibility. October 2012.

Appendix A: Sanitherm® Operations Manual

SaniBrane®
Operations Manual

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SANITHERM A DIVISION OF wellco

Over Sixty Years of Excellence

SANIBRANE® OPERATIONS MANUAL

TABLE OF CONTENTS

FORWARD:

This operations manual has been created to provide the user:

- An overview of Sanitherm's SaniBrane® Membrane
- Requirements for safe operations
- Installation information
- Operation information
- Maintenance procedures
- Peripheral equipment requirements

Important NOTE:

- All metric conversions (") were done using an electronic converter, however are not deemed exact.

- Operators must read through this manual to ensure efficient and effective operation.

OVERVIEW OF SANITHERM'S SANIBRANE® MEMBRANE:

1.1 Introduction:

The following is a brief overview of the operation and maintenance of SANITHERM SANIBRANE® MBR, a revolutionary system that utilizes cutting edge FLAT PLATE membrane technology. There are many benefits of our FLAT PLATE membranes. The design ensures effective, reliable air scouring and consistent, long-term flux rates. The design has been proven in installations around the world in both industrial and municipal applications.

1.2 Module:

The module, shown in Diagram 1.3i, consists of a membrane case and a diffuser case. The membrane case incorporates multiple membrane elements shown in Diagram 1.3ii, which are connected to a manifold with transparent tubes. The diffuser case contains the air header and diffusers. Each membrane element can be removed individually.

Diagram 1.3i - Module

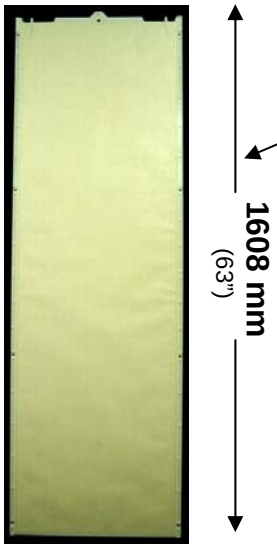
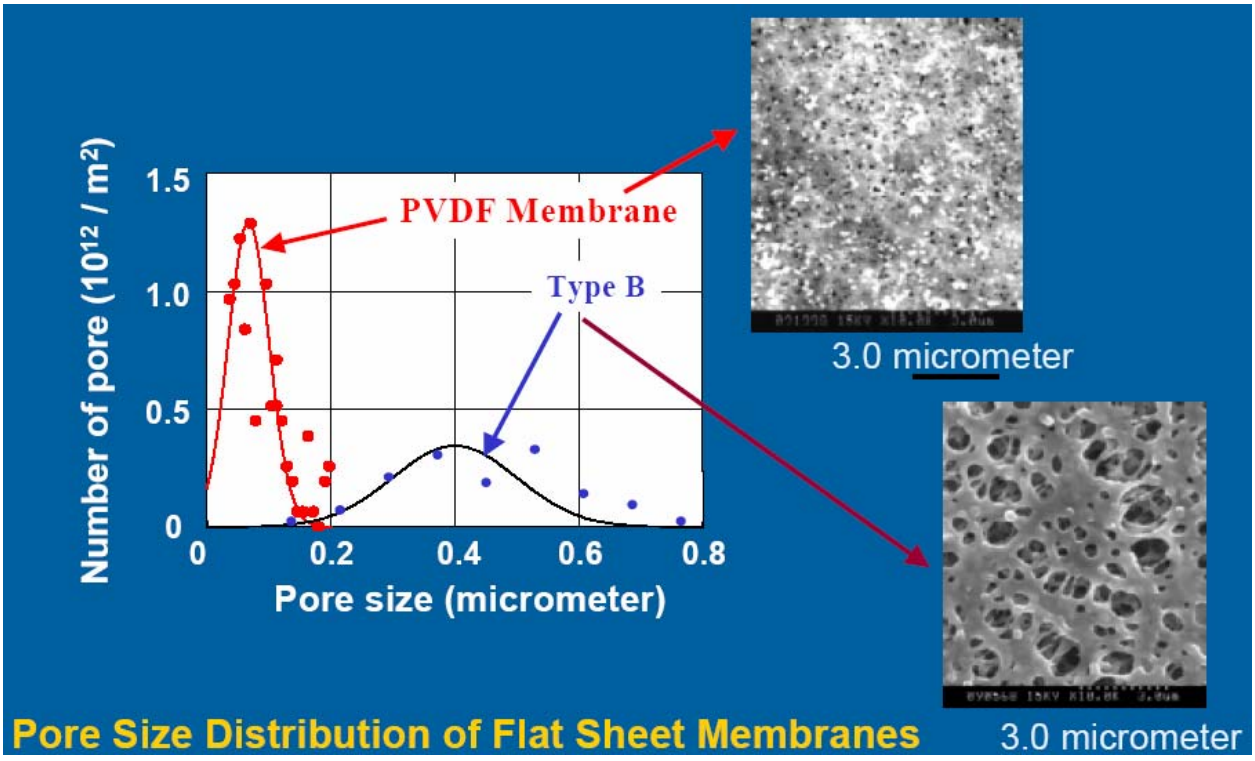


Diagram 1.3ii - Membrane element

1.3 Membrane Materials and Structure:

The membrane sheets are made from polyvinylidene fluoride (PVDF) that is bonded to the Polyethylene Terephthalete (PET) support fabric, chemically welding them to the surface. The PET is a non-woven fiber for the base and makes this membrane superior in strength and chemical stability.

The structure has a small pore size (.08 micron) with narrow pore size distribution. This structure gives an outstandingly high treated water quality.



2 SAFETY PRECAUTIONS:

All installation, operations and maintenance procedures must adhere to each jurisdictions occupational health and safety standards, including providing individuals with appropriate protective attire and safe working conditions.

Throughout this manual, special attention is given to areas that outline Danger, Caution and Warnings. Although they are outlined in each individual section, they are reiterated in Table 2.1, 2.2 and 2.3 for added awareness.

2.1 Danger:

The symbol within Table 2.1 shows anything that will pose a hazard to one's self or equipment.

Table 2.1 DANGER SYMBOLS

SYMBOL:	
MESSAGE(s):	• DO NOT leave the SaniBrane® in temperatures higher than 40^{O} C (104^{O} F). • Avoid direct sunlight • Protect SaniBrane® from freezing • Sparks from welding, fusion cutting or grinding can cause irreversible damage. Use fireproof sheets or other protective measures. • The chains or slings being used to raise the SaniBrane® must be sufficient for the weight of the SaniBrane® System. Lifting should be done in a straight upward motion not allowing any shaking of the product. • No one should ever be under the SaniBrane®! • To install SaniBrane® set a foothold. • Never climb on the module. • Use protective equipment to ensure the safety of the worker. • DO NOT place heavy objects on the module.

2.2 Warning:

The symbol within Table 2.2 indicates a possible or impending hazard to self or equipment.

Table 2.2 WARNING SYMBOLS

SYMBOL:	
MESSAGE(s):	• DO NOT use permeated water for drinking. To use permeated water, analyze its quality and ensure that the water quality meets the intended purpose. • Many chemical agents are extremely hazardous to one's health. When handling chemicals, one should wear protective goggles, gloves and any other available protective gear. Be sure to carefully read the details of the material safety data sheet (MSDS) BEFORE handling any chemicals. • If chemicals come in contact with your skin or clothes, immediately rinse with large amounts of water and see a physician. • Store chemicals in a dark, cold place away from direct sunlight. • If chemicals come in contact with your eyes, immediately flush with running water and see a physician. • Be sure to use the proper storage and mixing tanks for all chemicals • Do not mix sodium hypochlorite with heavy metals or acids. Its mixture with an acid generates toxic chlorine gas. • If an abnormality is found in the equipment during chemical cleaning, immediately stop the operation. • If chemicals are injected forcibly with the chemical feed pump or by any other means, the internal pressure of the element may increase, causing damage to the element. Be sure to inject chemicals by gravity at 10 pKa or less. • Before feeding chemicals for chemical cleaning, check that the water surface is 500 mm (20") or more above the top of the module. Feed chemicals after SaniBrane® are completely submerged.

2.3 Caution:

The symbol shown in Table 2.3 indicates care should be taken to avoid hazards or mistakes to one's self or equipment.

Table 2.3 CAUTION SYMBOLS

SYMBOL:	**CAUTION**
MESSAGE(s):	• DO NOT leave the SaniBrane® in temperatures higher than 40^{O} C (104^{O} F). • Avoid direct sunlight • Protect SaniBrane® from freezing • Sparks from welding, fusion cutting or grinding can cause irreversible damage. Use fireproof sheets or other protective measures. • DO NOT place heavy objects on the module. • To protect the membranes and prevent clogging, design the peripheral equipment in such a way that the raw water is supplied to the membrane submerged basin via a screen with openings 3 mm or less. • Avoid applying pressure to the permeate side. • Before feeding clean water to the membrane submerged basin, open the air discharge valve to release air form the element. After feeding water, close the air discharge valve. • DO NOT use raw ground water for start up testing. If it contains a large amount of iron, manganese, calcium and/or silica it may cause clogging the membrane. • Clean water operations tend to cause clogging, and should only be done cautiously. • After clean water operation, keep the membranes wet. Dried membranes will reduce permeable amounts of water. • To restart filtration after maintenance, keep the membranes wet during the maintenance. Dried membranes will reduce permeable amounts of water.

3 PRE-INSTALATION PRE-PREPARATION:

3.1 Equipment check:

To ensure that you are ready to start installation, keep in mind the following:

1. All items match the shipping slip*
2. There has not been any damage in transport.
3. The protective cover is in position.
4. There should be full preparation for the transportation of the SaniBrane® including a clear route.
5. You will require a cargo crane or forklift for unloading the SaniBrane® from the truck.

** Please contact the trucking company should any items be missing.*

3.2 Storage of the SaniBrane®:

Store the SaniBrane® indoors, keeping it upright, at 5^{O} to 40^{O} C (41^{O} to 104^{O} F). Avoid direct sunlight.

During the entire process take adequate measures to protect the elements and other components. Sparks from welding, fusion cutting or grinding can cause irreversible damage. Use fireproof sheets or other protective measures.
If the SaniBrane® system *must* be stored outdoors during the construction phase, make certain that it is not for a long period of time and note the following requirements:

1. Maintain the temperature from 5^{O} to 40^{O} C (41^{O} to 104^{O} F).
2. Prevent freezing.
3. Prevent it from getting wet
4. Prevent it from being immersed in water
5. Avoid direct sunlight

CAUTION

- DO NOT leave the SaniBrane® in temperatures higher than 40^{O} C (104^{O} F).
- Avoid direct sunlight
- Protect SaniBrane™ from freezing
- Sparks from welding, fusion cutting or grinding can cause irreversible damage. Use fireproof sheets or other protective measures.
- DO NOT place heavy objects on the module.

4 SPECIFICATIONS:

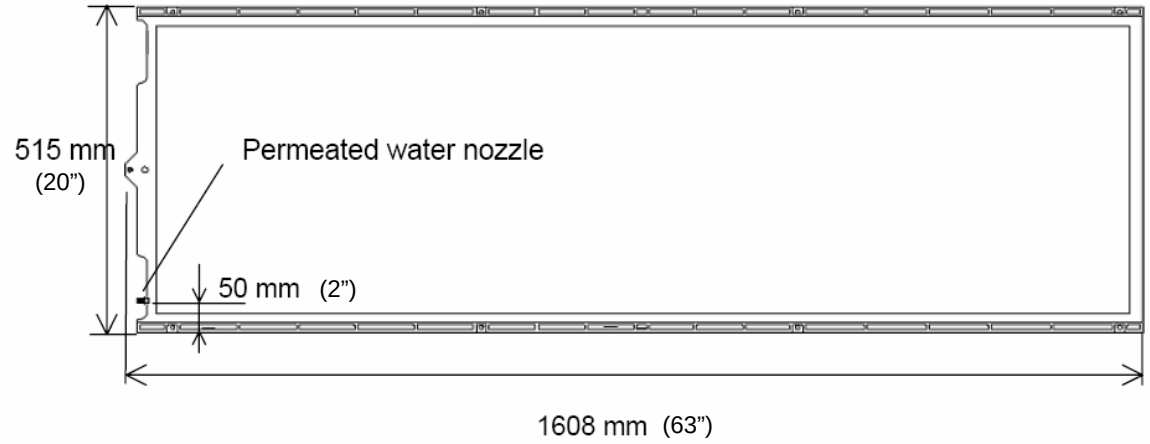
4.1 Specifications of the Element:

Table 4.1 and Diagram 4.1 – show the specifications and the appearance of the element, respectively.

Table 4.1 Element (TSP – 50150)

Model Name		TSP-50150
Membrane configuration		Flat Sheet
Application		Filtration of activated sludge
Filtration method		Suction filtration
Nominal pore diameter (um)		0.08
Effective membrane)area (m^2)		1.4
Dimensions (mm)	Total width	515
	Total Height	1,608
	Thickness	13.5
Weight	Dry	4.8
	Wet (Reference)	8.0
Main Material	Membrane	PVDF and PET non-woven fibre
	Supporting Panel	ABS resin

Diagram 4.1 Appearance of the Element.



4.2 Specifications of the Tube:

Table 4.2 shows the specifications of the tube.

Table 4.2 Specifications of the Tube

Material	TPU-ARET*[1]
Inside diameter/ outside diameter/ total length (mm)	8/12/360

* - Allowable temperature limit: 60° C (140° F)

*1 - The material name as per ISO-18064

4.3 Specifications and Performance of the Module:

Table 4.3i shows the specifications of the Module.

Table 4.3i Specifications of the Module

Model Name		TMR 140-050S	TMR140-100S	TMR140-200W	TMR 140-200D
Number of membrane elements		50	100	200	200
Element block structure		1 deck 1 row	1 deck 1 row	1 deck 2 rows	2 decks 1 row
Dimensions *[1]	Width (mm)	810	810	840	810
	Length (mm)	950	1,620	3,260	1,620
	Height (mm)	2,100	2,100	2,100	4,130
Weight (kg)	Module (dry)	400	695	1,430	1,365
	Aeration block (dry)	40	65	150	65
	Element block (dry)	360	630	1,280	1,300
	Element block (sludge clogging) *[2]	690	1,240	2,480	2,500
Material	Diffuser, Frame, Permeated water manifold	304 stainless steel			
Connection flange *[3]	Manifold	2” (50 mm)	2” (50 mm)	3” (75mm)	2” (50 mm)
	Air Diffuser	2” (50 mm)	2” (50 mm)	2” (50 mm)	2” (50 mm)
Operating Range	Temperature (degree C)	5-40			
	pH*[4] of liquid	5-10			
	MLSS (mg/L)	Not higher than 18,000			
	Trans-membrane pressure (kPa)	Not higher than 20 (2.9 psi)			
	Cleaning chemicals feed pressure (kPa)	Not higher than 10 (1.45 psi)			
	Cleaning chemicals and chemicals concentration	Sodium hypochlorite (effective chlorine concentration) : 2,000 – 6,000 mg/L (pH is around 12) Oxalic acid : 0.5 -1.0 wt% Citric Acid : 1.0 - 3.0 wt%			
	Scouring Air Flow Rate (NL/min/Module)	650-1,000	1,300 – 2,000	2,600 – 4,000	1,800 – 2,000
		23-35 cfm	46-71 cfm	92-142 cfm	64-71 cfm

*1 indicates the maximum size (excluding the connection tube)
*2 the maximum weight is assumed for a case of sludge clogging between elements.
*3 for flange dimensions see the drawings at the end of this manual
*4 Excludes chemical cleaning of the elements using a designated chemical
* comply with the above operating range.

