ENVIRONMENTAL ASSESSMENT REPORT AND REGISTRATION

PROPOSED GLYCOL CONCENTRATION FACILITY

Inland

Project No. NSD16265

February 6, 2002

Final Submission

Submitted by:

Jacques Whitford Environment Limited

ENVIRONMENTAL ASSESSMENT REPORT
AND REGISTRATION
INLAND TECHNOLOGIES CANADA INC.
PROPOSED GLYCOL CONCENTRATION FACILITY

PROJECT NO. NSD16265-2

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SUBMISSION TO

THE NOVA SCOTIA DEPARTMENT
OF ENVIRONMENT AND LABOUR
ENVIRONMENTAL ASSESSMENT BRANCH

ON

ENVIRONMENTAL ASSESSMENT REPORT AND REGISTRATION INLAND TECHNOLOGIES CANADA INC. PROPOSED GLYCOL CONCENTRATION FACILITY

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TABLE OF CONTENTS

Page No.

1.0 INTRODUCTION 1

1.1 Document Structure 1

1.2 Background 3

1.3 Environmental Approvals Process 3

2.0 PROJECT DESCRIPTION 4

2.1 Operations Activities 5

2.2 Construction Methods 9

2.3 Pre-construction and Schedule Activities 10

3.0 DESCRIPTION OF THE SITE AND EXISTING ENVIRONMENTAL CONDITIONS 11

4.0 POSITIVE SOCIO-ECONOMIC ASPECTS 15

5.0 POTENTIAL ENVIRONMENTAL RECEPTORS AND EFFECTS 15

6.0 PROPOSED MITIGATIVE MEASURES FOR CONSTRUCTION AND OPERATION 16

6.1 Specific Areas of Concern 16

6.1.1 Sediment Erosion Control 16

6.1.2 Spill Containment 17

6.1.3 Abandonment/Reclamation 17

6.1.4 Discharge of Wastewater to Sanitary Sewer – Mitigation Measures 17

6.2 General Areas of Concern 18

Acid Generating Bedrock 18

Blasting 18

Impacted Soils 18

Flora and Fauna 19

Air Emissions/ Odour 19

Spills and Emergency Response 19

Archeological Resources 19

7.0 CLOSING 19

8.0 REFERENCES 21

LIST OF FIGURES AND APPENDICES

FIGURES

Figure 1 Proposed Glycol Concentrator Facility–Halifax International Airport–Site Location Plan
Figure 2 Concentrator Facility Equipment Arrangement
Figure 3 Aircraft De-icing Fluid Production Quality Control
Figure 4 Layout of the Halifax International Airport

APPENDICES

Appendix A Required Information as per the Environmental Assessment Regulations
Appendix B Inland Technologies Aircraft De-icing Fluid Recovery Brochure and Modutank Brochure
Appendix C Letter of Support for the Undertaking
Appendix D Additional Approvals and Permits Required
Appendix E Operations Manual
Appendix F HRM and NSDEL Correspondence Re: Wastewater Discharge and By-Law W101.
Appendix G Spill Response Contingency Plan

1.0 INTRODUCTION

Inland Technologies Canada Inc. proposes to construct an on-site Glycol Concentration Facility at the Halifax International Airport (HIA). The site is approximately 70 m by 100 m and is located on Goudy Drive next to the airNova parking lot expansion. The proposed location is illustrated on Figure 1, the site location plan. The facility will be used to handle and recycle spent aircraft de-icing fluids. The purpose of the undertaking is to establish a more efficient and economic process to handle and recycle the fluids. The current operation involves transport of untreated de-icing fluids to Debert, Nova Scotia for biological treatment. The Glycol Concentration Facility is proposed to be a temporary facility (operating two to three years), and is viewed as a precursor to a more extensive processing system to be developed in the future. This facility expansion would occur during future expansions and infrastructure upgrades at the HIA.

This report describes the pre-construction planning, construction activities and operational process of the undertaking, as well as identifying potential environmental impacts resulting from the undertaking. The report will also detail the mitigative measures planned during the scheduled construction, and proposed operation of the facility.

1.1 Document Structure

This document is presented in six sections.

Section 1 presents a background of the project, outlining the nature and value of the development. A description of the environmental approval process and overview of the regulatory environment is also included in this section.

Section 2 presents the operational and construction details of the project, including project scheduling and pre-construction activities.

Section 3 details the site layout and adjoining areas. The focus of this section is to present the site sensitivity and potential environmental issues.

Section 4 summarizes the positive socio-economic considerations of the project.

Section 5 summarizes the receptors in proximity of the site with the potential for exposure to operational activities.

Section 6 presents the proposed mitigative measures and describes the components of environmental management.

AIR NOVA

PARKING

PROPOSED GLYCOL CONCENTRATOR FACILITY SITE

PARKING

PROM GOUDEY DR

SPARE DUCT

SPARE DUCT

SPARE DUCT

TAXI H

28581

BOUL BELL BLVD

TRANSFORMER "C"

PROM SILVER DART DR

VALVE CHAMBER

PARKING TOLL BOOTH

AIRPORT PARKING

AIRPORT TERMINAL BUILDING

BENNERY BROOK

PROM GOUDEY DR

TRANSFORMER "A"

DEICING PADS FOR FLUID COLLECTION

2ND SPARE

PROPOSED GLYCOL CONCENTRATOR FACILITY
HALIFAX INTERNATIONAL AIRPORT–SITE LOCATION PLAN

SCALE 1:2000

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FIGURE 1

Section 7 is a closure for the report.

Section 8 provides references for documents cited.

Supporting information is provided in the appendices at the end of this document. Information required pursuant to the *Environmental Assessment Regulations* is included in Appendix A.

1.2 Background

Inland Technologies is a Nova Scotia based environmental company involved in the re-refining and re-processing of liquid industrial waste products. The focus of glycol recycling technology is to provide a safe and efficient option for the recovery and reuse of the de-icing fluids. The proprietary technology is a process that concentrates spent aircraft de-icing fluids while producing a distillate with low concentrations of glycol. The concentrate can be further processed for applications such as polymer production, automotive antifreeze and re-use as de-icing fluids. Inland Technologies has commissioned numerous on-site aircraft de-icing fluid processing facilities at airports throughout North America and Europe. Presently, Inland Technologies is involved in the setup and construction of other glycol recycling facilities in Canada at the Ottawa, Vancouver, and St. John's airports. Additional information can be found in the Inland Aircraft De-icing Fluid Recovery brochure in Appendix B and on the company website at *www.inlandgroup.ca*.