Table 4.3ii shows the performance of the Module

Table 4.3ii Module Performance

Model Name		TM 140-050S	TMR 140-100S	TMR 140-200W	TMR 140-200D
Permeate water quality *1	TSS (mg/L)*2	Not higher than 1.0			
	Turbidity (NTU) *3	Not higher than 1.0			
Filtration capacity *4	<Reference> Quantity of water treated m3/d (USGPD)	53 (14,000)	105 (27,700)	210 (55,500)	210 (55,500)

*1 - This value can be attained when operated under the standard operating conditions as specified in this Instruction Manual during a period specified separately by Sanitherm, a division of Wellco Energy Services.
*2 – Measuring method of TSS is complied with Standard Method of Examination of Water and Wastewater 20th Edition (1998), Section 254OD, Total suspended Solids Dried at 103^{O} to 105^{O} or ISO 11923.
*3- Measuring method of NTU is complied with Standard Method of Examination of Water and Wastewater 20th Edition (1998), Section 2130, Turbidity or ISO 7027
*4 - Reference value, not a guaranteed value, for treatment of ordinary sewage in a case where the water temperature is higher than 15^{O} C (59^{O} F). Based on a flex rate of 0.75 M^3/ M^2/ D (18.4 9/ft 2/0)

5 PERIPHERAL EQUIPMENT DESIGN FOR SANIBRANE® SYSTEM:

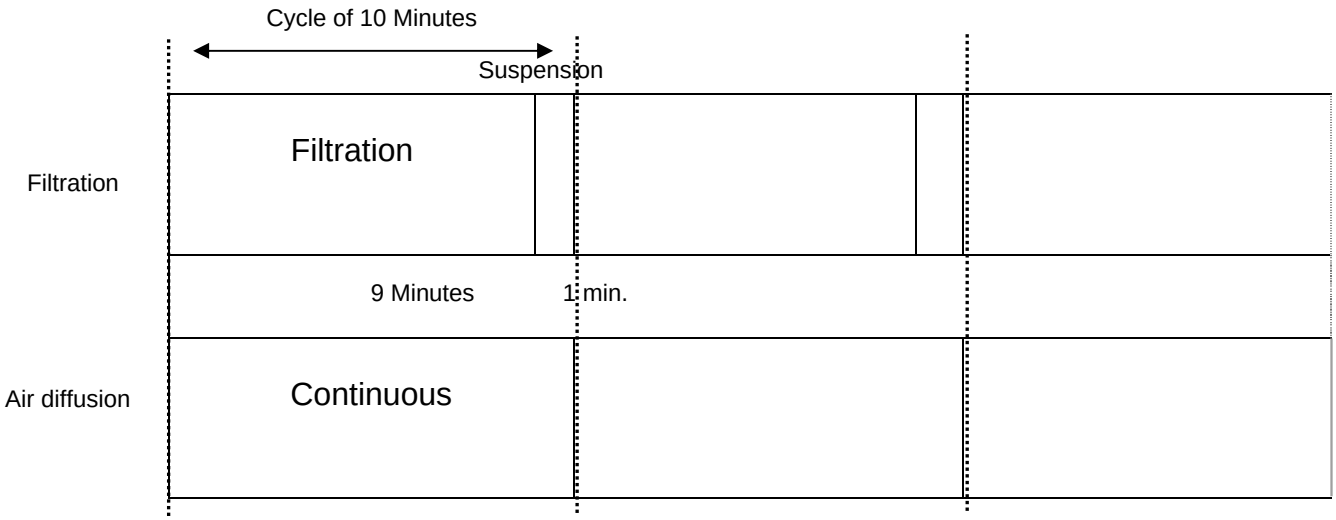
The following explains the standard time chart, membrane filtration flow chart, pipeline procedures and SaniBrane® system layout in the membrane submerged basin. This information will help you design the peripheral equipment necessary to operate your SaniBrane® system.
In order to design the peripheral equipment necessary to operate your SaniBrane® system, you must first understand the process.

5.1 Standard Time Chart:

Two operations are available for filtration, continuous filtration and intermittent filtration. In intermittent filtration, filtering operation is suspended at certain intervals while air diffusion continues, as shown in Diagram 5.1.

While filtration is suspended, air diffusion continues in the absence of suction, enabling effective cleaning of the membrane surfaces. Although a control device is required to start and stop filtration, intermittent filtration is recommended when you need a higher filtration flux.
Recommended intermittent filtration setting: 9 minutes for filtration and 1 minute for suspension:

Diagram 5.1: Standard Time chart:



5.2 Flow Diagram of Membrane Filtration:

Points (5.2.1) and (5.2.2) follow with standard examples of the operation of the SaniBrane® system with a natural water head and with suction pump. Ancillary devices necessary for operations are explained in (5.2.3).

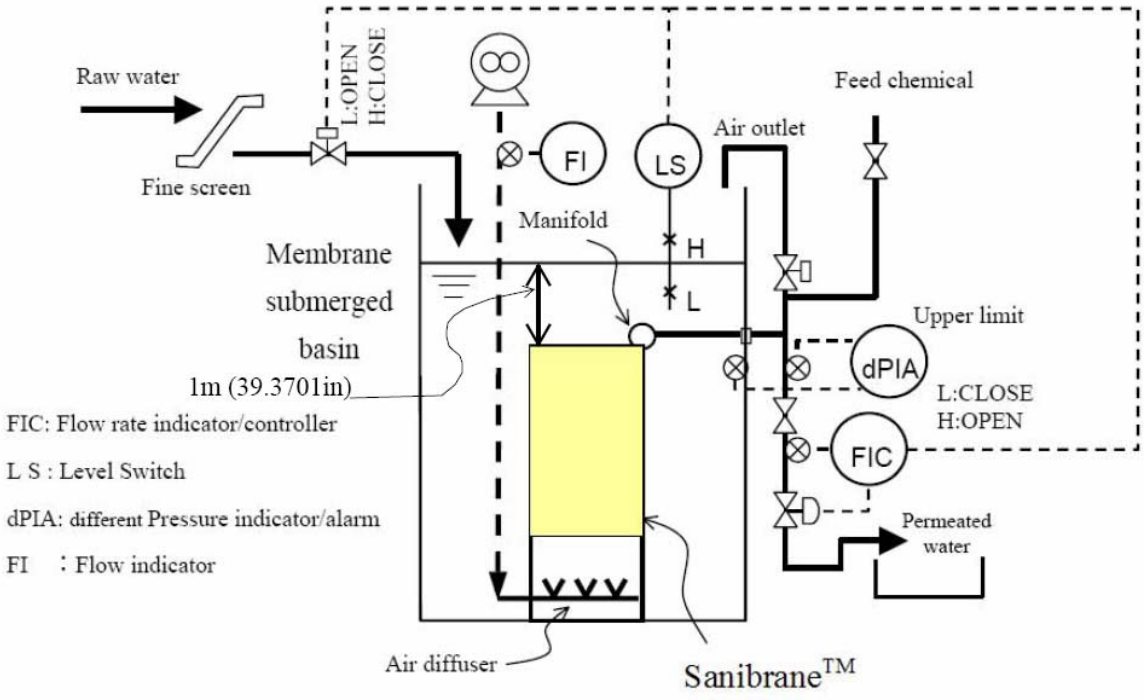
5.2.1 Operation with natural water head:

In natural water head operation, filtration is performed using the natural water head differential pressure, generated from the vertical distance between the membrane submerged basin's water surface and water outlet (see Diagram 5.2.1).

To produce a water head, the water outlet should be located below the surface of the water in the membrane submerged basin, typically 1 meter lower.

It is recommended that the permeated water pipe be connected to the water outlet so that the pipe penetrates the basin wall, as shown in Diagram 5.2.1.

Diagram 5.2.1 Natural Water Head Operation



The opening of the permeated water flow control valve is automatically controlled for flow rate. Moreover, if the water level in the membrane submerged basin gets to the lower limit, filtration will be stopped. If it gets to the higher limit, it will stop raw water inflow. The equalization tank (not shown) is designed to meet the fluctuation of the raw water flow rate.

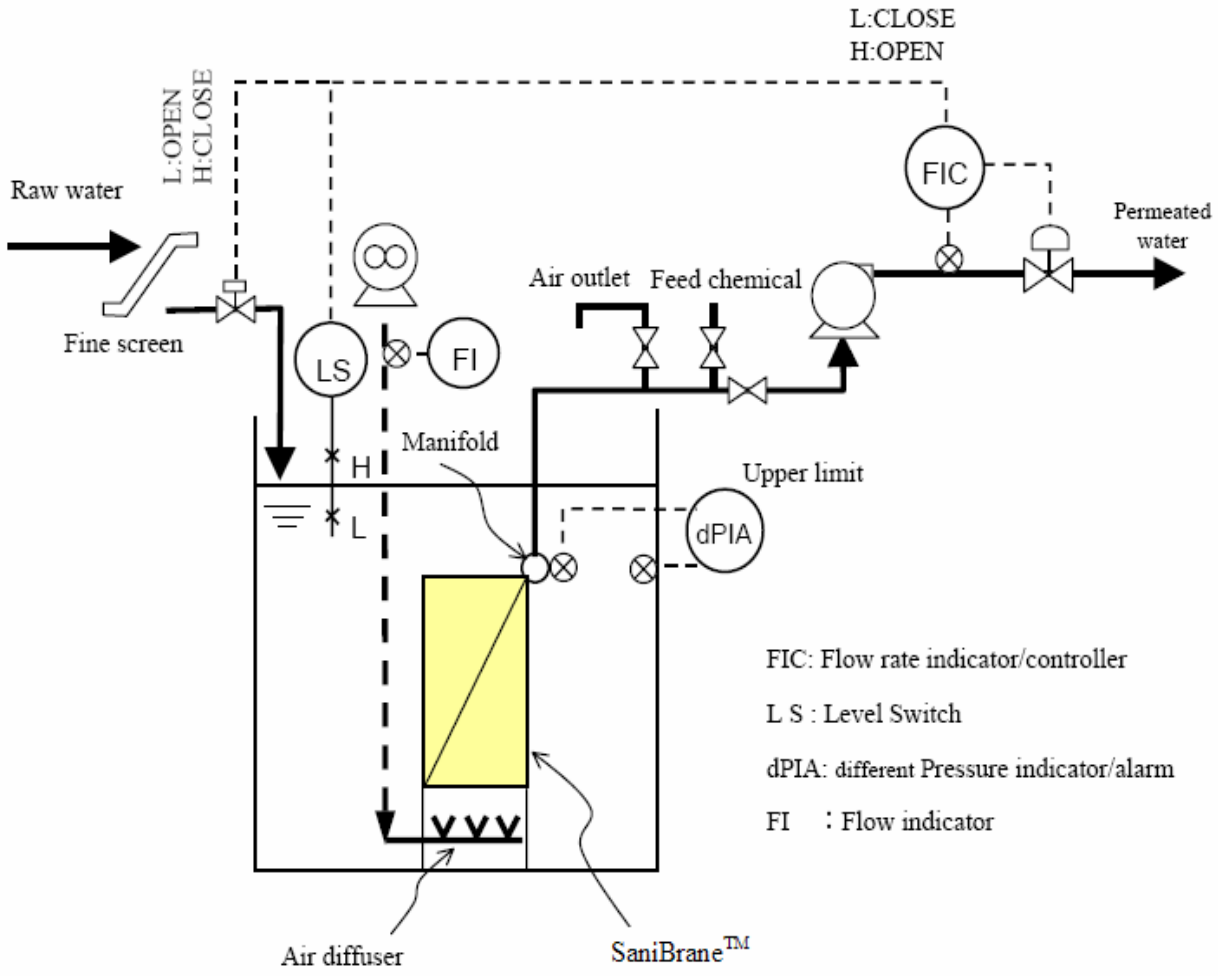
Air must be discharged once a day from the natural water head. If air were allowed to collect inside the pipe it will reduce its effectiveness.

If the pipe is connected to the water outlet by penetrating the basin wall, then air can be discharged by opening the air discharge valve during suspension of filtration. However, installing an automatic air discharge valve is highly recommended.

5.2.2 Operation with suction pump:

Filtration is performed by using the suction of a pump (see Diagram 5.2.2)

Diagram 5.2.2 Pump Suction Operation



In filtration, the opening of the permeated water flow control valve is automatically controlled for flow rate. If the water level in the membrane submerged basin gets to the lower limit, filtration will be stopped, and if it gets to the higher limit, it will stop raw water inflow. Fluctuation of the raw water flow rate is absorbed by the equalization tank (not shown), as its capacity is designed to meet the amount of fluctuation.

5.2.3 Ancillary Devices:

The following explains devices shown in the examples on the preceding pages. For the operation of the SaniBrane® System, devices other than those specified here may be used after consultation with Sanitherm:

a) Fine Screen
   To protect the membrane from clogging, raw water should be supplied to the membrane submerged basin through a screen with openings 3 mm or smaller.
b) Flow rate control device
   A flow rate controller, such as a flow rate control valve and flow meter, should be installed on the permeated water line to control the flow rate of permeated water. To operate multiple units of the SaniBrane® System, one should install one flow rate controller on each train of the SaniBrane® System.
c) Differential pressure instrument
   The sensors of the differential pressure instrument should be installed on the permeated water line and the membrane submerged basin at the same level to measure the trans-membrane pressure. To operate multiple units of the SaniBrane® System one should install a differential pressure instrument on each train.
d) Air supply unit (blower)
   This unit supplies air to the air diffuser. The flow rate of air supplied to a module should be equal to the specified scouring air flow rate for the module (see Table III-3)
e) Air Flow Meter.
   An air flow meter should be used to measure the amount of air supplied to the air diffuser. To operate multiple units of the SaniBrane® System, you should install an air flow meter on each train of the SaniBrane® System.
f) Permeate pump.
   A suction pump is required in order to operate with a pump suction install a self-priming pump compatible with the desired flow rate.
g) Level Switch
   It is required that a level switch be installed in the membrane submerged basin to control the liquid level.

CAUTION

- To protect the membranes and prevent clogging, design the peripheral equipment in such a way that the raw water is supplied to the membrane submerged basin via a screen with openings 3 mm or less.

5.3 Layout of the SaniBrane® System:

Diagram 5.3i shows how water circulates in the membrane submerged basin. An upward flow is generated as air is supplied from the lower side of the SaniBrane®. The flow then goes along both sides of the element block.

This circulation flow cleans the membrane surfaces and at the same time stirs up the sludge. It is extremely important to arrange units of SaniBrane® with appropriate distances in order to obtain an effective circulation flow.

Diagram 5.3i and Diagram 5.3ii present a top view and a side view of a basin containing three units of SaniBrane®. To install the modules, you are required to pay attention to dimensions W1, W2, W3, a and b.

Diagram 5.3i Example of SaniBrane® Modules layout in submerged basin (side view)

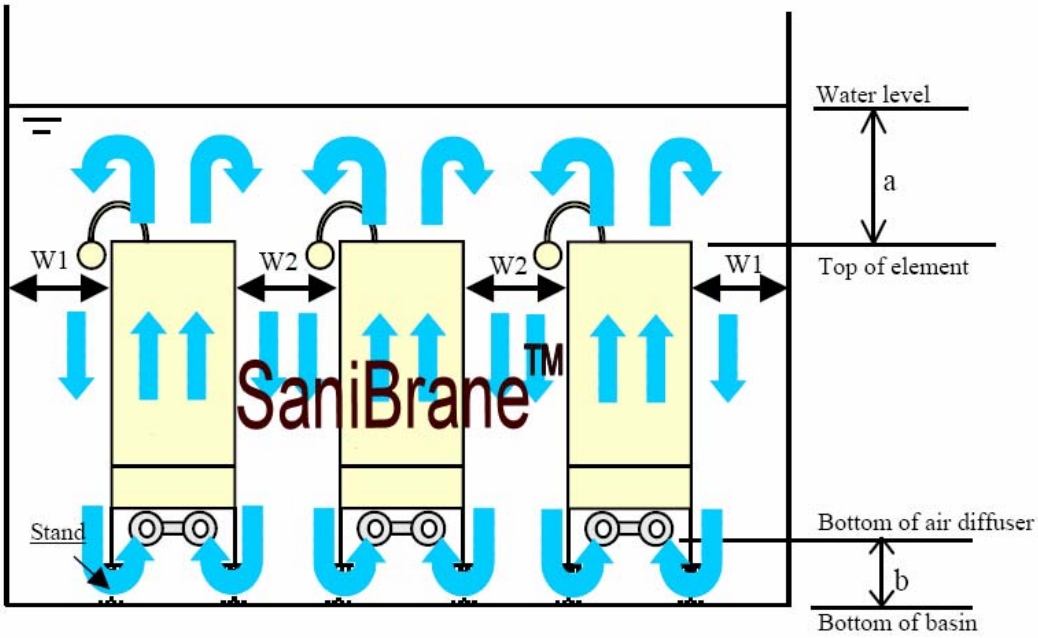
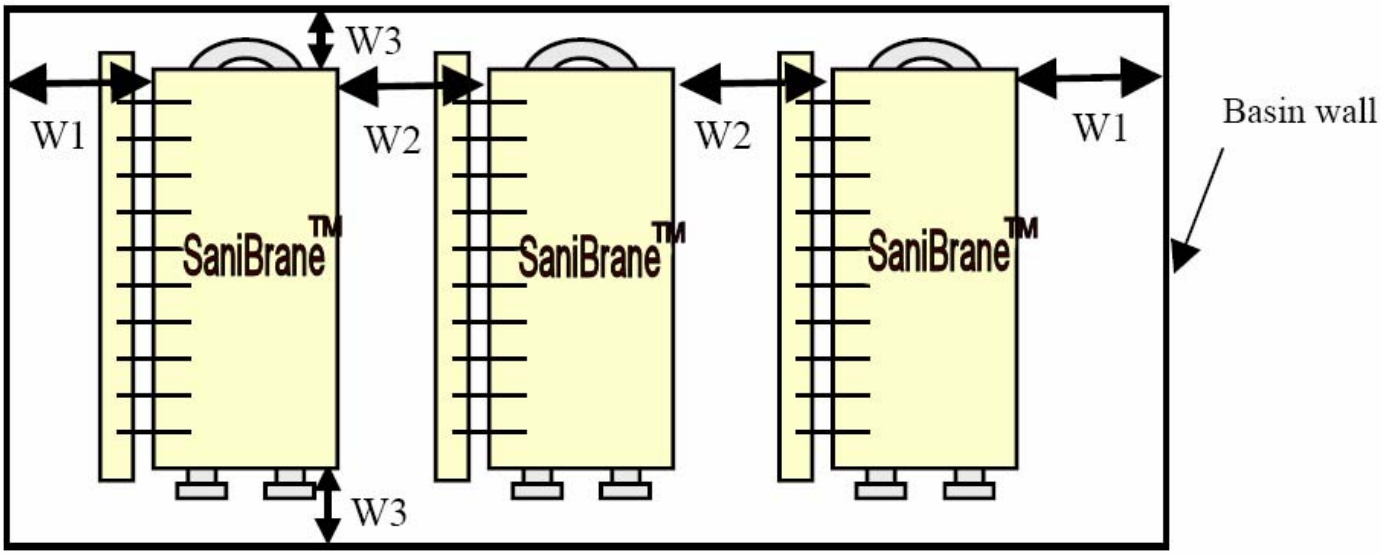


Diagram 5.3ii Example of SaniBrane® Modules layout in submerged basin (top view)



i. W1: 380 to 680 mm (15" to 27")
ii. W2: 430 to 730 mm (17" to 29")
iii. W3: Make W3 as small as possible (normally about 400mm (16") after allowing for piping and maintenance work.
iv. a: Allow at least 500 mm between the top of the element and the water level of the basin (lower limit for operation).
v. b: When a stand is used to support the module, the distance between the water level of the basin and the bottom of the air diffuser should not exceed 400mm (16").

- Please contact Sanitherm if you have any difficulty with the layout design, including installation of the SaniBrane® in an existing activated sludge tank.

5.4 Piping:

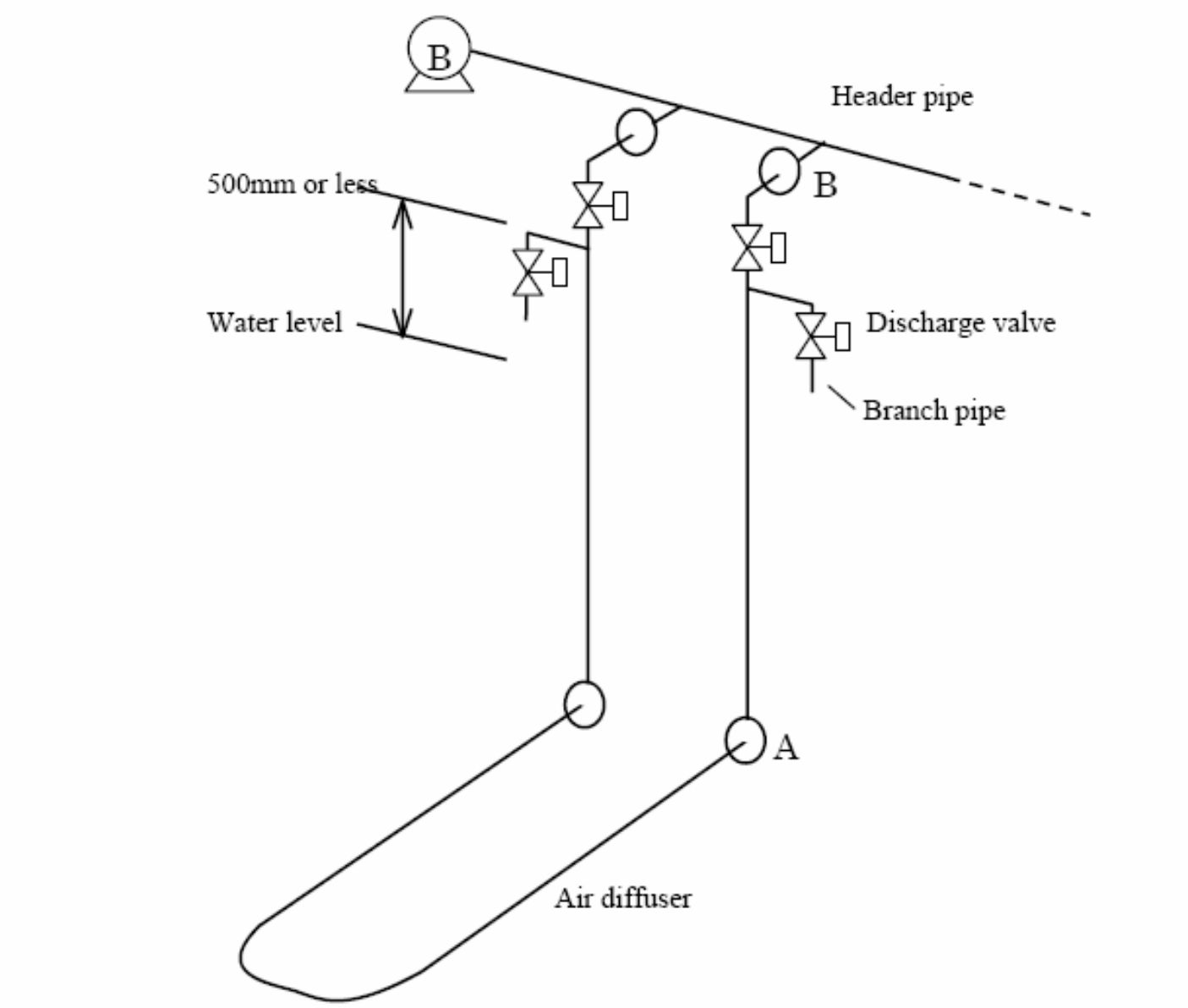
Following is a description of the procedure for piping to the air diffuser and manifold on a SaniBrane® System. For piping arrangements, see the product drawing at the end of this manual.

5.4.1 Piping into the air diffusers:

When piping into the air diffusers, use the flange (A) to connect the pipe from the air supply device to the side of the aeration block (see Diagram 5.4.1). Install another flange connection (B) above the liquid surface on this pipe line to disconnect piping in case it becomes plugged.

Also install branch piping and valves for cleaning the air diffuser into the pipe from the blower. Make sure to place the branch piping within 500mm (20”) above the liquid surface. It is recommended that the cleaning system be automated by installing automatic valves. For the air diffuser cleaning procedure 10.2.

Diagram 5.4.1 Example of piping to Air diffusers:



5.4.2 Piping to the manifold:

For piping into the manifold, Diagram 5.4.2i and Figure 5.4.2ii give two examples of leading permeated water from the membrane submerged basin. One demonstrates downward piping and the other upward piping.

In the operation of a natural water head, downward piping is recommended. In the operation of a suction pump, if the pump is located above the membrane submerged basin, upward piping is preferred, and vice versa.

In both upward and downward piping, a chemical injection valve and an air discharge valve should be installed on a branch pipe between the permeated water valve and the air diffusers. For devices necessary for chemical cleaning, see VIII-3 to VIII-6.

Diagram 5.4.2i Downward Piping from Basin

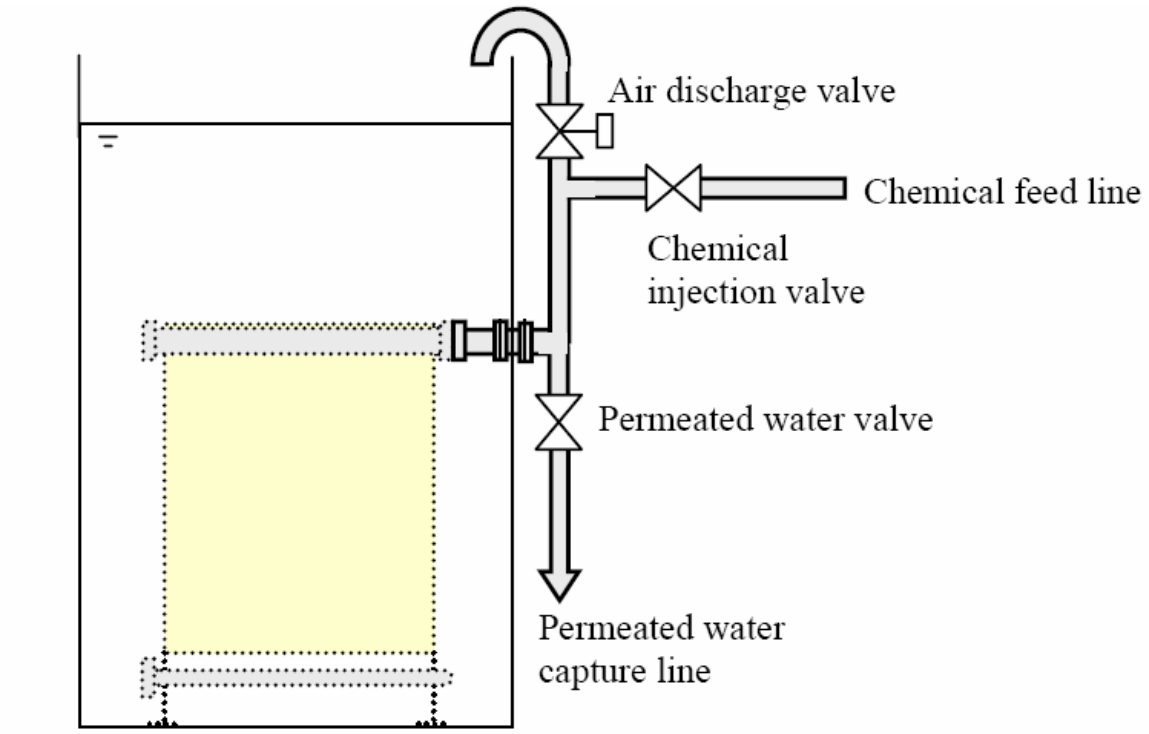
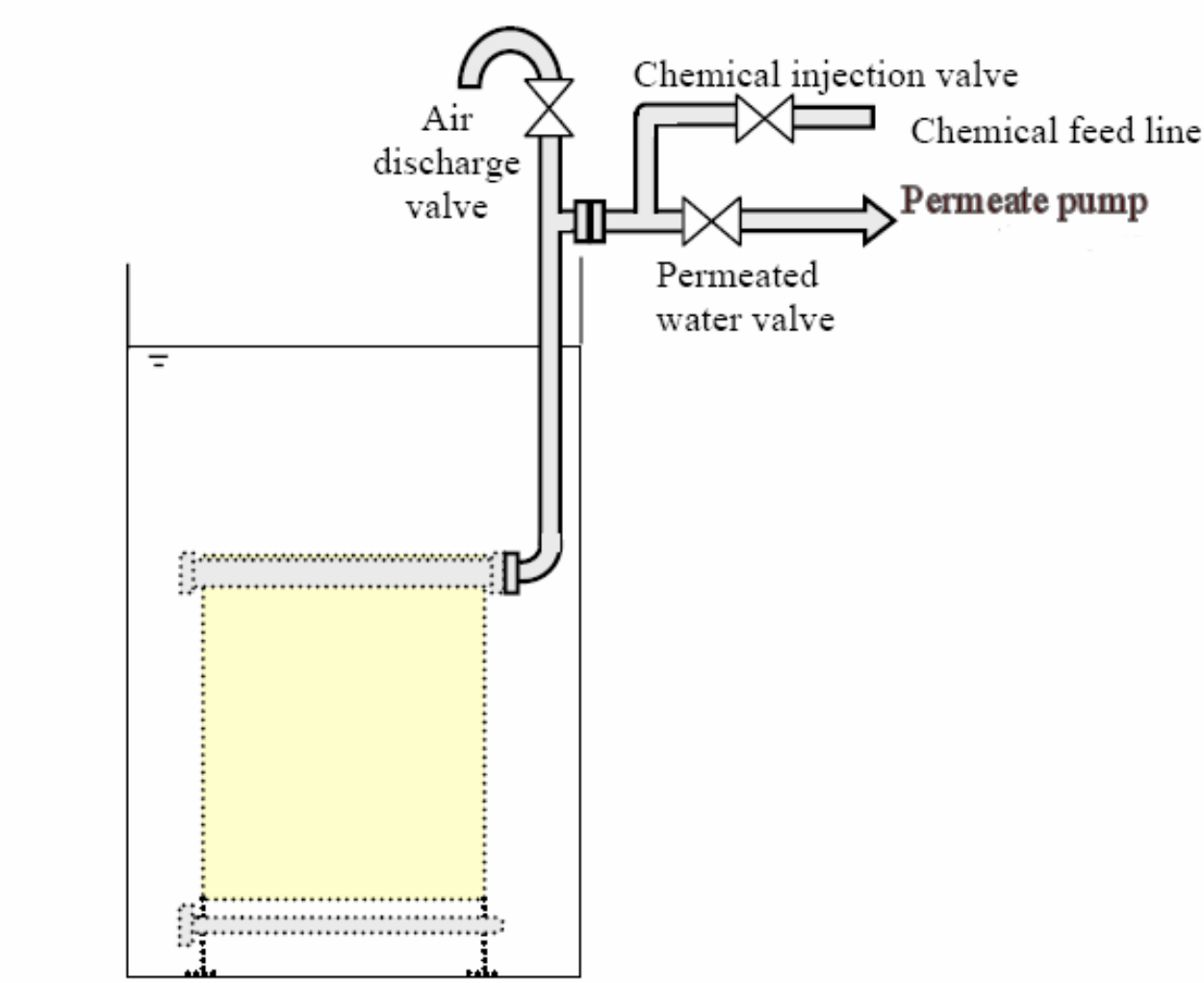


Diagram 5.4.2ii Upward Piping from Basin



6 INSTALLING SANIBRANE®:

6.1 Preparation:

1. There should be full preparation for the transportation of the SaniBrane® including a clear route.
2. You will require a cargo crane or forklift for unloading the SaniBrane® from the truck.
3. Ensure that the membrane submerged basin where the modules will be installed is clean. All waste such as concrete clusters, scrapes and mill ends must be removed.

6.2 Unloading SaniBrane®:

You will require a cargo crane or forklift to unload the SaniBrane®.

When lifting the SaniBrane® please note:

1. The Element block and the Aeration block are delivered in separate packages.
2. When lifting the element block keep it horizontal and lift from all lifting points equally. Be careful not damage the nozzles, air diffusers or other components.

DANGER

- The chains or slings being used to raise the SaniBrane® must be sufficient for the weight of the SaniBrane® System. Lifting should be done in a straight upward motion not allowing any shaking of the product.
- No one should ever be under the SaniBrane®!

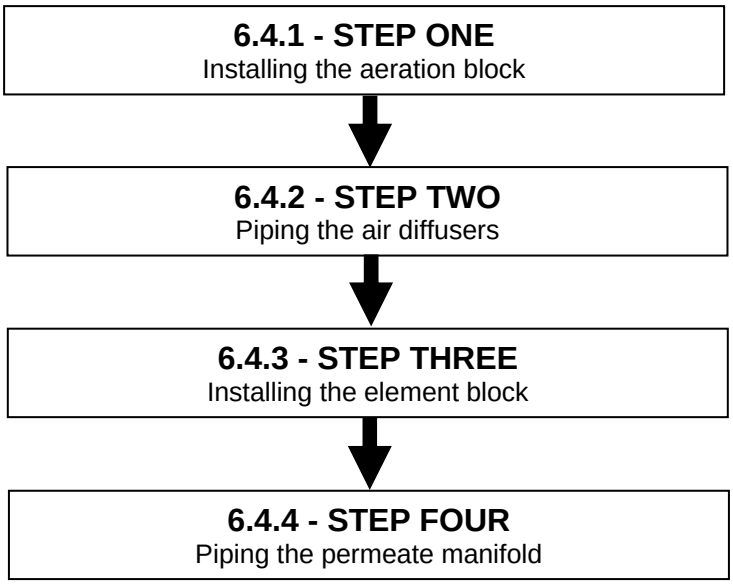
6.3 SaniBrane® check:

After you have the SaniBrane® in place, re-check the following;

1. All items match the shipping manifest.*
2. There has not been any damage in transport.
3. The protective cover is in position.

** Please contact the trucking company should any items be missing.*

6.4 Installation of the SaniBrane®:



6.4.1 STEP ONE - Installing the Aeration block:

Set the aeration block in the membrane submerged basin using anchors. In this installation, it is important to keep the air diffusers horizontal. In order to achieve uniform flows along the membrane surfaces of each element, the air diffuser must be completely level.

To ensure uniform flows, maintain the levelness within 3/1,000 (3mm over 1 meter or 1/8" over 40") on the top surface of the aeration block in both lateral and longitudinal directions.

6.4.2 STEP TWO - Piping the air diffusers:

Each air diffuser is furnished with two blank flanges. Modify the blank flanges or procure suitable flanges, and connect them to the pipe from the air supply unit. Prior to piping, flush the pipes.
After piping the air diffusers, feed clean water until the aeration block is completely submerged and then supplies air for diffusion. Next, check that the air is provided evenly among the aeration blocks and that it is diffused evenly in each aeration block.