For several years de-icing fluids from the HIA have been transported to the Industrial Environmental Services (IES) facility, located in Debert, Nova Scotia for handling and treatment. The proposed on-site facility at the HIA will greatly reduce transport volumes due to the close proximity of the de-icing area to the proposed glycol concentration location. Operation of the proposed facility will reduce highway traffic, decrease vehicle emissions and limit consumption of fuel related to transportation of the fluids. In general, the on-site process facilitates a more efficient and cost effective fluid recovery process.

The undertaking is highly supported by the Halifax Airport Authority (HIAA) because of the economic and environmental benefits over the present practice. The air carriers also support the proposed undertaking because the process creates a concentrate product that can be purchased directly and provides an economic saving to the air carrier (Appendix C). The project is viewed as a progressive means for improving long term environmental conditions at the HIA. The facility is regarded as a pilot operation for a larger and more extensive processing system to be developed during future expansions and infrastructure upgrades.

1.3 Environmental Approvals Process

This sub-section identifies the requirements of the approval process for the undertaking under the Nova Scotia *Environment Act*. The purpose of the environmental approval and review is to protect the environment during the construction and operation of a viable undertaking and to promote

environmental awareness in sustainable development. The environmental assessment identifies potential adverse environmental effects in the planning and scheduling stages of the project. The process helps to promote better project planning and responsibility among proponents.

The Nova Scotia *Environmental Assessment Regulations* requires a registration for assessment of an undertaking designated as Class 1 or 2 undertaking. This includes "A permanent commercial facility for the handling of waste dangerous goods." The proposed project is categorized as a storage and handling facility for substances of environmental concern (waste dangerous goods), as designated under the *Dangerous Goods Management Regulations* of the *Environment Act*. The classification is applicable due to concentrations involved in the proposed undertaking exceeding a regulation limit of 1000 mg/L and quantity exceeding a regulation limit of 10 000 L. Schedule A (E) of the *Environmental Assessment Regulations* indicate that the proposed facility will be considered as a Class 1 undertaking for the purposes of compliance with these regulations.

A formal review process begins with registration of the undertaking with the Environmental Assessment (EA) branch of the Nova Scotia Department of Environment and Labour (NSDEL). This submitted document includes details on the nature and purpose of the project, the project operations and potential environmental impacts resulting from the undertaking (outlined information prescribed by the NSDEL for the EA registration is presented in Appendix B). The proponent arranges for a notification of the undertaking to be published in a local and provincial newspaper and organizes viewing locations for interested public parties.

After the registration of the undertaking, the environmental assessment process requires 25 calendar days for a decision from the Minister of Environment and Labour. The following are the options for a decision: a) additional information is required; b) the undertaking is approved; c) a focus report is required; d) a full environmental assessment report is required; e) the undertaking is rejected. Since a request for additional information will extend the approval process, this document has been initially prepared as a draft report. The draft report allows for preliminary comments by the EA branch and selected government departments in an attempt to determine the need for additional information.

Additional approvals and permits required during the planning and construction of the undertaking are listed in Appendix D.

2.0 PROJECT DESCRIPTION

This section details the planning, construction and operational aspects of the undertaking.

2.1 Operations Activities

The following equipment is scheduled to be located on the site: an office trailer; a process trailer (includes a concentrator and a scrubber); a 2,000,000 litre aboveground Modutank; two 46,000 litre aboveground concentrate tanks; and one 25,000 litre aboveground distillate tank. The layout of the facility is shown in Figure 2. All product storage tanks and connection piping are dual wall-lined to prevent spills. All equipment will be pre-fabricated with only minimal on-site connections required with the exception of the Modutank that will require on-site assembly. See Appendix B for additional on information on Modutank installation and specifications.

The production and quality control of the system is illustrated in Figure 3. Additional detail of the procedure can be found in the operations manual, Appendix E. The process begins with the collection of the de-icing fluids from the de-icing pads. Primary collection of the fluids is performed using a Glycol Recovery Vehicle (GRV) that sweeps the area and collects the liquid using a vacuum system. The collected fluids are then transferred, for temporary storage, to a holding tank located near to the de-icing pads. Residual glycol, not collected by the GRV, is recovered along with rainfall via gravity fed drains located in the center of each pad. The glycol recovery drains are controlled by butterfly valves that are closed during the non-deicing periods. Stormwater runoff drains are also located on the de-icing pads that remain closed during the de-icing and fluid collection period. From the glycol recovery drains, the recovered fluid is gravity fed to pumping stations, located on each side of the de-icing area, and is then pumped to the de-icing pad holding tank for temporary storage.

Following collection of the de-icing fluids from the de-icing pads, the water and glycol mixture (concentration of 1% to 20% of glycol) is currently transported to Debert for biological treatment. The proposed undertaking would transport the fluids by truck for on-site processing. The close proximity (700 metres) of the de-icing pad areas to the proposed site and the travel route is shown in Figure 4. The recovered fluid is to be stored in the 2,000,000 litre Modutank that would serve as a feedstock for the system. Next, the fluid would be pumped to the glycol concentrator that is used to remove water from the spent deicing fluids. This apparatus is also capable of handling concentrations lower or higher than the initial 1% to 20% of glycol. The process is accomplished using evaporation with mechanical vapour recompression. The unit also contains a heat exchanger and unique heat recovery system to efficiently separate the glycol and water. The water (distillate containing <100 ppm glycol) is further processed using aeration to reduce organic impurities prior to release to the sanitary sewer. The concentrate (18% glycol), is stored on-site for transport or further on-site processing. Further on-site processing involves re-concentration of the primary concentrate (18% glycol) to produce a concentrate solution of approximately 50% glycol. The distillate from this process is transferred back into the Modutank for additional processing.

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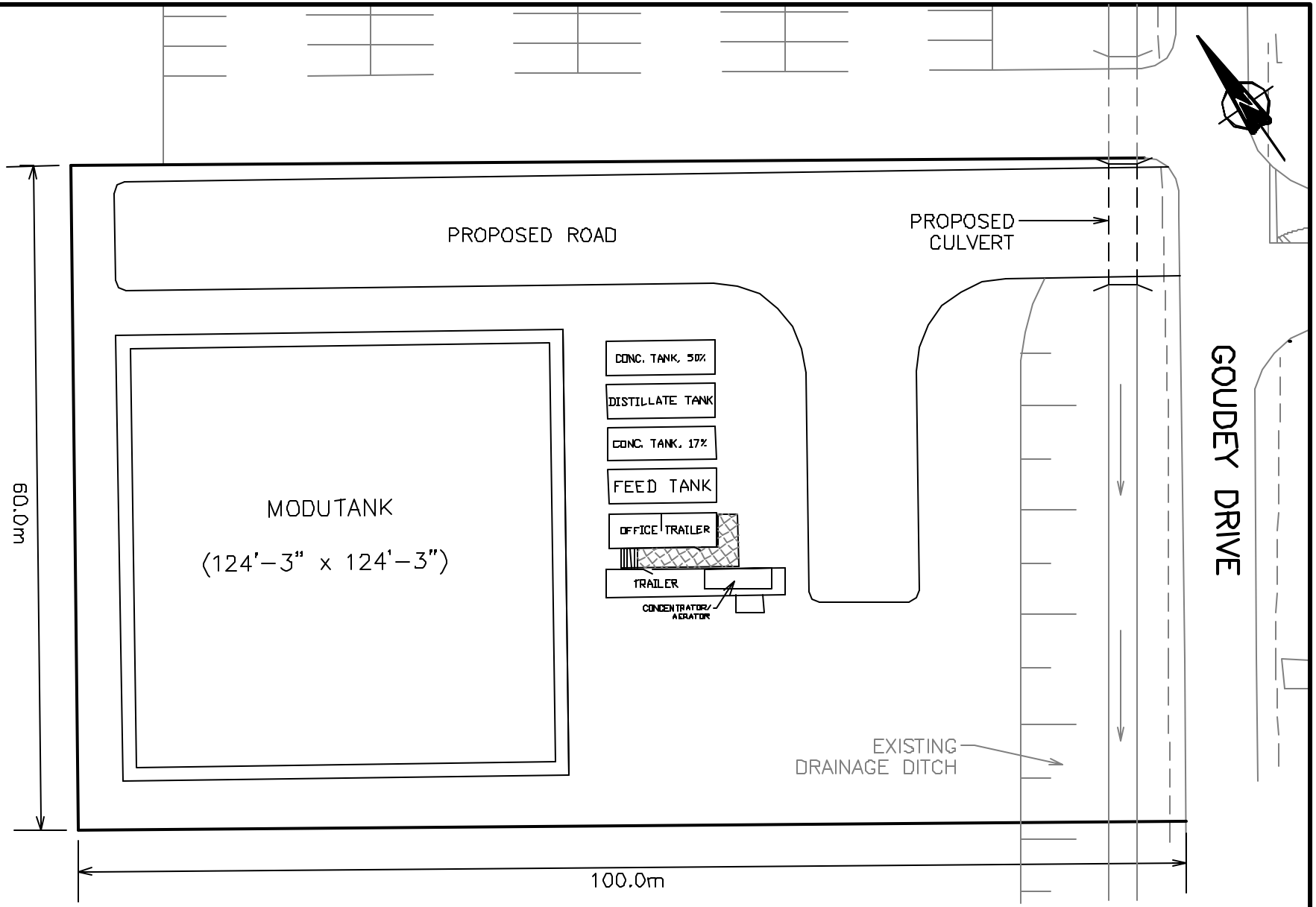
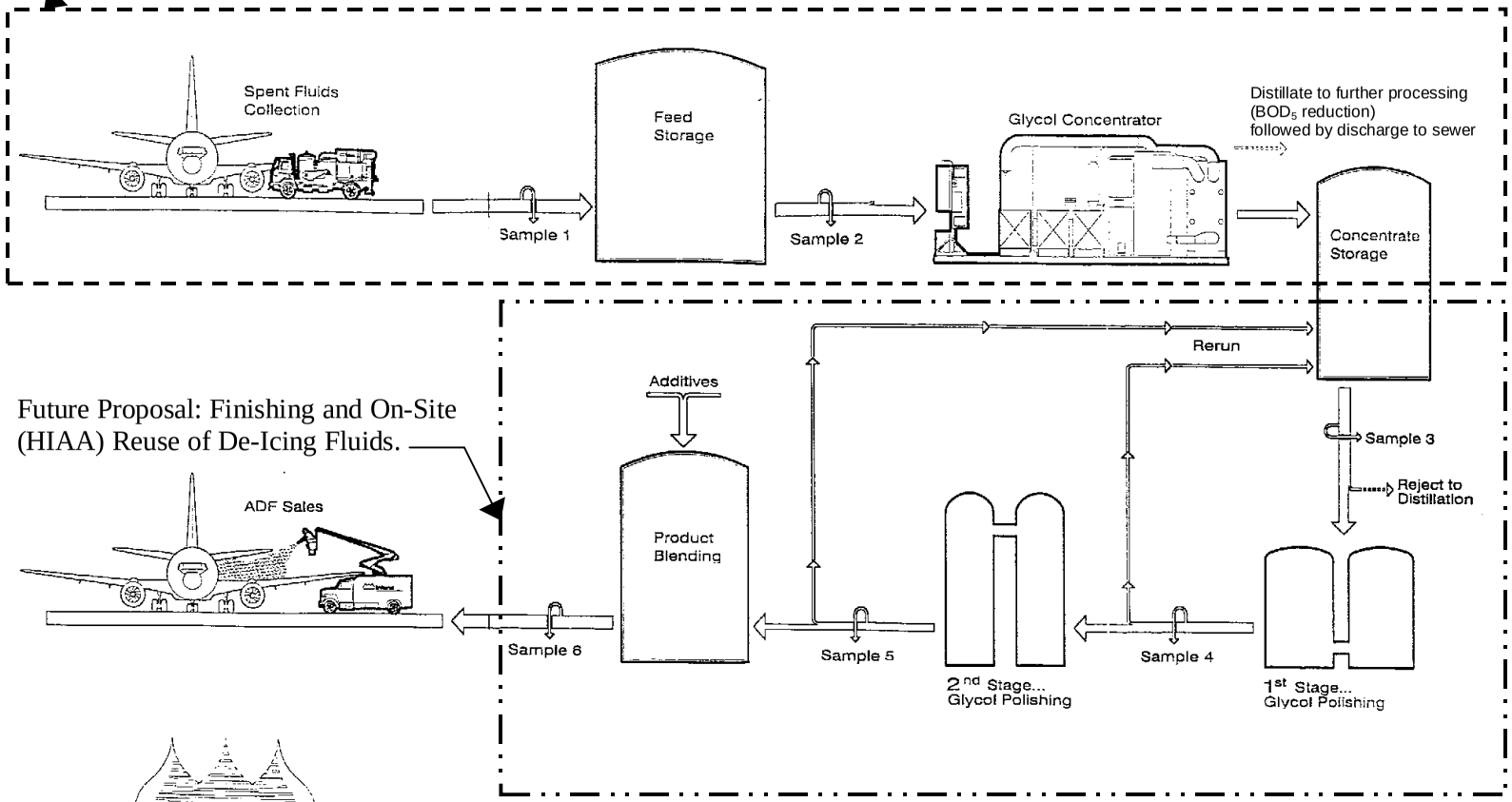


CONCENTRATOR FACILITY EQUIPMENT ARRANGEMENT

SCALE 1:500

FIGURE 2

Currently Proposed Process for the Halifax International Airport Operation (ie. current registration process).