6.4.3 STEP THREE – Installing the element block:

To install the element block, take the following steps, depending on the module type:

a) TMR140-050S and 100S
   Set the element block on the aeration block and connect the two with provided bolts.
b) TMR 140-200W

TMR 140-200W consists of two element blocks and one aeration block. Each element block has one manifold and each manifold is furnished with two blank flanges. In installation, these flanges may interfere with each other between the element blocks. In order to prevent this, offset either of the facing blank flanges. Then set two elements on the aeration block to fix them using the provided bolts.

c) TMR140-200D
Place an element block furnished with an intermediate block onto the aeration block, and secure them with the provided bolts. Place another element block on the first element block, and connect the two blocks with the provided bolts.

6.4.4 STEP FOUR – Piping the Permeate Manifold:

The manifold is furnished with blank flanges. Modify the blank flanges or procure suitable flanges. In piping, take the steps shown below in accordance with the module type.

The manifold is designed to allow fine adjustments with the brackets on both ends of it. To prevent air collection inside the manifold, vertically adjust the brackets to raise the permeated water outlet side a little higher than the other.

Prior to connecting the manifold to the pipe, flush the permeated water pipe and check the pipe for leakage.

Avoid applying pressure to the permeate side of the element or the element could suffer damage.

a. TMR140-050S and 100S
Connect one end of the manifold to the permeated water pipe. Leave the other end closed with a blank flange.

b. TMR140-200W
One-side connection
   i. Loosen the U-bolt on the manifolds, connect one manifold to the other on two element blocks. After piping, fasten all U-bolts and check that the manifolds are secured firmly.
   ii. Then connect one end of the joined manifolds to the permeated water pipe. Leave the other end closed with a blank flange.
   iii. Two side connection
   iv. Loosening the U-bolts on the manifolds, connect one manifold to the other on two element blocks. After piping, fasten all U-bolts and check that the manifolds are secured firmly.
   v. Then connect both ends of the joined manifolds to the permeated water pipe.

c. TMR140-200W
Connect one end of the upper and lower manifolds to the permeated water pipe on the relevant line. Leave the other end closed with a blank flange. To connect the manifold to a piping assembly, provide an upper and lower line.

DANGER

- The chains or slings being used to raise the SaniBrane® must be sufficient for the weight of the SaniBrane® System. Lifting should be done in a straight upward motion not allowing any shaking of the product.
- No one should ever be under the SaniBrane®!
- To install SaniBrane® set a foothold.
- Never climb on the module.
- Use protective equipment to ensure the safety of the worker.

CAUTION

- Avoid applying pressure to the permeate side.

7 START OF OPERATIONS:

When starting up the plant for the first time, fill the tank with fresh water, vent the air and test all pumps, blowers and level switches.

7.1 Clean Water Operation

7.1.1 Inspection and arrangements:

Prior to clean water operation; make the following inspection and arrangements:

a) Check that the air diffusion pipe and the permeated water pipes are connected properly.
b) Check that the element block is secured on the aeration block.
c) Check that the membrane submerged basin has been completely cleaned. Then remove the protective cover. The presence of soil, dust, concrete chips, wire ends ty-wrap ends etc. and dust may cause damage to the SaniBrane®.
d) Before feeding clean water to the membrane submerged basin, open the air discharge valve to release air from the element.
e) Feed clean water (tap water or filtered water) to the membrane submerged basin up to the operating level.
f) After feeding water, close the air discharge valve.

CAUTION

- Before feeding clean water to the membrane submerged basin, open the air discharge valve to release air from the element. After feeding water, close the air discharge valve.
- DO NOT use ground water for clean water operation. If it contains a large amount of iron, manganese, calcium or silica it may cause clogging in the membrane.

7.1.2 Clean water operation:

After feeding clean water to the membrane submerged basin, start clean water operation in accordance with the following procedure:

a) Start the blower and check that the required amount of air has been supplied and that the defused air is supplied evenly.
    - Foaming may occur in the membrane submerged basin during clean water operation. This phenomenon is caused by the dissolution of biodegradable hydrophilic components contained in the membrane. Operation can be continued regardless of the foaming.
b) When using only one blower to achieve air diffusion for two or more modules, check that an even amount of air is supplied to them. Otherwise, modify the piping structure (such as the diameter of the header pipe) to attain uniform air supply.

c) While maintaining clean water operation, check the control devices for proper performance.
d) Perform clean water filtration, and measure and record the trans-membrane pressure and water temperature at designed filtration rates (at a normal, maximum and minimum flow rate). These records should be maintained.
e) Upon completion of performance checks in clean water operation, immediately terminate the operation and stop air diffusion.

CAUTION

- Clean water operations tend to cause clogging, and should not be done excessively.
- After clean water operation, keep the membranes wet. Dried membranes may reduce permeable amounts of water.

7.1.3 Injecting seed sludge:

Be sure to inject seed sludge (where possible). Otherwise, if raw water is separated directly by the membranes, membrane clogging may occur at an early stage.

To follow are the steps for injecting seed sludge.

- **STEP ONE:**
  For seed sludge, procure sludge used for the treatment of same kind of waste water. Sludge with MLSS of 20,000 mg/L or higher is recommended.
- **STEP TWO:**
  Right before feeding raw water, inject seed sludge. To remove foreign matter, be sure to use a screen (with an opening of 3 mm or less).
- **STEP THREE:**
  The amount of seeding sludge injected should be adjusted so that MLSS of the membrane submerged basin is 7,000 mg/L or more.

DO NOT use seeding agents (engineered bacteria).

CAUTION

- Be sure to use a screen (with an opening of 3 mm or less) to remove foreign matter.

7.1.4 Actual Operation:

Upon completion of seeding sludge injection, start air diffusion. Then start filtration and the feeding of raw water. Once the permeated water level has been stabilized, measure and record the trans-membrane pressure and water temperature at the actual filtration rate. Details of operation management are given in the next chapter.

8 OPERATION CONTROL:

8.1 Standard Operating conditions:

Table 8.1 shows standard operating conditions for SaniBrane®.

To ensure stable performance, such operation parameters as MLSS, sludge viscosity, DO (dissolved oxygen concentration) and PH must be kept in a range of standard operation conditions given in 8.1.

If raw water contains foreign matter, big chunks of suspended solid or oil, pretreatment is required.

When using an antifoaming agent in the membrane, ensure that it is alcohol-based, such as Kurita Water Industries “Kuriless P.F-663”.

Table 8.1 Standard conditions for SaniBrane®

Parameter	Unit	Operating condition
MLSS	mg/L	7,000 – 18,000
Sludge viscosity*	mPa-s	Not higher than 250
DO	mg/L	1.0 or more
pH	-	6-8
Water temperature	Degree C	15 to 40
Continuous filtration flux	$m^3/m^2/d$	0.75 or less

*Measured by C-type viscometer

- **DO NOT** use permeated water for drinking. To use permeated water, analyze its quality and ensure that the water quality meets the intended purpose.
- **Please contact Sanitherm** if the operating conditions are not standard

CAUTION

- In the activated sludge tank, avoid using chemicals, toxic agents, oils or other substances that can adversely affect activated sludge.
- Avoid abrupt changes in pH, temperature, trans-membrane pressure or any other conditions even if they are within the standard operating conditions.
- Replace renewal parts regularly after inspection.
- Protect SaniBrane® from freezing.

8.2 Operation Control Parameters:

The performance of SaniBrane® varies in accordance with the raw water quality and the preset operating conditions. To ensure stable operation, it is recommended that you record monitored values of control parameters in order to monitor the performance and characteristics of your unit of SaniBrane®.

8.2.1 Control parameters for the operation of SaniBrane®:

1. Scouring Air Flow rate (blower air flow)
2. Diffusion pressure (blower discharge pressure)
3. Permeated water flow rate
4. Trans-membrane pressure (TMP)
5. Permeated water quality (BOD, COD, turbidity, T-N, T-P, TSS etc)
6. Liquid temperature of membrane submerged basin
7. Raw water quality (BOD, COD, turbidity, T-N, T-P, etc.)
8. Excess-sludge discharge rate
9. DO (dissolved oxygen concentration) of membrane submerged basin
10. pH of membrane submerged basin
11. MLSS
12. Sludge viscosity
13. Sludge volume (SV30 or SV60)

8.3 Daily inspection of the Membrane submerged basin:

To ensure consistent operation of SaniBrane® it is essential to stabilize the trans-membrane pressure, diffused air condition, and biological treatment.

8.3.1 Inspection steps:

1. Trans-membrane pressure:

Check that the trans-membrane pressure is stable. A sudden increase in differential pressure suggests membrane clogging, caused by abnormal diffused air conditions or deteriorating sludge properties. In such an event, check the following parameters and take necessary action, such as chemical cleaning of the elements.

2. Diffused air condition:

Check that the standard amount of diffused air is supplied and that the air is diffused evenly. Deviation in the scouring air flow rate from the standard value, or extraordinary uneven diffusion, may cause membrane clogging. In such a case, stop filtration, and check the leakage from the piping, valve situation and the blower condition. If necessary, take

appropriate action, such as fix the leakage, correct the valve situation, adjust the blower condition, clean the air diffusers and adjust the scouring air flow rate.

CAUTION

- If the scouring air flow rate drops or becomes extremely irregular, or if air supply is stopped, then immediately stop filtration to prevent membrane clogging.

3. Colour and smell of activated sludge:

Sludge appropriate for treatment should be brownish-red, coagulable, and free from odour. If the sludge appears to be failing to meet these requirements, then measure its MLSS, viscosity, DO, pH, temperature and BOD load. If necessary, take appropriate action, such as additional injection of seeding sludge or adjust the organic loading, etc.

4. MLSS:

The sludge should have an MLSS of 7,000 to 18,000 mg/L. If MLSS is too low, add seeding sludge or stop sludge transfer. If MLSS is too high, increase the sludge wasting rate.

5. Sludge viscosity:

The sludge viscosity should not be more than 250 mPa-s. If the sludge viscosity is too high, replace the sludge or transfer the sludge to the sludge storage tank until an appropriate viscosity value is attained.

6. DO:

DO values should be 1 mg/L or more at any point in the membrane submerged basin. If this requirement is not met, you may increase the scouring airflow rate to the extent that the rate does not exceed its maximum permissible value. Reduce incoming BOD strength. Add supplemental aeration.

7. pH:

pH range should be 6 to 8. If this requirement is not met and activated sludge property is not good, adjust pH by adding acid or alkali.

8. Liquid temperature:

The liquid temperature should be 15^{O} C to 40^{O} C (59^{O} to 104^{O} F). If this requirement is not met and activated sludge property is not good, it is recommended that you take corrective measures.

9. Liquid level:

Check that the liquid level of the membrane submerged basin is in the appropriate range. If this requirement is not met, check (i) the liquid-level meter, (ii) the suction pump, and (iii) the trans-membrane pressure, and when necessary, take corrective action, such as adjusting the control system.

9 MAINTENANCE OF SANIBRANE®:

9.1 Maintenance Items and Maintenance Frequency:

To maintain SaniBrane® perform the following at specified intervals:

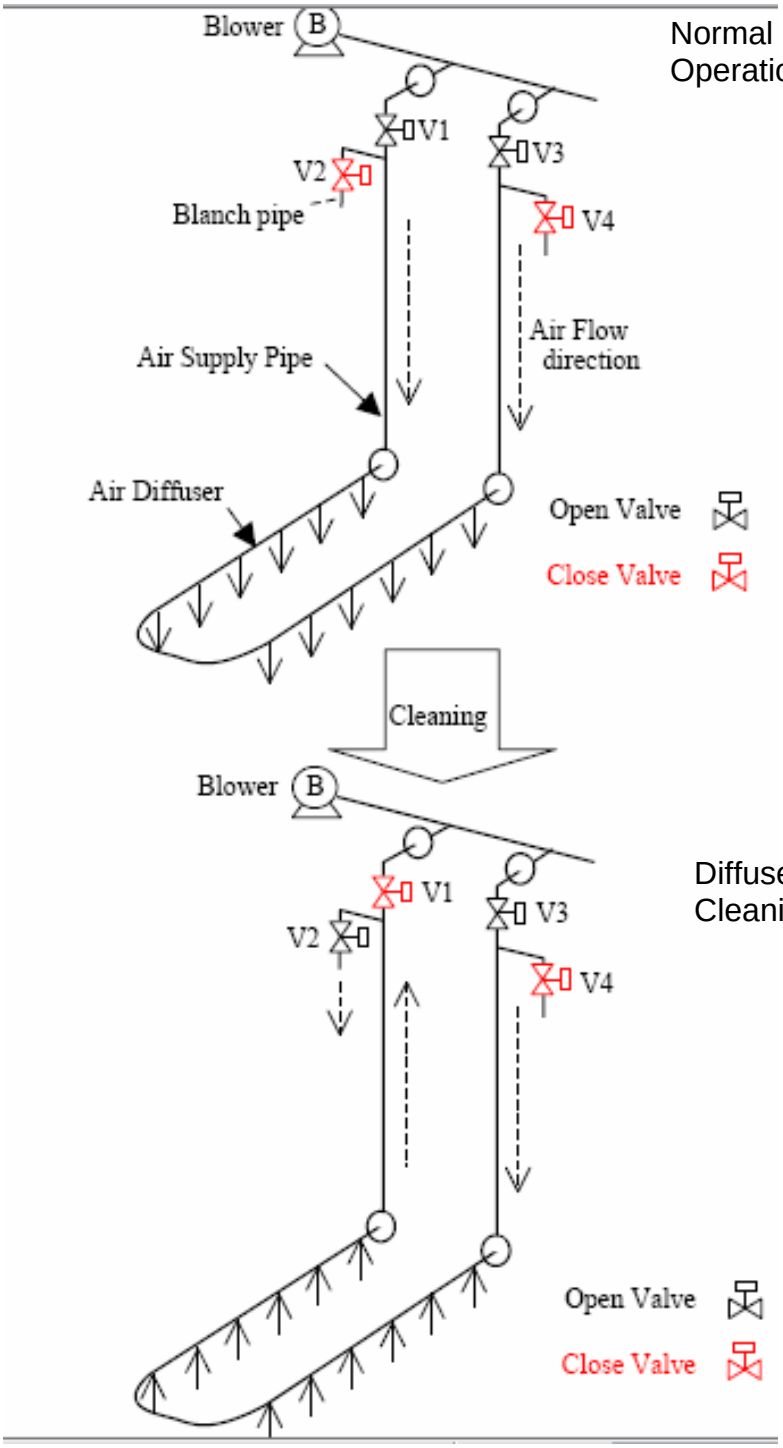
1. Clean the air diffusers (everyday)
2. Chemical cleaning of the element, every six (6) months or when the trans-membrane pressure has risen by 5 kPa or more from its initial operating level at the same permeated water flow rate, whichever occurs earlier.
3. Replace connection tubes (once in three (3) years, or when deteriorated)
    - In replacement of parts, be sure to use specified types.
    - For detailed specifications and procurement routes for replacement parts, please contact us.
    - In replacing tubes, insert the tube securely into the foot of the nozzle.
    - In replacing tubes, avoid applying excess force to the element and manifold nozzles to prevent damage.

9.2 Air Diffuser Cleaning:

Clogging of diffuser holes may lead to uneven air diffusion and membrane clogging. To prevent such clogging, clean the air diffusers at least once a day (it is recommended to automate the air diffuser cleaning process by using automatic valves). Ensure that the permeate flow is stopped before starting.

The cleaning is done by the reverse flow of the sludge from the diffuser hole into the diffuser piping. This is accomplished by opening the air diffuser cleaning valve and releasing the pressure inside the air diffuser, discharging such sludge by the diffusing air through the branch valve.

9.2.1 Air diffuser cleaning procedure:



1. Stop Filtration
2. Close V1 Valve
3. Open V2 valve. At this step, the sludge liquid comes through the diffuser holes into diffuser piping, and is discharged together with the air.
4. Keep V2 valve open for about one (1) minute.
5. Close V2 valve, and then open V1 valve.
6. Clean the other line in the same manner as follows.
7. Close V3 valve.
8. Open V4 valve. At this step, the sludge liquid comes through the diffuser holes into the diffuser piping, and is discharged together with the air.
9. Keep V4 valve open for about one (1) minute.
10. Close V4 valve, and then open V3 valve
11. Restart filtration.

9.3 Chemical Cleaning of Element:

Chemical cleaning of the element should be conducted when the trans-membrane pressure rises in excess of operational limits. Such a pressure increase can be caused when contaminants clog the pores of the membrane surface. The timing of chemical cleaning should be determined as follows:

1. Every six (6) months or when the trans-membrane pressure has risen by 5 k Pa from its initial operating level at the same permeated water flow rate, whichever occurs earlier.
2. If the Trans-membrane pressure is rising rapidly, conduct chemical cleaning much earlier. Early chemical cleaning is effective to remove contaminates clogged in the membrane pores.
3. In the case that the trans-membrane pressure rises by 5 k Pa within six (6) months, record how many months it took to rise and conduct chemical cleaning accordingly. This measure is effective in prolonging the life of membranes.

9.4 Chemical Agents Used for Chemical Cleaning:

For chemical cleaning of the element, it is important to select chemicals in accordance with the type of adherent contaminant. Cleaning under inappropriate cleaning conditions or using the wrong chemicals may cause poor filtration performance or damage to the element. Select chemicals suitable for each contaminant. Table 9.4 shows suitable chemicals and standard cleaning conditions.

Table 9.4 Cleaning Chemicals and Standard Cleaning Conditions by Contaminant

Contaminant	Chemical	Solutions concentration	Amount used	Hold time
Organic matter	Sodium hypochlorite	2,000 – 6,000 mg/L (effective chlorine concentration) (pH is about 12)	5L/ element (1.32 USG)	1 to 3 hours
Inorganic matter	Oxalic acid	0.5 - 1.0 wt %	5 L/element (1.32 USG)	1 to 3 hours
Inorganic matter	Citric acid	1.0 – 3.0 wt%	5 L/element (1.32 USG)	1 to 3 hours

9.5 Handling of Chemical Agents:

Some chemical agents used for chemical cleaning are harmful when they come in contact with skin. In handling chemicals, wear protective goggles, protective gloves and other protectors. Before using chemicals, be sure to check the details of its material safety data sheet (MSDS) and the instructions given below. If chemicals come into contact with your skin, follow the MSDS to take suitable action for each chemical.

Table 9.5i Chemical Handling precautions:

Agent:	Sodium hypochlorite Solution/ NaClO	Oxalic Acid / $(COOH)_2$	Citric acid/ $HOOCCH_2C(OH)(COOH)CH_2COOH$
CHEMICAL HANDLING PRECAUTIONS	Ventilate well. Avoid heat sources and sparks. Also avoid contact with acids.	Keep away from acids and bases.	Keep away from strong acids and bases.
	Handle the chemical container with great care. Avoid toppling, bumping or dragging it.		
	Take care to prevent leaks, spillover or splattering. Do not cause dust or vapor.		
	Firmly seal the container after use.		
	After using chemicals, thoroughly wash your hands and face and rinse out your mouth.		
	Do not eat or drink except in a designated place.		
	Keep gloves in a designated area away from any rest area or lunch rooms.		
	Forbid unauthorized entry to the place where chemicals are handled.		
	Wear appropriate protectors to avoid inhalation, eye or skin contact, and direct contact with your clothes.		
	To handle chemicals outdoors, provide local ventilation.		

Table 9.5ii Storage Precautions:

Agent:	Sodium hypochlorite Solution/ NaClO	Oxalic Acid / $(COOH)_2$	Citric acid/ $HOOCCH_2C(OH)(COOH)CH_2COOH$
STORAGE PRECAUTIONS	Store container in a dark, cold place. Avoid direct sunlight. Firmly seal to prevent direct contact with air.		
	For storage, use corrosion-resistant containers.		

- Many chemical agents are extremely hazardous to one's health. When handling chemicals, one should wear protective goggles, gloves and any other available protective gear. Be sure to carefully read the details of the material safety data sheet (MSDS) BEFORE handling any chemicals.
- If chemicals come in contact with your skin or clothes, immediately rinse with large amounts of water.
- Store chemicals in a dark, cold place away from direct sunlight.
- If chemicals come in contact with your eye, immediately flush with running water and see a physician.
- In the chemical storage tanks, be sure to use a material suitable for each chemical in order to prevent corrosion.
- Do not mix sodium hypochlorite with heavy metals or acids. Its mixture with an acid generates toxic chlorine gas.

9.6 Chemical Cleaning Procedure:

9.6.1 For Elements:

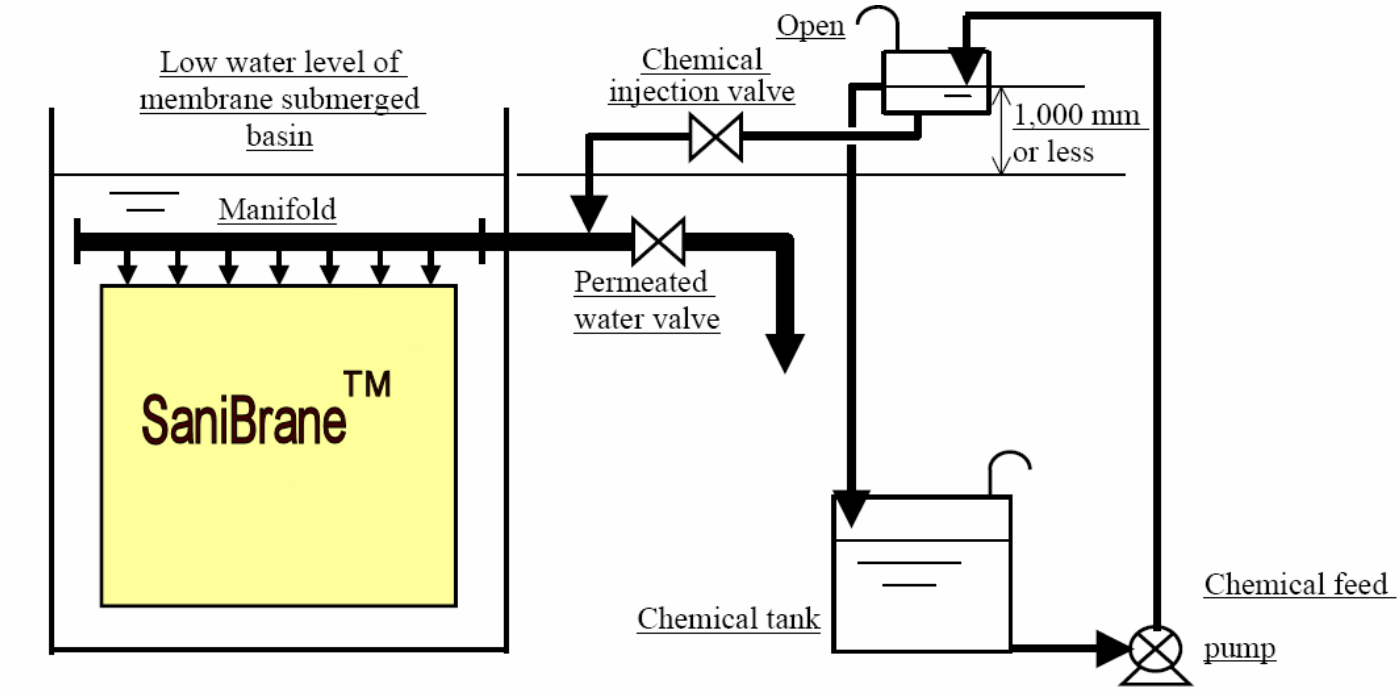
When cleaning, slowly inject chemicals via the permeated water nozzle into the elements until they percolate through the membranes.

Depending on the location of the chemical tank, use a natural water head when injecting chemicals, as shown below.

1. Chemical cleaning with the chemical tank located at the bottom (Diagram 9.6.1A)

a) Check that the chemical injection valve is closed and that the chemical feed pump is at rest.
b) Fill the chemical tank with specified amounts of chemicals.
c) Stop filtration and close the permeated water valve (air diffusion should be continued).
d) Start the chemical feed pump and check that the chemicals circulate.
e) Slowly open the chemical injection valve to inject chemicals.
f) After injecting the specified amount of chemicals, stop the chemical feed pump.
g) Leave the equipment for 1 to 3 hours.
h) Close the chemical valve, open the permeated water valve and restart filtration.
i) Chemicals remain in the permeated water in an early phase of filtration (for a period of 2 or more intermittent cycles). Send back the permeated water to the raw water. Otherwise, dispose of it in accordance with applicable legal standards for waste disposal.

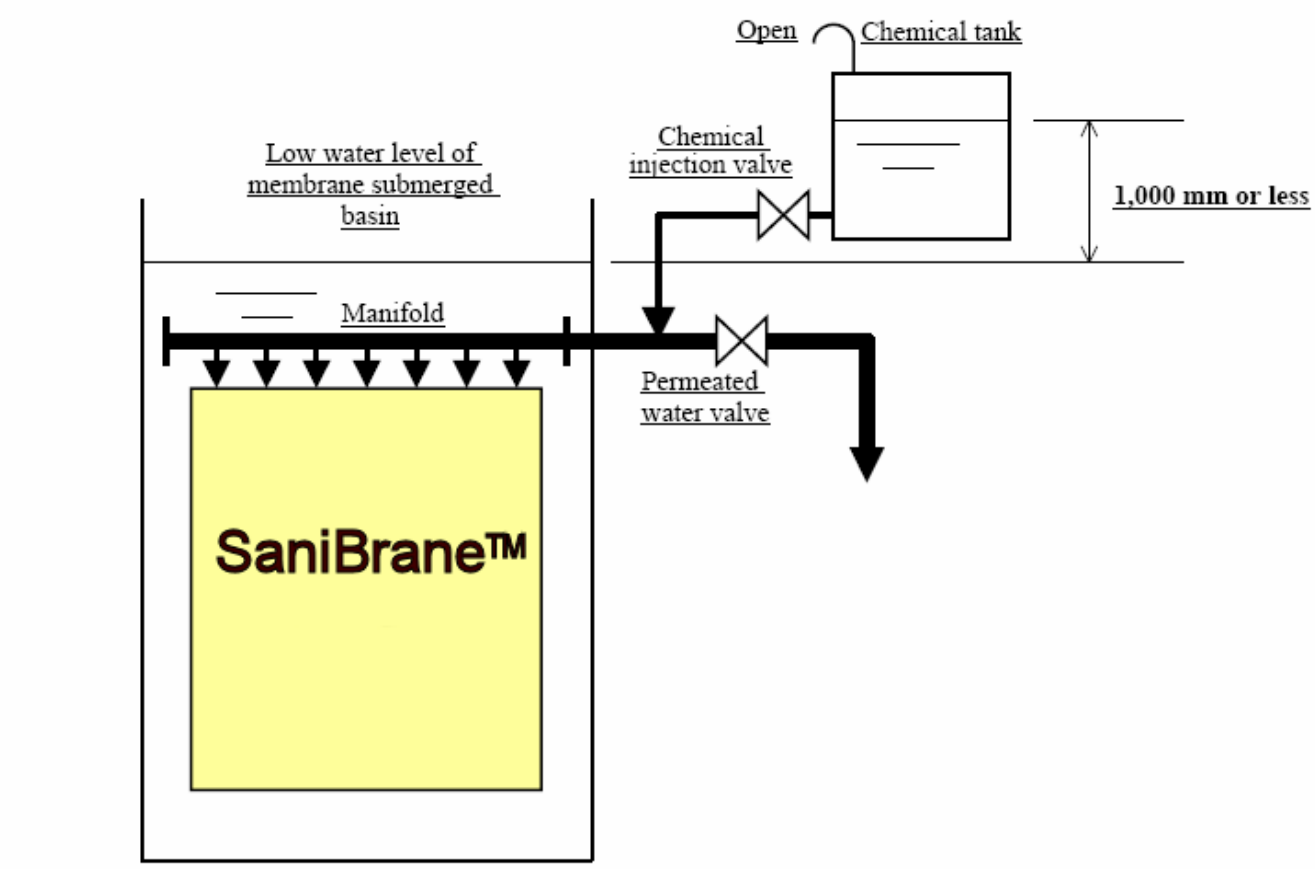
Diagram 9.6.1A - Chemical cleaning with Chemical Tank Located below the MBR liquid level:



2. Chemical cleaning with the chemical tank located above the membrane submerged basin (Diagram 9.6.1B)

a) Check that the chemical injections valve is closed
b) Feed the chemical tank with specified amounts of chemicals.
c) Stop filtration and close the permeated water (air diffusion should be continued)
d) Slowly open the chemical injection valve to inject chemicals
e) After injecting chemicals, leave the equipment for 1 to 3 hours
f) Close the chemical injection valve, open the permeated water valve and restart filtration
    - Chemicals remain in the permeated water in an early phase of filtration (for a period of 2 or more intermittent cycles). Send back the permeated water to the raw water tank. Otherwise, dispose of it in accordance with applicable legal standards for waste disposal.

Diagram 9.6.1 B – Chemical cleaning with Chemical Tank Located above the MBR liquid level



9.6.2 Precautions for chemical cleaning of elements:

a) Inject chemicals using gravity. Maintain the pressure at 10 kPa (1.45 psi or approximately 1 meter) or less. Avoid forcibly applying pressure with the pump directly connected. A higher pressure can damage the elements.
b) Inject chemicals with SaniBrane® submerged in the membrane submerged basin. To ensure the safety of the operator, keep the top of the module at least 500 mm (20") below the water surface.
c) Continue air diffusion during chemical cleaning. Note, however, that foaming may occur inside the membrane submerged basin depending on the type of chemicals used or other conditions. In such a case, reduce the defused air rate.
d) A higher temperature of chemicals produces greater cleaning effects. However, maintain the temperature at 40^{O}C or below. Conversely, a lower temperature causes poor cleaning effects, hampering the recovery of the membrane function. Maintain as high of a temperature as is possible inside the membrane submerged basin.
e) After chemical cleaning, a small amount of chemicals remain inside the elements and filtration piping right. To restart filtration, send back the permeated water to the

raw water tank until the permeated water is free from the effects of the chemicals (for a period of at least 2 intermittent cycles). Otherwise, dispose of it in accordance with applicable legal standards for waste disposal.

- If an abnormality is found in the equipment during chemical cleaning, immediately stop the operation.
- If chemicals are injected forcibly with the chemical feed pump or by any other means, the internal pressure of the element may increase, leading to damage to the element. Be sure to inject chemicals by gravity at 10 pKa or less.
- Before feeding chemicals for chemical cleaning, check that the water surface is 500 mm or more above the top of the module. Feed chemicals after SaniBrane® are completely submerged.

9.7 Lifting Procedure:

To lift SaniBrane® for maintenance, take the following steps:

1. Completely empty the membrane submerged basin.
2. To lift only the element block, remove the manifold. To lift the aeration block along with the element block, also remove the air diffuser pipe.
3. To remove and lift only the element block, remove the bolts connecting it to the aeration block.
4. For TMR140-200W, if the manifold is connected to two element blocks, remove the bolts and separate the manifold.
5. To lift the aeration block along with the element block, remove the fastened anchors.

- The chains or slings being used to raise the SaniBrane® must be sufficient for the weight of the SaniBrane® System. Lifting should be done in a straight upward motion not allowing any shaking of the product.
- The element block will be significantly heavier after operation. Ensure the lifting equipment is suitable.

CAUTION

- To restart filtration right after lifting maintenance, keep the membranes wet during the maintenance. Dried membranes may reduce permeable amounts of water.

10 TROUBLESHOOTING:

Most abnormalities in SaniBrane® concern abnormal air diffusion, increased trans-membrane pressure, decreased permeated water flow rate, and degenerated permeated water quality. The following explains such abnormalities and corrective actions against them:

Table 10 - Troubleshooting

	Problem	Cause	Action
1	The air diffusion rate is below the standard level.	The blower is broken or worn	Check the blower
		The air diffusers are clogged	Clean the air diffusers
2	The air diffusion is uneven inside a module or between modules.	The air diffusers on the module are clogged.	Clean the air diffusers on the module.
3	The permeated water flow rate was decreased. Or, the trans-membrane pressure has increased.	Membrane clogging has worsened.	Perform chemical cleaning.
		Decreased or uneven diffused air is preventing smooth membrane cleaning.	Inspect the blower and clean the air diffusers to improve air diffusion.
		Abnormal properties of sludge have worsened its filterability.	Improve sludge properties: • Adjust the sludge discharge rate. • Prevent entry of abnormal components, such as oils. • Adjust BOD load • Adjust the raw water quality (add nitrogen, phosphorous, etc.)
		Partial clogging of membrane	• Perform an extensive air scour with permeate flow off.
4	The concentration of suspended solids in the permeate water has increased.	An element or tube has fractured.	Seal the element and manifold nozzle.*1
		A leakage has occurred in the permeated water piping.	Inspect the faulty part *2 and correct the fault.
		Germs are generated on the membrane.	To clean the permeated water piping, inject into it a sodium hypochlorite solution with an effective chlorine concentration of 100 to 200 mg/L.

*1: Even if a cause is found in the tube, there still is the possibility of contamination inside the element. Thus, seal the element and manifold nozzle.

*2: To check the piping joints and welds for leakage with pressure being applied, take care not to exert pressure.