Inland

Aircraft De-icing Fluid Production
Quality Control

Figure 3

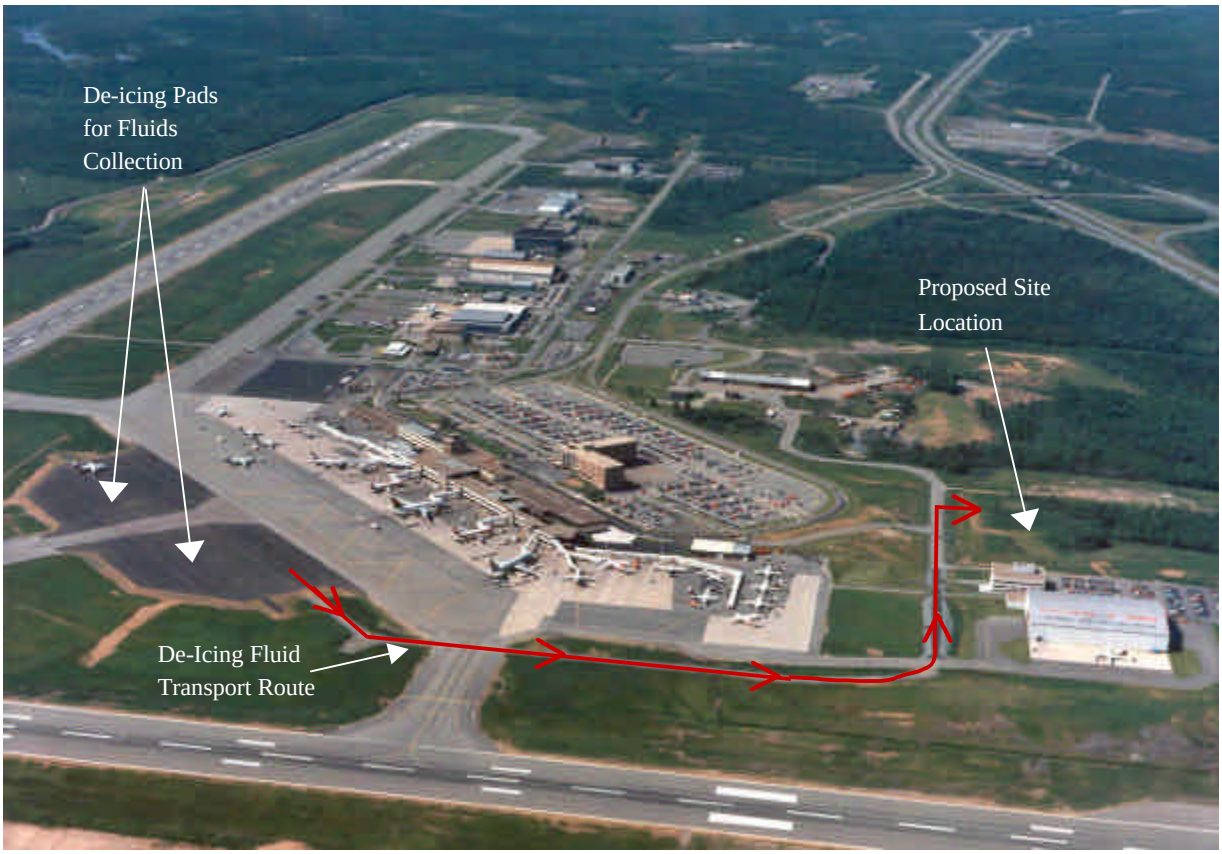


Figure 4: De-icing Pads at the Halifax International Airport

The concentrated glycol is scheduled for temporary storage on-site for transportation to the United States (New Jersey) for sale or product blending. Inland Technologies anticipates that in the near future the need for transport will be reduced or eliminated as potential local markets in the offshore industry become available.

The distillate (distilled water with < 100 ppm glycol) produced from the process is scheduled for release to the sanitary sewer. The proposed plan to release the distillate to the Aerotech sewage treatment plant led to discussions with Mr. Bernard Matlock (NSDEL) in regards to the Biochemical Oxygen Demand (BOD_5) concentration expected for the discharge effluent. Mr. Matlock has specified the maximum BOD_5 concentration for discharged effluent to the Aerotech sewage treatment plant as 300 mg/L, as detailed in the correspondence included in Appendix F. This specified concentration is also in compliance with the regulatory Halifax Regional Municipality (HRM) By-Law W-101.

In consideration to the specified and regulatory BOD_5 concentration limit, a supplementary process has been incorporated in the proposed undertaking as a means to reduce BOD_5 in the distillate. The modification incorporates aeration used to remove dissolved gases and volatile compounds, such as organic material, from the distillate and consequently lowers the concentration of BOD_5 in the

wastewater. The process utilizes a countercurrent of air passing the distillate stream that acts as a receptor for the impurities. The air subsequently passes through an activated carbon filter prior to release to the atmosphere.

In addition to the aforementioned process, Inland Technologies have reviewed other common process techniques for BOD_5 reduction and consider the aeration method as the most applicable for use in glycol processing. However, if discharge requirements can not be met through on-site processing Inland Technologies have also arranged a contract with Industrial Environmental Services (IES) in Debert to handle all non-compliant distillate produced from the proposed facility.

Monitoring of the distillate prior to discharge will include a sampling schedule, in compliance with the Halifax Regional and Municipality By-Law W-101 and, as described in the proposed monitoring program correspondence included in Appendix F. The discharge will be sampled using an auto sampler, on an ongoing 24-hour basis. Inland is scheduled to analyze samples once a week for concentration limits as per listings in the By-law W-101. This is scheduled for the first four (4) weeks of operation and will continue until the test results are satisfied by HRM as in compliance with the By-Law. These data can be forwarded to the NSDEL on an as requested basis. In addition, for the first fourteen (14) days of operation, the samples will be analysed daily for BOD_5, Total Suspended Solids (TSS), Total Oil and Grease (TOG) and Ethylene Glycol (EG). Following this period, the samples will be analyzed for the parameters on a weekly basis until satisfaction is met in accordance of the By-Law. Flow meters will also be installed to monitor flow rates and volumes.

The annual operation period of the facility will be dependent on the length of the de-icing season. The typical de-icing season runs from early October to mid-May. The correlated operation of the facility would run from mid-November to early June. The system apparatus is capable of processing 1000 litres/hour. The average assumed capacity is scheduled to be approximately 950 litres/hour. Annual volumes to be processed are assumed to be 2-3.5 million litres. All feed for the process will be collected from the de-icing of aircraft at the HIA; fluids from other airports are not intended to be handled at the site. The site process will be a 24 hour operation and will be supervised by trained operators at all times.