Appendix B: Material Safety Data Sheets for Chemicals used in the WWTP

MATERIAL SAFETY DATA SHEET

SUPPRESSOR 2360
Product ID: FC236004
Revised: 04-22-2010
Replaces: 02-08-2010

1. PRODUCT AND COMPANY IDENTIFICATION

Product Name:	SUPPRESSOR 2360
Synonyms:	N.A.
CAS Number:	MIXTURE
Chemical Family:	Defoamer
Formula:	Proprietary Information

Hydrite Chemical Co.
300 N. Patrick Blvd.
Brookfield, WI 53008-0948
(262) 792-1450

EMERGENCY RESPONSE NUMBERS:
24 Hour Emergency #: (414) 277-1311
CHEMTREC Emergency #: (800) 424-9300

2. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW: CAUTION! May cause mild eye and skin irritation.

Physical State:	Liquid.
Color:	Transparent. Yellow.
Odor:	Low odor.

POTENTIAL HEALTH EFFECTS

Routes of Exposure: Eyes. Ingestion. Inhalation. Skin.

Target Organs: Lungs.

Eye Contact: May cause mild irritation.

Skin Contact: May cause mild irritation.

Skin Absorption: No data available.

Inhalation: No hazard expected under normal use. Vapor from heated material or mist may cause: respiratory irritation.

Ingestion: No hazard expected under normal use. Small amounts swallowed incidental to normal handling operations are not likely to cause injury; swallowing amounts larger than that may cause injury. May cause: gastrointestinal irritation.

Medical Conditions Aggravated by Exposure to Product: No data available.

Other: Effects of repeated exposure: In animals, effects have been reported on the following organs following exposure to aerosols: lung.

Cancer Information:
This product does not contain 0.1% or more of the known or potential carcinogens listed in NTP, IARC, or OSHA.

Potential Environmental Effects: See Section 12.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Component	CAS Number	% by Wt.
Proprietary Components	MIXTURE	100 %

4. FIRST-AID MEASURES

Eye Contact: Immediately flush eyes with plenty of water for at least 15 minutes while holding eyelids open. Tilt head to avoid contaminating unaffected eye. Get immediate medical attention.

Skin Contact: Flush skin with plenty of water while removing contaminated clothing and shoes. Do not reuse clothing or shoes until cleaned. If irritation develops or persists, get medical attention.

Inhalation: Remove to fresh air. If breathing is difficult, administer oxygen. If not breathing, give artificial respiration, preferably mouth-to-mouth. GET MEDICAL ATTENTION IMMEDIATELY.

Ingestion: If swallowed, call a physician immediately. DO NOT induce vomiting unless directed to do so by a physician. Never give anything by mouth to an unconscious person. If vomiting occurs spontaneously, keep head below hips to prevent aspiration of liquid into the lungs.

5. FIRE FIGHTING MEASURES

Extinguishing Media: Water spray. Water fog. Carbon dioxide. Dry chemical. Foam. Alcohol resistant foams (ATC type) are preferred. General purpose synthetic foams (including AFFF) or protein foams may function, but will be less effective. DO NOT USE: Direct water stream.

Fire Fighting Methods: Evacuate area of unprotected personnel. Wear protective clothing including NIOSH-approved self-contained breathing apparatus. Remain upwind of fire to avoid hazardous vapors and decomposition products. Use water spray to cool fire-exposed containers. Do not use direct water stream. May spread fire. Move containers from fire area if possible without hazard. Burning liquids may be moved by flushing with water to protect personnel and minimize property damage. Run-off from fire control may cause pollution. CAUTION: Spilled material may be slippery.

Fire and Explosion Hazards: Combustible at high temperatures.

Hazardous Combustion Products: During a fire, smoke may contain the original material in addition to combustion products of varying composition, which may be toxic and/or irritating. Combustion products may include and are not limited to: Irritating and/or toxic gases. Carbon oxides.

6. ACCIDENTAL RELEASE MEASURES

Spill Clean-Up Procedures: Eliminate all sources of ignition. Evacuate unprotected personnel from area. Maintain adequate ventilation. Follow personal protective equipment recommendations found in Section 8. Never exceed any occupational exposure limit. Contain spill, place into drums for proper disposal. Soak up residue with inert absorbent material. Place in non-leaking containers for immediate disposal. Flush remaining area with water to remove trace residue and dispose of properly. Avoid direct discharge to sewers and surface waters. Notify authorities if entry occurs. CAUTION: Spilled material may be slippery.

7. HANDLING AND STORAGE

Handling: Avoid contact with eyes, skin, and clothing. Use with adequate ventilation. Do not swallow. Avoid breathing vapors, mists, or dust. Do not eat, drink, or smoke in work area. Wash thoroughly after handling. Product on surfaces can cause slippery conditions. Avoid formation of aerosols or mists.

Storage: Store in a cool, dry place. Keep away from incompatible materials. Keep containers tightly closed. Protect from moisture. Store above 40 Deg. F. Do not contaminate this product with any foreign materials.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

OSHA Exposure Guidelines:

Component	Limits
No components found.	

ACGIH Exposure Guidelines:

Component	Limits
No components found.	

Engineering Controls: General room ventilation is required. Local exhaust ventilation may be necessary for some operations. Maintain adequate ventilation. Avoid formation of aerosols or mists.

Eye/Face Protection: Wear safety glasses with side shields while handling this product. Wear additional eye protection such as chemical safety goggles and/or face shield when the possibility exists for eye contact with splashing or spraying liquid, or airborne material.

Skin Protection: Prevent contact with this product. Wear gloves and protective clothing depending on condition of use. Protective gloves: Impervious. Butyl rubber. Nitrile. Neoprene.

Respiratory Protection: None required under normal use. If needed, wear: NIOSH-Approved air-purifying respirator with: Organic vapor cartridge and particulate pre-filter. NIOSH-Approved self-contained breathing apparatus. DO NOT exceed limits established by the respirator manufacturer. All respiratory protection programs must comply with OSHA 29 CFR 1910.134 and ANSI Z88.2 requirements and must be followed whenever workplace conditions require a respirator's use.

Other Protective Equipment: Eye-wash station. Safety shower. Protective clothing.

General Hygiene Conditions: Wash with soap and water before meal times and at the end of each work shift. Handle in accordance with good industrial hygiene and safety practice.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State: Liquid.
Color: Transparent. Yellow.
Odor: Low odor.
Boiling Point (deg. F): N.D.
Freezing Point (deg. F): N.D.
Melting Point (deg. F): N.D.
Vapor Pressure (mm Hg): N.D.
Vapor Density (air=1): N.D.
Solubility in Water: Dispersible
pH: N.D.
Specific Gravity: 0.96 @ 25C
% Volatile (wt%): N.D.
Evaporation Rate (nBuAc = 1): N.D.
VOC (wt%): N.D.
VOC (lbs/gal): N.D.
Viscosity: N.D.
Flash Point: > 200 Deg. F.
Flash Point Method: Estimated.
Lower Explosion Limit: N.D.
Upper Explosion Limit: N.D.
Autoignition Temperature: No Data
Fire Point: N.D.

10. STABILITY AND REACTIVITY

Stability: Stable under recommended storage conditions.

Conditions to Avoid: Avoid elevated temperatures.

Incompatible Materials: Strong bases. Strong acids. Oxidizing agents. Isocyanates.

Hazardous Decomposition Products: Hazardous decomposition products depend upon temperature, air supply, and the presence of other materials. Decomposition products can include and are not limited to: Aldehydes. Ketones. Organic acids. Polymer fragments. Alcohols. Ethers. Hydrocarbons. Carbon monoxide. Nitrogen oxides. Dense smoke. Unidentified by-products. Carbon oxides.

Possibility of Hazardous Reactions: Hazardous polymerization will not occur under normal conditions. The reaction of polyols and isocyanates generates heat.

11. TOXICOLOGICAL INFORMATION

Component	Oral LD50	Dermal LD50	Inhalation LC50
No components found or no data available for product.			

12. ECOLOGICAL INFORMATION

Ecotoxicological Information: The sample of Suppressor 2360 is not acutely toxic to Daphnia magna at recommended allowed dosage by the Minnesota Pollution Control Agency (MPCA), which is 100mL of product per 850 gallons of water. Daphnia magna LC50 was greater than the one hundred percent solution of 0.311 ppm.

The sample of Suppressor 2360 is not acutely toxic to fathead minnows at recommended allowed dosage by the Minnesota Pollution Control Agency (MPCA), which is 100mL of product per 850 gallons of water. Pimephales promelas LC50 was greater than the one hundred percent solution of 0.311 ppm.

The sample of Suppressor 2360 is not acutely toxic at the highest dose allowed by the Minnesota Pollution Control Agency (MPCA), allowing SF Analytical Bioassay Laboratories to present Suppressor 2360 Defoamer Product with a PASS grade to be used at 100mL per 850 gallons of water.

Chemical Fate Information: No data available.

13. DISPOSAL CONSIDERATIONS

Hazardous Waste Number: N.A.
Disposal Method: Dispose of in accordance with all local, state and federal regulations. The information offered here is for the product as shipped. Use and/or alteration to the product such as mixing with other materials may significantly change the characteristics of the material and alter the RCRA classification and the proper disposal method. Since emptied containers retain product residue, follow label warnings even after container is emptied. DO NOT pressurize, cut, weld, solder, drill, grind or expose empty containers to heat, flame, sparks or other sources of ignition. Regulations may vary in different locations. Waste characterizations and compliance with applicable laws are the responsibility solely of the waste generator. Do NOT dump into any sewers, on the ground, or into any body of water.

14. TRANSPORTATION INFORMATION

DOT (Department of Transportation):

Proper Shipping Name: Not regulated by the DOT.

15. REGULATORY INFORMATION

TSCA Inventory Status: All components of this product are on the TSCA Inventory or are exempt from TSCA Inventory requirements.

SARA Title III Section 311/312 Category Hazards:

Immediate (Acute)	Delayed (Chronic)	Fire Hazard	Pressure Release	Reactive
No	Yes	No	No	No

Regulated Components:

Component	CAS Number	CERCLA RQ	SARA EHS	SARA 313	U.S. HAP	WI HAP	Prop 65
No components found.							

***Prop 65 - May Contain the Following Trace Components**
This product may contain a detectable level of (a) chemical(s) subject to Proposition 65.

16. ADDITIONAL INFORMATION

Hazard Rating System
Health: 1*
Flammability: 1
Reactivity: 0
* = Chronic Health Hazard

NFPA Rating System
Health: 1

Flammability: 1
Reactivity: 0
Special Hazard: None

MSDS Abbreviations
N.A. = Not Applicable
N.D. = Not Determined
HAP = Hazardous Air Pollutant
VOC = Volatile Organic Compound
C = Ceiling Limit
N.E./Not Estab. = Not Established

MSDS Prepared by: CSH

Reason for Revision: Change(s) made in Section 12.

MATERIAL SAFETY DATA SHEET

1. IDENTIFICATION

OSTREM CHEMICAL CO. LTD.
2310 - 80 AVENUE
EDMONTON AB T6P 1N2

Phone: 780-440-1911 or 780-446-0177
In Case of Emergency Only:
phone CANUTEC at (613) 996-6666

Product name: LIQUID CHLORINE 12% SANITIZER Code: J436
Other name:
Distributed by:
Product use: sanitizer, bleaching agent
Date completed: July 13, 2011

2. COMPOSITION/INFORMATION ON INGREDIENTS

Ingredient	%W/W	CAS number
sodium hypochlorite (providing 12% available chlorine)	60-100	7681-52-9

3. HAZARDS IDENTIFICATION

Corrosive liquid. Causes burns. Harmful if swallowed. Oxidizing Material.
Do not mix with acid; poisonous chlorine gas will be liberated.

4. FIRST AID MEASURES

Inhalation: Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.
Ingestion: Induce vomiting only on the direct advice of a poison control centre. Drink 1-2 glasses of water. Never give anything by mouth to an unconscious person. Get medical attention.
Eye contact: Flush with plenty of water for at least 15 minutes. Get medical attention.
Skin contact: Remove contaminated clothing and flush with plenty of water.

5. FIRE - FIGHTING MEASURES

Flash point (test method): Not applicable
Flammable limits (%): Not applicable
Lower:
Upper:
Fire extinguishing substances: water
Autoignition temperatures: not applicable
Hazardous combustion products: may produce chlorine gas and/or hydrogen chloride gas
Explosion data:
Sensitivity to mechanical impact: Not available
Sensitivity to static discharge: Not available
Special firefighting procedures: As for surrounding fire. Fire fighters should wear full protective clothing and self contained breathing equipment.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions: Wear appropriate protective equipment.
Environmental precautions: Prevent from entering sewers, waterways or low areas.
Methods for cleaning up: Isolate hazard area and restrict access. Small spills: soak up with inert absorbent material and scoop into containers. Large spills: prevent contamination of waterways. Dike and pump into suitable containers. Clean up residual with absorbent material, place in appropriate container and flush with water.

7. HANDLING AND STORAGE

Handling: Do not ingest. Avoid contact with eyes, skin and clothing. Wash thoroughly after handling.

Storage: Keep out of reach of children. Keep container tightly closed. Store in a cool, dry, well-ventilated area and away from incompatible materials. Venting of containers is advisable.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering controls: Provide exhaust ventilation to keep airborne levels below recommended exposure limits.

Respiratory protection: If exposure exceeds occupational exposure limits, use an appropriate NIOSH approved respirator

Eye protection: Chemical goggles. Wear a face shield if splashing hazards exists.

Other protection: Wear protective clothing as necessary to prevent skin contact.

Exposure limits:

INGREDIENT	ACGIH	OSHA	Other
sodium hypochlorite	1ppm (chlorine)		

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical state:	Liquid	**Solubility in water:**	soluble
Boiling point:	slowly decomposes above 40C	**Vapour pressure:**	12.1 mm Hg at 20C
Vapour density:	Not available	**Evaporation rate:**	Not available
Freezing point:	-19C	**Odour threshold:**	Not available
Sp. Gravity:	1.167	**pH:**	12.6 1% solution: 9.8

Appearance & odour: pale yellow liquid with strong chlorine odour

10. STABILITY AND REACTIVITY

Stability: Stable

Conditions of instability: unstable at temperatures above 40C, in sunlight, and in contact with acid

Incompatibility: ( ) Water (X) Oxidizers (X) Acid ( ) Base ( ) Other

Conditions of reactivity: Not available

Hazardous decomposition products: chlorine (by reaction with acids)

11. TOXICOLOGICAL PROPERTIES

POTENTIAL ACUTE HEALTH EFFECTS

Inhalation: Irritating to respiratory system.

Ingestion: Harmful if swallowed. Causes burns to mouth, throat and stomach.

Eye contact: Corrosive to eyes. Causes severe burns.

Skin contact: Corrosive to skin. Causes severe burns.

Skin absorption: Not applicable

POTENTIAL CHRONIC HEALTH EFFECTS:

Inhalation: Repeat or prolonged exposure may cause damage to lungs.

Ingestion: Not available

Eye contact: Not available

Skin contact: Prolonged contact may cause discomfort.

Skin absorption: Not available

Irritancy of product: See WHMIS criteria

Sensitization of product: Not available

Carcinogenicity: IARC (1, 2A or 2B) No known significant effects.

ACGIH: (A1, A2 or A3)	No known significant effects.
Reproductive toxicity:	No known significant effects.
Teratogenicity:	No known significant effects.
Mutagenicity:	No known significant effects.
Synergistic product:	Not available

HAZARDOUS INGREDIENTS	CAS NO.	TOXICITY DATA
sodium hypochlorite	7681-52-9	LD_{50} Oral (rat) 8910 mg/kg

12. ECOLOGICAL INFORMATION

Ecotoxicological information: Not available

Other information:

13. DISPOSAL CONSIDERATIONS

Waste disposal: Disposal of all waste must be done according to local, provincial and federal regulations.

14. TRANSPORT INFORMATION

TDG classification: HYPOCHLORITE SOLUTION; Class 8; UN 1791; PG III

15. REGULATORY INFORMATION

WHMIS:

E	Corrosive Material
C	Oxidizing Material
D2B	Toxic Material

NSF Certification: This product is certified under NSF/ANSI Standard 60 for disinfection and oxidation at a maximum usage of 87 mg/L.

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR.

16. PREPARATION INFORMATION

Prepared by: Technical Services Department, Ostrem Chemical Co. Ltd., Ph: (780) 440-1911

CLEARTECH

MATERIAL SAFETY DATA SHEET

Sodium Hypochlorite 5-20%

Section 01 - Chemical And Product And Company Information

Product Identifier ..... Sodium Hypochlorite (5-20%)

Product Use ..... Disinfectant, bleaching agent, source of available chlorine, deodorizer.

Supplier Name..... ClearTech Industries Inc.
2302 Hanselman Avenue
Saskatoon, SK. Canada
S7L 5Z3

Prepared By..... ClearTech Industries Inc. Technical Department
Phone: (306)664-2522

Preparation Date..... December 22, 2010

24-Hour Emergency Phone..... 306-664-2522

Section 02 - Composition / Information on Ingredients

Hazardous Ingredients..... Sodium Hypochlorite 4.90-16.80%

CAS Number..... Sodium Hypochlorite 7681-52-9

Synonym (s).....Industrial bleach, hypo, bleach, Javel water, household bleach

Section 03 - Hazard Identification

Inhalation..... Irritant of the nose and throat, causing coughing, difficulty breathing, and pulmonary edema.