The undertaking will produce minimal air emissions. Activated carbon filters are used to prior to the venting of air to the environment and vent condensers are used to diminish odours from the operation. Solid waste will be minimal relating to paper and related articles produced within the small process control office of the facility. Sanitary waste will be minimal and will be directed to the sanitary services adjacent to the site.

2.2 Construction Methods

The construction period of the site is expected to be short. The site is scheduled for the re-working of surface material, site grading, roadway construction and assembly of the Modutank. Asphalt paving of

the roadway is scheduled to follow when weather and seasonal temperatures permit. All process equipment will be pre-fabricated with only minimal on-site connections required, with the exception of the Modutank that will require on-site assembly. Connection to sewer, water and electrical services is also required. The required permits and approvals for these connections will be obtained pending successful registration of this undertaking. General environmental protection measures are briefly outlined in this section. Additional mitigative measures can be found in Section 6.

Site Grading

Any grubbing required for the site will be performed just prior to grading of the site. Control of the surface water flow will be accomplished by grading the site to allow for proper drainage. Existing material is to be used to provide the design grade. The stratigraphy of the site is expected to be fill underlain by till and bedrock. As bedrock is expected to be at a depth greater than 6 m, there is no scheduled removal of bedrock during the grading of the site. The re-worked material will be compacted and gravel sheeting will be placed on the site. The area for the Modutank will be constructed in accordance with recommendations as determined by a geotechnical consultant. A roadway will also be constructed and will incorporate erosion sediment control with respect to the embankment slopes. Erosion of sediment will also be minimized during construction by limiting the period of exposure of subsurface soil to the atmosphere.

Asphalt paving

Asphalt paving of a roadway is scheduled to occur during the following paving season. The placement and grading of the granular sub-base material will be performed prior to paving.

Services Connection and Installation

Components of the project associated with service installation are the connection of water and sanitary sewer lines to the existing mains, the connection of electrical power and the installation exterior, and emergency lighting. Water demand for the site will be minimal and will include a required concentrator startup volume of 400 litres and the use of one washroom.

2.3 Pre-construction Activities and Schedule

Activities prior to construction have included reviewing the history of the site to determine the existing pre-construction conditions of the site. This has been accomplished through conducting interviews with facilities and environmental personnel at the HIA as well as a review of geotechnical investigation reports available for the area. Also, a site visit was conducted by a terrestrial biologist.

The project planning has been performed with regard to applicable regulations. An application has been submitted to the NSDEL for approval under the *Activities Designation Regulations* of the *Environment Act*. As noted previously, other required HRM permits have been investigated and will be obtained prior to commencement of the undertaking (Appendix D).

A geotechnical investigation of the site will be performed to determine subsurface conditions and to specify the bearing design for the Modutank and other structural components.

The scheduling of the operation of the undertaking is dependent on the de-icing season. Inland Technologies is anticipating operation to begin in 2002 to handle aircraft de-icing fluids collected during the present season.

3.0 DESCRIPTION OF THE SITE AND EXISTING ENVIRONMENTAL CONDITIONS

General

The facility will be constructed on a parcel of land (70 m by 100 m) leased from the HIAA located immediately to the southwest of the airNova expansion parking area on Goudy Drive and northwest of the airport parking and terminal building (Figure 1). This area has been previously disturbed and was graded with fill material. The property was reported to have been vacant since grading was performed.

Adjacent Facilities

The site is located in an industrial area of the airport property. The adjacent property southwest of the proposed lot is vacant land and is next to the snow disposal area for the HIA. There are no residential buildings within 500 m of the site. Buildings near the site include the airNova hangar located northeast to the proposed facility.

The roadway to the site is used almost exclusively by airline and airport service vehicles, although it is accessible to the public. The site is a very low traffic area and is readily accessible for any form of emergency response services as related to the proposed operation or other facilities nearby.

Terrain/Topography/Soils

The majority of the site is relatively flat, however the west corner of the site slopes downward (approximately 10-20%) to the southwest. The property is not within any known or frequently flooded area. The site is covered with sparse grasses and clover and no natural topsoil was observed on the surface of the site. Geological maps of the area indicate that the site is underlain by Meguma Group Halifax Formation siltstone and slate bedrock.

Terrestrial Habitat

A site visit was conducted by a qualified terrestrial biologist on January 10, 2002.

Given the time of year it was not possible to compile a vascular plant inventory for the site or conduct breeding bird or herpetile surveys. The area was largely covered by approximately 5 cm of snow; however, enough of the ground surface was exposed to permit the plant communities present on the site to be described. The potential presence of rare or sensitive species of plants or animals was assessed on the basis of professional judgement and a review of available information regarding the presence of rare or sensitive species in the vicinity of HIA.

Vegetation within the foot print of the site consists of two habitat types, a highly disturbed area and an immature hardwood forest stand. The highly disturbed area appears to have been cleared and grubbed within the last five years. Ground cover is patchy and composed largely of early successional grasses and forbs. The most abundant species on the site are poverty grass (*Danthonia spicata*), pink earth lichen (*Baeomyces roseus*), rough goldenrod (*Solidago puberula* and *S. rugosa*), New York aster (*Aster novi-belgii*), grass-leaved goldenrod (*Euthamia graminifolia*), plantain (*Plantago major*), fall dandelion (*Leontodon autumnalis*), and lamb's quarters (*Chenopodium album*). A few shrub seedlings are present, the most abundant of which are meadowsweet (*Spiraea alba*), willow (*Salix* sp.) and trailing blackberry (*Rubus hispidus*). This habitat occupies approximately 0.6 ha (86 %) of the proposed site.

The immature hardwood forest is approximately 15 years old. The forest canopy consists of a mixture of white birch (*Betula papyrifera*), trembling aspen (*Populus tremuloides*), downy alder (*Alnus viride*), and willow (*Salix* sp.). There is a dense low shrub understory composed almost entirely of meadowsweet. The ground vegetation layer is composed mainly of rough goldenrod (*Solidago rugosa*). This habitat type occupies 0.1 ha (14 %) of the proposed site.

Two rare plants have been recorded in the vicinity of the proposed site. These include southern twayblade (*Listera australis*) and variegated horsetail (*Equisetum variegatum*). Both of these species are listed as rare in Nova Scotia (Pronych and Wilson 1993). Neither species is considered to be endangered, threatened or a species of special concern by COSEWIC (COSEWIC 2001) although Argus and Pryer (1990) consider the southern twayblade to be nationally imperiled due to rarity. The southern twayblade was found in a bog at the southern end of the airport property (D. Archibald pers. comm. 2002). This species grows in bogs or damp woods and is typically associated with sphagnum moss (*Sphagnum* spp.) and conifers such as spruce, fir or tamarack. The preferred habitat of this species is not present at the proposed site. The site is well drained and no conifers or sphagnum moss are present. It is therefore, highly unlikely that this species would be present.

Variegated horsetail has been found growing on gold mine tailings at Oldham north of the airport (Pronych and Wilson 1993). It has also been found at a number of locations in ditches along Highway 102 (M. Crowell pers. comm. 2002). This species is typically associated with anthropogenic habitats such as tailings ponds, quarries, ditches, and woods roads growing on mineral soils. It is almost always found in poorly drained areas which are saturated with water for at least part of the growing season. Although the proposed site is a disturbed area with much exposed mineral soil, it is well drained and unlikely to provide suitable habitat for variegated horsetail. This species is evergreen and grows stiffly erect making it quite visible on a poorly vegetated site. It was not observed during the site visit. In recent years this species has been discovered in a wide variety of sites in Nova Scotia and New Brunswick and it may be delisted as a rare species in the near future.

Birds recorded on or near the site during the site visit included American Crow (*Corvus brachyrhynchos*), and European Starling (*Sturnus vulgaris*). An American Robin (*Turdus migratorius*) nest probably dating from the 2001 breeding season was also found. The American Robin nest was found in the immature hardwood forest while the American Crow and European Starling were recorded in the disturbed area. Bird species which may be expected to regularly use the site would include the species recorded during the site visit as well as Killdeer (*Charadrius vociferus*), Song Sparrow (*Melospiza melodia*), Common Yellowthroat (*Geothlypis trichas*), Rock Dove (*Columba livia*), American Goldfinch (*Carduelis tristis*), House Sparrow (*Passer domesticus*), and Common Raven (*Corvus corax*). Of these species, Killdeer, American Robin, Song Sparrow and Common Yellowthroat would be expected to breed there.

One rare bird species, Horned Lark (*Eremophila alpestris*), has been recorded as breeding at the Halifax International Airport (Tufts 1984, Erskine 1992). Horned Larks are a rare breeding bird species in Nova Scotia although they are common here during migration. Although the breeding population of this species in Nova Scotia is low, the Nova Scotia population is considered to be secure (NSDNR 2001). Horned Larks are abundant elsewhere in their range. Horned Larks breed in open fields and sandy plains. At the airport Horned Larks breed in the mowed grassy strips between runways. Open areas containing relatively little vegetation such as the disturbed habitat of the site are frequently used as breeding and foraging habitat by Horned Larks; consequently, the site may be used as breeding habitat by this species. A breeding bird survey conducted in late April or early May would be required to determine whether or not this species breeds on the site. Concerns only exist should nesting be found to occur on the site.

Mammal species found at the site include varying hare (*Lepus americanus*) and meadow vole (*Microtus pennsylvanicus*). Varying hares were found in the immature hardwood forest and meadow vole was recorded in the disturbed area. Other mammal species expected to occupy the study area include red-backed vole (*Clethrionomys gapperi*), deer mouse (*Peromyscus maniculatus*), masked shrew (*Sorex cinereus*), and short-tailed shrew (*Blarina brevicauda*). Species which may occasionally forage on the

site include raccoon (*Procyon lotor*), striped skunk (*Mephitis mephitis*), white-tailed deer (*Odocoileus virginianus*), coyote (*Canis latrans*) and red fox (*Vulpes vulpes*). No rare or particularly sensitive mammal species are expected to make use of the site.

Given the time of the year it was not possible to conduct a herpetile survey on the site. One rare amphibian species, four-toed salamander (*Hemidactylium scutatum*), has been recorded in wetlands in the southern part of the airport property (M. MacDonald pers. comm. 2002). This species is listed as rare in Nova Scotia (Scott 1990) and is considered to be sensitive to anthropogenic activities (NSDNR 2001). Four-toed salamanders are typically found in bogs and swamps which provide suitable breeding habitat. In Nova Scotia four-toed salamanders typically lay their eggs in sphagnum hummocks located near the edges of sluggish streams or pools. Suitable four-toed salamander breeding habitat is not present in the proposed site so it is highly unlikely that this species is present. Herpetile species which may be expected to occur on the site include eastern American toad (*Bufoamericanus*), maritime garter snake (*Thamnophis sirtalis*), eastern smooth green snake (*Opheodrys vernalis*), and northern redbelly snake (*Storeria occipitomaculata*).

In addition to the site visit, Mr. D. Archibald, a regional biologist for The Department of Natural Resources Wildlife Division was consulted on January 30, 2002 in regards to the potential for occurrence of species at risk in this location. There were no records indicated for the proposed site.

Groundwater

There are no potable groundwater sources within 500 m of the site and all buildings in the area are serviced with water and sewer from the HIAA system. The water table was not encountered during excavation of test pits (depths ranging from 1.7 meters to 5.5 meters) for the geotechnical investigation on the adjacent site conducted in August 2000.

*Drainage and Surface Watercourse*s

Drainage from the site is to the southwest. The nearest surface water course is Bennery Brook located about 190 m southwest from the site behind a well defined (about 15 m wide) vegetated buffer strip of thick grasses, small shrubs, alders and trees. The proposed site is considered a significant distance from Bennery Brook and is not considered to be a potential environmental receptor to the proposed undertaking.

Site Services

Three phase electrical power is available at the site as are a number of existing power poles to provide the required overhead lighting for the facility. Sanitary sewers are available adjacent to the site which

service all of the airport area and eventually flow off of the airport site to for treatment at the Aerotech Park HRM operated sewage treatment facility located about 5 km south of the site.

Heritage Resources

Where the site has previously been disturbed by grading/filling, it is unlikely that there are significant archeological or heritage resources on the site.

4.0 POSITIVE SOCIO-ECONOMIC ASPECTS

The proposed undertaking will have positive socio-economic effects. The operation will produce four new full-time seasonal jobs during the operating period of mid-November, to mid June each year. These positions will require a background in process control and are intended to be complementary to an asphalt plant operator type background such that these seasonal (summer) workers will be considered as operators to provide a collective full years employment.

The project will also provide positive effects as related to reduced energy consumption and transport requirements by eliminating hauling the raw de-icing fluids from HIA to the existing treatment facility in Debert. These are substantial benefits, not just in cost reductions to the local air carriers, who ultimately bear these transportation costs, but to the public at large because of the reduced trucking transportation. The reduced trucking has a direct positive correlation with decreased deterioration of highway infrastructure particularly during months of the spring thaw. In general, reduced truck traffic is also related to an improvement in highway safety.