CLEARTECH

Skin Contact / Absorption..... Causes severe skin irritation with blistering and ulceration.

Eye Contact..... Causes severe irritation of the mucous membranes of the eyes. May cause severe eye damage.

Ingestion..... Burning of the mouth and throat, abdominal cramps, nausea, vomiting, diarrhea, shock. May lead to convulsions, coma, and even death.

Exposure Limits..... ACGIH/TLV-TWA: 0.5ppm (chlorine)

Section 04 - First Aid Measures

Inhalation..... Remove victim to fresh air. Give artificial respiration only if breathing has stopped. If breathing is difficult, give oxygen. Seek immediate medical attention.

Skin Contact / Absorption..... Remove contaminated clothing. Wash affected area with soap and water. Seek medical attention if irritation occurs or persists.

Eye Contact..... Flush immediately with water for at least 20 minutes. Forcibly hold eyelids apart to ensure complete irrigation of eye tissue. Seek immediate medical attention.

Ingestion..... Do not induce vomiting. If vomiting occurs, lean victim forward to prevent breathing in vomitus. Give large amounts of water. Do not give anything by mouth to an unconscious or convulsing person. Seek immediate medical attention.

Additional Information..... Not available

Section 05 - Fire Fighting

Conditions of Flammability..... Non-flammable

Means of Extinction..... Product does not burn. Use appropriate extinguishing media for material that is supplying the fuel to the fire.

Flash Point..... Not applicable

Auto-ignition Temperature..... Not applicable

Upper Flammable Limit ..... Not applicable

CLEARTECH

Lower Flammable Limit..... Not applicable

Hazardous Combustible Products... Decomposition may produce chlorine gas and/or hydrogen chloride gas.

Special Fire Fighting Procedures..... Wear NIOSH-approved self-contained breathing apparatus and protective clothing.

Explosion Hazards..... Pressure buildup in containers could result in an explosion when heated or in contact with acidic fumes. Vigorous reaction with oxidizable organic materials may result in a fire.

Section 06 - Accidental Release Measures

Leak / Spill..... Wear appropriate personal protective equipment. Ventilate area. Stop or reduce leak if safe to do so. Restrict access to spill area until clean up is complete. Prevent material from entering sewers, waterways or confined spaces. Soak up smaller spills with absorbent material that does not react with spilled material. Flush with water to remove any residue.

Deactivating Materials..... Spills can be carefully neutralized first with sodium sulphite, sodium metabisulphite or other dechlorination agent for no chlorine residual, then a pH adjustment may be required with hydrochloric acid until the pH is 7. Note neutralization reactions may produce heat so necessary precautions must be taken. Local regulatory agencies should also be contacted for proper disposal.

Section 07 - Handling and Storage

Handling Procedures..... Use proper equipment for lifting and transporting all containers. Use sensible industrial hygiene and housekeeping practices. Wash thoroughly after handling. Avoid all situations that could lead to harmful exposure.

Storage Requirements..... Store in a cool, dry, well-ventilated place. Keep container tightly closed, and away from incompatible materials. Venting of containers is advisable.

Section 08 - Personal Protection and Exposure Controls

Protective Equipment

Eyes..... Chemical goggles, full-face shield, or a full-face respirator is to be worn at all times when product is handled. Contact lenses should not be worn; they may contribute to severe eye injury.

Respiratory..... A NIOSH-approved respirator suitable for chlorine is recommended. Where a higher level of protection is required, use a self-contained breathing apparatus.

CLEARTECH

Gloves..... Impervious gloves of chemically resistant material (rubber or PVC) should be worn at all times. Wash contaminated clothing and dry thoroughly before reuse.

Clothing..... Body suits, aprons, and/or coveralls of chemical resistant material should be worn at all times. Wash contaminated clothing and dry thoroughly before reuse.

Footwear..... Impervious boots of chemically resistant material should be worn at all times.

Engineering Controls

Ventilation Requirements..... Mechanical ventilation (dilution or local exhaust), process or personnel enclosure and control of process conditions should be provided. Supply sufficient replacement air to make up for air removed by exhaust systems.

Other..... Emergency shower and eyewash should be in close proximity.

Section 09 - Physical and Chemical Properties

Physical State..... Liquid

Odor and Appearance..... Strong chlorine odour. Clear, greenish-yellow solution.

Odor Threshold..... Not available

Specific Gravity (Water=1)..... 1.17 at 20°C (12% trade)

Vapor Pressure (mm Hg, 20C)..... 12.1mm Hg at 20°C (12.5 wt %)

Vapor Density (Air=1)..... Not available

Evaporation Rate..... Not available

Boiling Point..... Slowly decomposes above 40°C.

Freeze/Melting Point..... ~ -15°C (12% trade)

pH..... < 12

Water/Oil Distribution Coefficient.... Not available

Bulk Density..... Not available

% Volatiles by Volume..... Not available

CLEARTECH

Solubility in Water..... Complete

Molecular Formula..... NaOCl

Molecular Weight..... 74.44

Section 10 - Stability and Reactivity

Stability..... Unstable at temperatures above 40°C, in sunlight, and in contact with acid.

Incompatibility..... Incompatible with strong acids, ammonia, oxidizable materials, nickel, copper, tin, manganese, and iron.

Hazardous Products of Decomposition.. Chlorine (by reaction with acids), oxygen (by reaction with nickel, copper, tin, manganese, iron), sodium chloride, sodium chlorate, with increased temperature.

Polymerization..... Will not occur

Section 11 - Toxicological Information

Irritancy..... Strong irritant

Sensitization..... Not available

Chronic/Acute Effects..... If over-exposed to the solution, there will be constant irritation of the eyes, nose, and throat.

Synergistic Materials..... Not available

Animal Toxicity Data..... LD_{50}(oral,rat): 8910mg/kg (undiluted sodium hypochlorite)

Carcinogenicity..... Not considered to be carcinogenic (IARC and ACGIH).

Reproductive Toxicity..... Not available

Teratogenicity..... Not available

Mutagenicity..... Not available

Section 12 - Ecological Information

Fish Toxicity..... Not available

CLEARTECH

Biodegradability..... Not available

Environmental Effects..... Not available

Section 13 - Disposal Consideration

Waste Disposal..... Dispose in accordance with all federal, provincial, and/or local regulations including the Canadian Environmental Protection Act.

Section 14 - Transportation Information

TDG Classification

Class..... 8 (not regulated at solutions below 7%)

Group..... III (not regulated at solutions below 7%)

PIN Number..... UN 1791(not regulated at solutions below 7%)

Other..... Secure containers (full and/or empty) with suitable hold down devises during shipment.

Section 15 - Regulatory Information

WHMIS Classification.....E

NOTE: THE PRODUCT LISTED ON THIS MSDS HAS BEEN CLASSIFIED IN ACCORDANCE WITH THE HAZARD CRITERIA OF THE CANADIAN CONTROLLED PRODUCTS REGULATIONS. THIS MSDS CONTAINS ALL INFORMATION REQUIRED BY THOSE REGULATIONS.

NSF Certification.....Product is certified under NSF/ANSI Standard 60 for disinfection and oxidation at a maximum dosage for the following:

sodium hypochlorite 5%: 200mg/L
sodium hypochlorite 6%: 175mg/L
sodium hypochlorite 7%: 161mg/L
sodium hypochlorite 8%: 146mg/L
sodium hypochlorite 9%: 131mg/L
sodium hypochlorite 10%: 116mg/L
sodium hypochlorite 11%: 101mg/L
sodium hypochlorite 12%: 87mg/L
sodium hypochlorite 13%: 82mg/L
sodium hypochlorite 14%: 76mg/L
sodium hypochlorite 15%: 70mg/L
sodium hypochlorite 16%: 66mg/L
sodium hypochlorite 17%: 62mg/L
sodium hypochlorite 18%: 58mg/L
sodium hypochlorite 19%: 54mg/L
sodium hypochlorite 20%: 50mg/L

Sanitizer Use: to obtain 10 liters of a 200 mg/L solution as available chlorine, use 16.7 mL of Hypochlor-12 for each 10 liters of clean, potable water.

Section 16 - Other Information

Note: The responsibility to provide a safe workplace remains with the user. The user should consider the health hazards and safety information contained herein as a guide and should take those precautions required in an individual operation to instruct employees and develop work practice procedures for a safe work environment. The information contained herein is, to the best of our knowledge and belief, accurate. However, since the conditions of handling and use are beyond our control, we make no guarantee of results, and assume no liability for damages incurred by the use of this material. It is the responsibility of the user to comply with all applicable laws and regulations.

Attention: Receiver of the chemical goods / MSDS coordinator

As part of our commitment to the Canadian Association of Chemical Distributors (CACD) Responsible Distribution® initiative, ClearTech Industries Inc. and its associated companies require, as a condition of sale, that you forward the attached Material Safety Data Sheet(s) to all affected employees, customers, and end-users. ClearTech will send any available supplementary handling, health, and safety information to you at your request.

If you have any questions or concerns please call our customer service or technical service department.

ClearTech Industries Inc. - Locations

Corporate Head Office: 2302 Hanselman Avenue, Saskatoon, SK, S7L 5Z3
Phone: 306-664-2522
Fax: 306-665-6216

www.ClearTech.ca

Location	Address	Postal Code	Phone Number	Fax Number
Richmond, B.C.	12431 Horseshoe Way	V7A 4X6	604-272-4000	604-272-4596
Calgary, AB.	5516E - 40th St. S.E.	T2C 2A1	403-279-1096	403-236-0989
Edmonton, AB.	11750 - 180th Street	T5S 1N7	780-452-6000	780-452-4600
Saskatoon, SK.	2302 Hanselman Avenue	S7L 5Z3	306-933-0177	306-933-3282
Regina, SK.	555 Henderson Drive	S42 5X2	306-721-7737	306-721-8611
Winnipeg, MB.	340 Saulteaux Crescent	R3J 3T2	204-987-9777	204-987-9770
Mississauga, ON.	7480 Bath Road	L4T 1L2	905-612-0566	905-612-0575

24 Hour Emergency Number - All Locations - 306-664-2522

POLYMER 7557

MATERIAL SAFETY DATA SHEET

SECTION I: IDENTIFICATION OF PRODUCT

COMPANY:	**Diversity Technologies Corp.** **8750 – 53rd Ave.** **Edmonton, AB T6E 5G2**	DATE: PHONE: FAX:	December 11, 2009 780-468-4064 780-469-1899
PRODUCT NAME:	**ZETAG 8125; ZETAG 7557; ZETAG 7587**		
PRODUCT USE:	Oilwell and industrial drilling fluid additive.		
CHEMICAL FAMILY:	Cationic acrylamide polymer	CAS#:	Not available

WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM (WHMIS)

WHMIS CLASSIFICATION:	D2B
WORKPLACE HAZARD:	Eye irritant

TRANSPORTATION OF DANGEROUS GOODS (TDG)

PROPER SHIPPING NAME:	Not regulated under TDG
TDG CLASSIFICATION:	Not applicable
UN NUMBER (PIN):	Not applicable
PACKING GROUP:	Not applicable

SECTION II: HAZARDOUS INGREDIENTS

INGREDIENT	% (w/w)	CAS NUMBER	LD_{50} Oral-Rat	LC_{50} Inhal-Rat	ACGIH-TLV
Adipic acid	1.0 – 5.0	124-04-9	1900 mg/kg	Not available	5 mg/m^3

SECTION III: HEALTH HAZARDS

ROUTE OF ENTRY:	[XX] EYE CONTACT [ ] SKIN [ ] INHALATION [ ] INGESTION
EYE CONTACT:	May cause irritation and redness.
SKIN CONTACT:	Prolonged or repeated contact may cause slight irritation.
INGESTION:	Low acute oral toxicity (LD_{50} oral-rat > 2000 mg/kg). May cause gastrointestinal upset.
INHALATION:	May cause upper respiratory tract irritation.
CARCINOGENICITY:	Not a known carcinogen.
TERATOGENICITY:	Not a known teratogen.
REPRODUCTIVE TOXICITY:	No information available.
MUTAGENICITY:	Not a known mutagen.

SYNERGISTIC PRODUCTS:	None known.

SECTION IV: FIRST AID MEASURES

SKIN CONTACT:	Wash with soap and water. If irritation persists, obtain medical attention. Remove contaminated clothing and launder before re-use.
EYE CONTACT:	Flush with gently flowing warm water 15 minutes. Obtain medical attention.
INGESTION:	Do not induce vomiting. Rinse mouth and drink 2 to 4 glasses of water. If spontaneous vomiting occurs, keep head below hips to ensure vomitus is not aspirated. Seek immediate medical attention. Never give anything by mouth to an unconscious or convulsing victim.
INHALATION:	Move to fresh air. Apply oxygen or artificial respiration if required. If breathing difficulties, or distress, continue obtain medical attention.

SECTION V: PHYSICAL DATA

APPEARANCE AND ODOUR:	White free-flowing powder; little odour	
SPECIFIC GRAVITY:	0.75 – 1.00	
BOILING POINT (°C):	Not available	
MELTING POINT (°C):	Not available	
SOLUBILITY IN WATER:	Soluble	pH: 3.5 – 4.5 (1% sol'n)
PERCENT VOLATILE BY VOLUME:	Not available	
EVAPORATION RATE:	Not available	
VAPOUR PRESSURE (mmHg):	Not available	
VAPOUR DENSITY (air = 1):	Not available	
BULK DENSITY:	Zetag 8125 = 750 kg/m^3	

SECTION VI: FIRE AND EXPLOSION HAZARD DATA

FLASH POINT:	Not applicable
FLAMMABLE LIMITS:	Not applicable
EXTINGUISHING MEDIA:	Dry chemical, foam or CO_2 in preference to water spray.
SPECIAL FIRE FIGHTING PROCEDURES:	Self-contained breathing apparatus required for fire fighting personnel. Move from fire area if possible.
UNUSUAL FIRE AND EXPLOSION HAZARDS:	As with most organic powders, flammable dust clouds may be formed in air. Avoid creating dust. Avoid sources of ignition.

SECTION VII: REACTIVITY DATA

STABILITY:	STABLE [XX] UNSTABLE [ ]
INCOMPATIBILITY (CONDITIONS TO AVOID):	Avoid contact with strong oxidizers. Avoid ignition sources if dust clouds created.
CONDITIONS OF REACTIVITY:	Not determined.
HAZARDOUS DECOMPOSITION PRODUCTS:	Oxides of carbon on thermal decomposition.
HAZARDOUS POLYMERIZATION:	WILL NOT OCCUR [XX] MAY OCCUR [ ]

SECTION VIII: PREVENTATIVE MEASURES

SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION:	Suggest NIOSH approved dust mask for dust levels below TLV. If dust concentration in air exceeds TLV use an approved respirator with dust cartridges.
VENTILATION:	Use local exhaust ventilation, process enclosure or other engineering controls to maintain dust level below TLV.
PROTECTIVE GLOVES:	Personal preference.
EYE PROTECTION:	Wear safety glasses with side-shields or goggles.
OTHER PROTECTIVE EQUIPMENT (Specify):	Ensure eyewash station and emergency shower are available.

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING

Avoid skin and eye contact. Wash thoroughly after handling. Avoid breathing dust. Avoid creating dust cloud during handling. Use only in a well ventilated area. Use nonsparking tools and grounded/bonded equipment and containers when transferring. Store in a cool, dry area away from oxidizers and ignition sources. Empty packaging contains residual hazardous material and must be stored and handled as if full.

STEPS TO BE TAKEN IN CASE THE MATERIAL IS SPILLED OR RELEASED

Use appropriate safety equipment. Eliminate ignition sources. Contain spill. Collect by vacuum if possible to avoid generation of dust. Collect uncontaminated material for repackaging. Collect contaminated material in an approved container for disposal. Wash contaminated area with water. Collect washings for disposal. Do not flush to sewer.

WASTE DISPOSAL METHOD

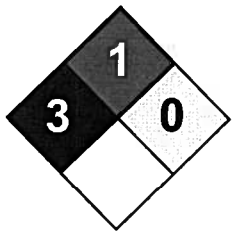
Dispose in accordance with federal, provincial and local regulations. It is the responsibility of the end user to determine if material meets the criteria of hazardous waste at the time of disposal.

SECTION IX: PREPARATION

THE INFORMATION CONTAINED HEREIN IS GIVEN IN GOOD FAITH,
BUT NO WARRANTY, EXPRESSED OR IMPLIED, IS MADE.

DATE ISSUED:	December 11, 2009	BY:	Product safety committee
SUPERSEDES:	February 1, 2007	PHONE:	780-440-4923

Diversity Technologies Corp. is the parent company of Canamara-United Supply, Hollimex Products, The Drilling Depot and Westcoast Drilling Supplies.