As well, operation of the on-site facility will improve environmental conditions at the HIA by allowing for the collection of higher glycol recovery rates. This is possible due to the collection of lower spent concentrations becoming more economically feasible. The collection of lower spent concentrations reduces nonpoint source pollution resulting from residual de-icing fluids transport in runoff during the off season.

5.0 POTENTIAL ENVIRONMENTAL RECEPTORS AND EFFECTS

No human health receptors have been identified as sensitive to the proposed undertaking. Minimal environmental receptors have been identified as potentially affected by the undertaking. It is unlikely that valued terrestrial habitat will not be affected by the project. Air quality will be minimally affected by the project. It is unlikely that archeological or heritage resources will be affected.

The discharge of process wastewater to the sanitary sewer has been identified as a potential environmental receptor of the activities of the undertaking.

Discharge of Wastewater to Sanitary Sewer

Wastewater effluent resulting from the process of concentrating de-icing fluids to 18% glycol will be ultimately discharged to the sanitary sewer. Wastewater from the process of concentrating 18% glycol fluids to 50% glycol will not be discharged to the sanitary sewer and will be returned to the 2,000,000 litre feed stock tank for further processing.

Discussions with the Nova Scotia Department of Environment and Labour (NSDEL) regarding discharge of the wastewater to the Aerotech sewage treatment plant have led to Inland Technologies incorporating a process to further treat the distillate. This process uses aeration along with activated carbon to remove dissolved gases and volatile compounds from the wastewater prior to discharge. This modification to the operation reduces the Biochemical Oxygen Demand (BOD_5) concentration in the distillate in consideration to the NSDEL specified limit of 300 mg/L (Appendix F). The specified limit is also in compliance with the regulatory *Halifax Regional Municipality (HRM) By-Law – W 101 Respecting Discharge into Public Sewers*. Correspondence regarding this issue is provided Appendix F. It should also be noted that if discharge requirements can not be met through on-site processing Inland Technologies have arrangements with Industrial Environmental Services (IES) in Debert to handle all non-compliant wastewater for the process.

6.0 PROPOSED MITIGATIVE MEASURES FOR CONSTRUCTION AND OPERATION

6.1 Specific Areas of Concern

Inland Technologies Canada Incorporated is an environmental technologies solutions company. The company is committed to minimizing or eliminating risk to the environment as described in the following sections.

6.1.1 Sediment Erosion Control

Construction

Sediment controls will be maintained during the course of the construction until all exposed soils are protected from erosion. Sediment controls include sediment fence installed downgradient of the construction prior to the disturbance of soils. The exposed soils will be protected from erosion on the permanent facility by soil compaction and gravel sheeting as required. The roadway is also scheduled for asphalt paving to be conducted in the following paving season. All surface runoff on the site will be graded to direct drainage away from collector tributaries and surface drainage toward Bennery Brook, the nearest surface water course which is located approximately 190 m from the subject property.

The construction period will be minimized by designing the site grades and other required specifications prior to disturbance of the soil on the site. As an additional precaution, the construction will be sequenced to optimize good (i.e., no rain) weather conditions. Contractors will be made aware of the potential risks, and supervision will be provided to ensure the erosion and sediment controls are implemented effectively.

6.1.2 Spill Containment

Operation

Risk to the environment during operation of the facility is from a spill or leak of glycol materials containment or piping. This risk will be managed by using proper equipment, trained (full time) on-site personnel, spill containment on site, and an effective Spill Contingency Response Plan. The details include:

1. All storage tanks and piping equipment for the storage and piping of the glycol product will be dual wall materials meeting or exceeding current codes and regulations

2. The facility will be supervised on a full time, 24 hour per day basis, with a trained operator to monitor the process functions. A visual inspection of the facility for leaks and spills will be made at least once every two hours each day. In addition, the operator will monitor fluid levels and controls on the computerized process control equipment which will have an alarm setting to alert staff to a spill or loss of product from the system. The operator will be trained in emergency response and be responsible for implementing the Spill Contingency Response Plan

6.1.3 Abandonment/Reclamation

The Glycol Concentration Facility is regarded as an advanced pilot operation for a larger and more extensive processing system to be developed during future expansions and infrastructure upgrades at the HIA. The proposed operation is expected to be in operation for two to three years. Following the termination of the pilot operation, the process equipment and storage tanks are expected to be removed from the proposed site and transferred to the future location. The site conditions will be restored in accordance to the HIAA lease agreement and in consideration to environmental concerns.

6.1.4 Discharge of Wastewater to Sanitary Sewer – Mitigation Measures

NSDEL has reviewed results of the wastewater BOD_5 analysis and recommended implementing a process to reduce the BOD_5 concentration prior to discharge to the Aerotech sewage treatment plant (Appendix F). As a result Inland has integrated a process modification to reduce the BOD_5

concentration in the wastewater distillate. The process uses aeration and granulated activated carbon for adherence to the NSDEL specified maximum BOD_5 criteria of 300 mg/L. This concentration is also in compliance with HRM By-Law requirements.

HRM (Appendix F) had also requested results of the continuous analysis of wastewater discharge for BOD_5, SS, TOG, EG from a current representative operation to be forwarded to their office for review. The proposed undertaking is expected to meet all HRM requirements, however, if testing shows that discharge requirements can not be met through on-site processing, all non-compliant distillate is scheduled to be removed from the discharge waste stream. The non-compliant distillate would be transported/treated by the existing environmental services, Industrial Environmental Services (IES) in Debert. As well, Inland is committed to continuously improve and lower wastewater concentrations in the future.

6.2 General Areas of Concern

Acid Generating Bedrock

Test pits investigated on the adjacent site indicate that the depth to bedrock is greater than two to five meters below grade. No excavation of acid producing bedrock is anticipated for grading and leveling of the site. The site will be graded by reworking existing soil on site. However, should bedrock be encountered and require removal, all work will be completed in accordance with the "Sulphide Bearing Material Disposal Regulations" under the N.S. Environment Act as well as any specific requirements of the HIAA. Underground services will be required to be installed for connection to the sanitary and water lines in the adjacent street.

Blasting

No blasting will be undertaken for the Project.

Impacted Soils

Based upon interviews conducted with environmental and facilities personnel from the HIAA, no impacted soils are anticipated to be encountered on the site. If any impacted soils are encountered they will be dealt with in accordance with the "Guidelines For the Management of Contaminated Sites In Nova Scotia" and in concert with the HIA directions. As well, no soils will be exported from the site during the development.