Health	3
Fire	1
Reactivity	0
Personal Protection	J

Material Safety Data Sheet
Oxalic acid dihydrate MSDS

Section 1: Chemical Product and Company Identification

Product Name: Oxalic acid dihydrate

Catalog Codes: SLO1429, SLO1054

CAS#: 6153-56-6

RTECS: Not available.

TSCA: TSCA 8(b) inventory: No products were found. It is a hydrate and exempt from TSCA inventory requirements.

CI#: Not applicable.

Synonym: Ethanedioic Acid, dihydrate

Chemical Name: Oxalic Acid, dihydrate

Chemical Formula: (COOH)2.2H2O

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Oxalic acid dihydrate	6153-56-6	100

Toxicological Data on Ingredients: Oxalic acid dihydrate LD50: Not available. LC50: Not available.

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation. Hazardous in case of skin contact (permeator), of eye contact (corrosive). Slightly hazardous in case of skin contact (corrosive). The amount of tissue damage depends on length of contact. Eye contact can result in corneal damage or blindness. Skin contact can produce inflammation and blistering. Inhalation of dust will produce irritation to gastro-intestinal or respiratory tract, characterized by burning, sneezing and coughing. Severe over-exposure can produce lung damage, choking, unconsciousness or death. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to kidneys, the nervous system, mucous membranes, heart, brain, skin, eyes. Repeated or prolonged exposure to the substance can produce target organs damage. Repeated exposure of the eyes to a low level of dust can produce eye irritation. Repeated skin exposure can produce local skin destruction, or dermatitis. Repeated inhalation of dust can produce varying degree of respiratory irritation or lung damage.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention immediately.

Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Cold water may be used.Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: May be combustible at high temperature.

Auto-Ignition Temperature: Not available.

Flash Points: Not available.

Flammable Limits: Not available.

Products of Combustion: These products are carbon oxides (CO, CO2).

Fire Hazards in Presence of Various Substances:
Slightly flammable to flammable in presence of heat. Non-flammable in presence of shocks.

Explosion Hazards in Presence of Various Substances:
Slightly explosive in presence of open flames and sparks. Non-explosive in presence of shocks.

Fire Fighting Media and Instructions:
SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use water spray, fog or foam. Do not use water jet.

Special Remarks on Fire Hazards: As with most organic solids, fire is possible at elevated temperatures

Special Remarks on Explosion Hazards:
Fine dust dispersed in air in sufficient concentrations, and in the presences of an ignition source is a potential dust explosion hazard.

Section 6: Accidental Release Measures

Small Spill:

Use appropriate tools to put the spilled solid in a convenient waste disposal container. If necessary: Neutralize the residue with a dilute solution of sodium carbonate.

Large Spill:
Corrosive solid. Stop leak if without risk. Do not get water inside container. Do not touch spilled material. Use water spray to reduce vapors. Prevent entry into sewers, basements or confined areas; dike if needed. Eliminate all ignition sources. Call for assistance on disposal. Neutralize the residue with a dilute solution of sodium carbonate. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep container dry. Keep away from heat. Keep away from sources of ignition. Empty containers pose a fire risk, evaporate the residue under a fume hood. Ground all equipment containing material. Do not ingest. Do not breathe dust. Never add water to this product. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, metals, alkalis.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection:
Splash goggles. Synthetic apron. Vapor and dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor and dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 1 STEL: 2 (mg/m3) from ACGIH (TLV) [United States] TWA: 1 STEL: 2 (mg/m3) from OSHA (PEL) [United States] TWA: 1 STEL: 2 (mg/m3) from NIOSH [United States] TWA: 1 STEL: 2 (mg/m3) [United Kingdom (UK)] TWA: 1 STEL: 2 (mg/m3) [Canada]Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Crystalline solid)

Odor: Odorless.

Taste: Not available.

Molecular Weight: 126.07 g/mole

Color: Colorless. White.

pH (1% soln/water): Not available

Boiling Point: Not available.

Melting Point: 101.5°C (214.7°F)

Critical Temperature: Not available.

Specific Gravity: Density: 1.653 @ 18.5 eg. C(Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: 4.4 (Air = 1)

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, diethyl ether.

Solubility:
Soluble in cold water, diethyl ether. Soluble in alcohol, glycerol. Insoluble in benzene, petroleum ether. Solubility in cold water: 1g/7ml. Solubility in hot water: 1g/2ml

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Excess heat, incompatible materials, dust generation.

Incompatibility with various substances: Reactive with oxidizing agents, metals, alkalis.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Incompatible with chlorites, hypochlorites, silver and silver compounds, furfuryl alcohol. Hygroscopic; keep container tightly closed.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Inhalation. Ingestion.

Toxicity to Animals:
LD50: Not available. LC50: Not available.

Chronic Effects on Humans:
May cause damage to the following organs: kidneys, the nervous system, mucous membranes, heart, brain, skin, eyes.

Other Toxic Effects on Humans:
Very hazardous in case of skin contact (irritant), of ingestion, of inhalation. Hazardous in case of skin contact (permeator), of eye contact (corrosive). Slightly hazardous in case of skin contact (corrosive).

Special Remarks on Toxicity to Animals:
LD50 data for Oxalic acid, ahydrous (CAS no. 144-62-7): LD50[rat] - Route: oral; Dose: 7500 mg/kg

Special Remarks on Chronic Effects on Humans: May cause adverse reproductive effects based on animal test data. No human data found.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: Skin: Causes skin irritation. Rare chemical burns may occur. Harmful if absorbed through the skin. Eyes: Causes severe eye irritation with possible burns. It may result in corneal damage and conjunctivitis. Inhalation: Causes irritation of the respiratory tract, ulceration of the mucous membranes. Inhalation of oxalic acid may also cause digestive disturbances such as nausea and vomiting as well as affecting the nerves and urinary system and causing

headache, muscular irrritability, weakness, and albuminuira Ingestion: Harmful if swallowed. Causes severe digestive tract irritation and possible burns. It may affect the cardiovascular system, and urinary system. Symptoms may include vomiting (often bloody or with coffee-ground appearance), diarrhea, bloody stool, hypermotility, abdominal pain, intense burning pain in the throat, esophagus, stomach, ulceration/burning of the mouth, esophagus, and stomach, severe purging, weak pulse, hypotension, caridac irregularities, cardiovascular collapse. Other symptoms may include convulsions, headache, twitching, tetany, stupor, coma, tingling of fingers and toes, muscular irritability. Renal damage, as evidenced by oliguria, albuminuria, hematuria, may occur because Oxalic acid can bind calcium to form calcium oxalate which is insoluble at physiological pH. The calcium oxalate formed might precipitate in the kidney tubules. Hypocalcemia may also occur, which is what may affect the function of the heart and nerves and cause the above cardiovasular and nervous system effects. Chronic Potential Health Effects: Skin: Prolonged or repeated exposure may cause localized pain and cyanosis of the fingers, and even

Section 12: Ecological Information

Ecotoxicity:
Ecotoxicity in water (LC50): 4000 mg/l 24 hours [Fish (Bluegill)]. 1000 ppm 0.5 hours [Fish (Goldfish)]. 100 ppm 0.3 hours [Fish (Trout)].

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Class 8: Corrosive material

Identification: : Corrosive Solid, Acidic, Organic, n.o.s. (Oxalic Acid, Dihydrate) UNNA: 3261 PG: III

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations: Pennsylvania RTK: Oxalic acid dihydrate

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). Oxalic Acid, anhydrous (CAS no. 144-62-7) is listed on the Canadian DSL Oxalic Acid, dihydrate (CAS 6153-56-6) is not listed on the Canadian DSL. EINECS no. for Oxalic Acid, anhydrous: 205-634-3 EINECS no. for Oxalic Acid, dihydrate: unlisted Oxalic Acid, dihydrate is on the inventory lists for China, Japan, and Philippines.

Other Classifications:

WHMIS (Canada): CLASS E: Corrosive solid.

DSCL (EEC):
R21/22- Harmful in contact with skin and if swallowed. S24/25- Avoid contact with skin and eyes.

HMIS (U.S.A.):

Health Hazard: 3

Fire Hazard: 1

Reactivity: 0

Personal Protection: j

National Fire Protection Association (U.S.A.):

Health: 3

Flammability: 1

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Synthetic apron. Vapor and dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/10/2005 08:44 PM

Last Updated: 11/01/2010 12:00 PM

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NSF Reference Standards

MATERIAL SAFETY DATA SHEET

NAME OF PRODUCT: Citric Acid MSDS DATE: 17 Nov. 2011

Notice

NSF Reference Standards are for test and assay use only and are not intended for human or animal consumption. This document communicates information relating to test and assay use only and may not be applicable for any unauthorized use.

SECTION 1: PRODUCT AND COMPANY IDENTIFICATION

Product Name:	Citric Acid
Catalog Code:	RS1-0039
Synonym:	2-hydroxypropane-1,2,3-tricarboxylic acid
Chemical Formula:	$C_6H_8O_7$
CAS #:	77-92-9

Contact Information:

NSF International
789 N. Dixboro Road
Ann Arbor, MI 48113-0140, USA
Toll Free (USA): 800-NSF-MARK (800-673-6275)
Telephone: (+1) 734-769-8010
Fax: (+1) 734-769-0109
www.nsf-rs.org

SECTION 2: COMPOSITION/INFORMATION ON INGREDIENTS

Name: Citric Acid

CAS#: 77-92-9

% by Weight: 100%

Toxicological Data on Ingredients:
LD50 (mouse): 5040 mg/ kg, LD50 (rat): 3000 mg/ kg

SECTION 3: HAZARDS IDENTIFICATION

Potential Acute Health Effects:
Slightly hazardous in case of skin contact (irritant, sensitizer), of eye contact (irritant), of ingestion, of inhalation (lung irritant). Tissue damage is dependent on length of contact. Skin contact can produce

inflammation and blistering. Severe overexposure can produce lung damage, choking, unconsciousness, or death.

Potential Chronic Health Effects:
Slightly hazardous in case of skin contact (sensitizer).
CARCINOGENIC EFFECTS: Not Available
MUTAGENIC EFFECTS: Mutagenic for Human somatic cells, and bacteria/ yeast cells
TERATOGENIC EFFECTS: Not Available
DEVELOPMENTAL TOXICITY: Not Available
Repeated or prolonged exposure to the substance can produce target organ damage.

Repeated or prolonged exposure to the substance is not known to aggravate medical conditions.

SECTION 4: FIRST AID MEASURES

Eye Contact:
Check for and remove contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Seek medical attention if irritation occurs.
Skin Contact:
In case of contact, immediately wash skin with non-abrasive soap and plenty of water. Cover the irritated skin with an emollient. Seek medical attention if irritation develops.
Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.
Inhalation:
If inhaled, remove to fresh air. If not breathing give artificial respiration. Seek medical attention.
Serious Inhalation:
Not Available
Ingestion:
Do not induce vomiting. Loosen tight clothing. If a large quantity of citric acid is swallowed, seek medical attention if symptoms appear.
Serious Ingestion: Not Available.

SECTION 5: FIRE-FIGHTING MEASURES

Flammability of the Product: May be combustible at high temperature.
Auto-Ignition Temperature: 1010 °C
Flammable Limits: Lower: 0.28 kg/m^3 (Dust) Upper: 2.29 kg/m^3 (Dust)

Flash Points: Not Available

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Products of Combustion: These products are carbon oxides (CO, CO_2)
Special Remarks on Explosion Hazards: Not Available.

Fire Hazards in Presence of Various Substances:
Slightly flammable to flammable in presence of open flames.

Explosion Hazards in Presence of Various Substances:
Slightly explosive in the presence of flames and sparks.
Risks of explosion of the product in presence of mechanical impact: Not Available.
Risks of explosion of the product in presence of static discharge: Not Available.
Special Remarks on Fire Hazards: Fire is possible at elevated temperatures.

Fire Fighting Media and Instructions:
SMALL FIRE: Use DRY chemical powder.
LARGE FIRE: Use water spray, fog or foam. Do not use water jet.

SECTION 6: ACCIDENTAL RELEASE MEASURES

Small Spill:
Use appropriate tools to put the spilled solid in a convenient waste disposal container. After powder clean up, spread water on the contaminated surface and dispose of according to local and regional authority requirements.

Large Spill:
Stop leak if without risk. Do not touch spilled material. Call for assistance. Use appropriate tools to put the material into a suitable waste disposal container. After powder clean up, spread water on the contaminated surface and dispose of according to local and regional authority requirements.

SECTION 7: HANDLING AND STORAGE

Precautions:
Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe dust. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and provide the container or the label. Avoid contact with skin and eyes. Keep away from oxidizing agents, reducing agents, metals, alkalis.

Storage:
Keep container tightly closed. Keep container in a cool, well-ventilated area.

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SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls:
If laboratory operations generate dust, fume or mist, use local exhaust ventilation or other appropriate engineering controls to keep exposure to airborne contaminants below the exposure limit.

Personal Protection:
Safety glasses. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves (impervious).

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits: Not Available.

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

Physical state and appearance: Solid. (crystalline powder)
Odor: Odorless
Taste: Acidic, Strong
Molecular Weight: 192.13 g/mol
Color: Not Available
pH (1% soln/water): Not Available
Boiling Point: Decomposes
Melting Point: 153 °C
Critical Temperature: Not Available
Specific Gravity: 1.665
Vapor Pressure: Not applicable.
Vapor Density: Not Available.
Volatility: Not Available.
Odor Threshold: Not Available.
Water/Oil Dist. Coeff.: Citric acid is more soluble in water; log(oil/water) = -1.7
Ionicity (in Water): Not Available
Dispersion Properties: Not Available
Solubility: Soluble in cold water, hot water.

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SECTION 10: STABILITY AND REACTIVITY

Stability: The product is stable.
Instability Temperature: Not Available.
Conditions of Instability: Excessive heat, incompatible materials.
Incompatibility with various substances: Reactive with oxidizing agents, reducing agents, metals, alkalis
Corrosivity: Corrosive in the presence of aluminum, zinc, of copper. Not corrosive in presence of glass.
Special Remarks on Reactivity: Incompatible with oxidizing agents, potassium tartrate, alkali, alkaline earth carbonates and bicarbonates, acetates and sulfides, metal nitrates.
Special Remarks on Corrosivity: Will corrode copper, zinc, aluminum, and their alloys.
Polymerization: Will not occur.

SECTION 11: TOXICOLOGICAL INFORMATION

Routes of Entry: Inhalation. Ingestion.

Toxicity to Animals: Acute oral toxicity (LD50): 3000 mg/kg [Rat]

Irritancy data: Skin/ rabbit: not irritating; Eye/ Rabbit: not irritating

Chronic effects on humans: May cause damage to teeth.

Other Toxic Effects on Humans: Slightly hazardous in case of skin contact (irritant, sensitizer), of ingestion, or inhalation (lung irritant).

Special Remarks on Toxicity to Animals:
LDL [Rabbit] – Route: oral; Dose: 7000 mg/kg

Special Remarks on Chronic Effects on Humans: Not Available

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects:
Skin: May cause mild to moderate irritation/ sensitization, allergic reaction
Eyes: May cause moderate to severe eye irritation and possible injury
Inhalation: May cause respiratory tract and mucous membrane irritation.
Ingestion: May cause GI irritation with nausea, vomiting, diarrhea. Excessive intake may cause teeth erosion and hypocalcaemia. May affect nervous system (tremor, convulsions, muscle contraction).
Chronic potential Health effects:

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SECTION 12: ECOLOGICAL INFORMATION

Ecotoxicity: Not Available.
BOD5 and COD: Not Available.
Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.
Toxicity of the Products of Biodegradation:
The products of degradation and the product itself are not toxic.
Special Remarks on the Products of Biodegradation: Not Available

SECTION 13: DISPOSAL CONSIDERATIONS

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

SECTION 14: TRANSPORT INFORMATION

DOT Classification: Not a DOT controlled material in the United States
Identification: Not applicable.
Special Provisions for Transport: Not applicable.

SECTION 15: REGULATORY INFORMATION

Federal and State Regulations: TSCA 8(b) inventory: Citric Acid

Other Regulations: EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances/
Other Classifications:
WHMIS (Canada): Class E : Corrosive Solid
DSCL (EEC):
R 36/37/38 – Irritating to eyes, respiratory system, and skin.
S 26 – In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
S 37/39 – Wear suitable gloves and eye/ face protection.

HMIS (U.S.A.):
Health Hazard: 2

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Fire Hazard: 1
Reactivity: 0
Personal Protection: E

National Fire Protection Association (U.S.A.):
Health: 2
Flammability: 1
Reactivity: 0
Specific hazard:

Protective Equipment:
Gloves (Impervious). Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Safety glasses.

SECTION 16: OTHER INFORMATION

References: Not Available.
Other Special Considerations: Not Available.

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