Flora and Fauna

Approximately 86 % of the site is situated within an area that has been heavily disturbed by industrial activity. It currently supports little vegetation and is located adjacent to areas which are regularly used by large numbers of humans. It provides relatively poor habitat for most species of rare or sensitive wildlife. However, it may provide suitable habitat for two rare species which are adapted to surviving on highly disturbed sites and which have been recorded in the general vicinity of the HIA. These include variegated horsetail and Horned Lark. Given the timing of the site visit it is not possible to state with certainty whether or not these species are present on the site. It is recommended that a site visit be conducted in early May to determine whether or not variegated horsetail grows on the site and/or Horned Larks breed on the site. The recommended time of the site visit corresponds with the early part of the breeding season for Horned Larks. Variegated horsetail is visible at this time since it is an evergreen species. Once the site visit has been conducted and the presence or absence of these species has been determined, appropriate mitigative measures can be developed if required.

Air Emissions/ Odour

Air emissions and odors associated with the undertaking are determined to be minimal. Air is released to the environment following the aeration process for removing of dissolved gases and volatile compounds from the distillate. This air is passed through an activated carbon filter prior to release to the atmosphere. Also incorporated in the operation is a vent condenser. The condenser uses a portion of the feed stream that is re-circulated through filters and the condenser coil for cooling and condensing of the steam. This process diminishes the venting of steam and any odours produced in the system.

Spills and Emergency Response

All employees will be trained in the area of spills and emergency response. The Spill Response Contingency Plan for the undertaking is included in Appendix G.

Archeological Resources

Portions of the site have been previously graded. It is therefore unlikely that any archeological resources will be encountered. In the event some materials of potential archeological importance are uncovered during site preparation, the Nova Scotia Museum will be contacted for advice and guidance.

7.0 CLOSING

Inland Technologies Canada Inc. has considered the potential environmental effects of its proposed Glycol Concentration Facility at the Halifax International Airport pursuant to its responsibilities under the Nova Scotia *Environment Act* and *Environmental Assessment Regulations*. The facility site is within an area that has been previously disturbed. The project will likely not interact with any archeological or

heritage resources. There is an unlikely probability that a rare plant and bird species may be present on the site. A field survey will be conducted at the appropriate time of the year to verify the absence or presence of these species. Bennery Brook, the closest watercourse, is considered a significant distance from the proposed site and is not considered to be a receptor for any emissions associated with the undertaking. During operation, a spill control and emergency response plan will be implemented. Process wastewater will only be discharged to the municipal sewer system in accordance with HRM by-laws. The project will generate minimal air emissions or odours. Other potential environmental issues such as acid generating bedrock will be managed through standard practices and adherence to all relevant regulations and guidelines. The project will generate important socio-economic benefits including employment and avoidance of the current practice of trucking product to a remote site for processing. In summary, the proposed project is not likely to create significant adverse environmental effects after proposed mitigative measures are applied; it is however, expected to generate positive socio-economic benefits.

PROJECTS\Enveng\16xxx\16265 Inland Technologies\EA Regisration Report\Final Report\Revised - Final Report.doc

8.0 REFERENCES

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APPENDIX A

REQUIRED INFORMATION AS PER THE *ENVIRONMENTAL ASSESSMENT REGULATION*

Appendix A

Prescribed Information as per the Environmental Assessment Regulations.

a) Name of the Undertaking
Glycol Concentration Handling Facility (Inland Technologies Canada Inc.).

b) Location of the Undertaking
Halifax International Airport on Goudey Drive adjacent to the airNova expansion parking. See section *1.0 Introduction* of the report for further details.

c) Name, Address and Contact Identification
Inland Technologies Canada Inc.

9-11 Commercial Street,
Truro, Nova Scotia
B2N 5C1

Mr. Richard Johnson: Contact (Operations Supervisor)
Mr. James Bagnell: Chief Executive Officer

d) Nature of undertaking
Handling and recycling of spent aircraft de-icing fluids (glycol). See sections *1.2 Background* and *2.0 Project Description* of the report for further details.

c) Purpose and Need for Undertaking
The present facility for handling aircraft de-icing fluids for the Halifax International Airport is located in Debert, Nova Scotia. The purpose of the proposed facility is to establish a more efficient and economic process to handle and recycle the fluids. This local facility will reduce transport volumes and will function as a pilot project for development of a larger treatment facility at the Halifax International Airport. See sections *1.2 Background* and *4.0 Positive Socio-Economic Aspects* of the report for further details.

e) Construction and Operation Schedules
The proposed construction is scheduled to be completed by early 2002. The facility will be operational for two to three years.

f) Description of the Undertaking
See section *2.0 Project Description* of the report for further details.

g) List of Required Approvals and Other Forms of Authorization
See Appendix C.

h) Sources of Public Funding
None.

APPENDIX B

INLAND TECHNOLOGIES AIRCRAFT DE-ICING FLUID RECOVERY BROCHURE AND MODUTANK BROCHURE

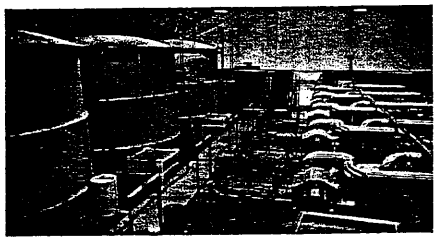
INLAND UPDATE
AIRCRAFT DE-ICING FLUID RECOVERY

Reported by Inland Technologies Inc.—May 2001

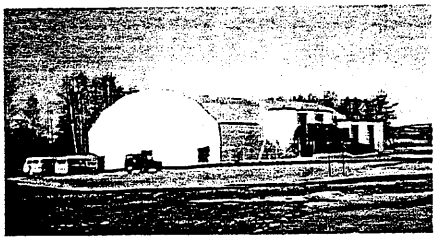
Inside this issue:

The 2000/01 De-Icing Season	
Spent ADF Recycling & Treatment	
Effluent Treatment	
The Complete Solution	
Recovery of Spent ADF for Reuse	
Company Contacts	

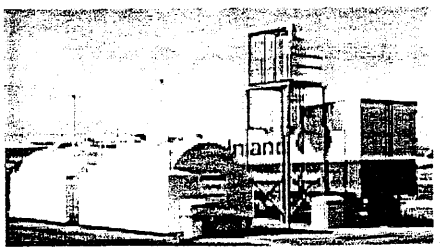
AIRCRAFT DE-ICING FLUID RECOVERY & RECYCLING PROCESSES



⇧ *Spent ADF Treatment Facility Oslo, Norway* ⇩



⇧ *Inland's ADF Concentrator Mobile ADF Treatment Unit—Vancouver, Canada* ⇩



The on-site airport processing of spent aircraft de-icing fluids (ADF) is gaining momentum on a worldwide scale. Several ADF processing units were commissioned at airports throughout North America and Europe. *(See 2000/2001 de-icing season report - Page 2.)*

Last season Inland's glycol concentrator technology was modified with improvements being made to the systems glycol removal process. These systems, in both small and large scale applications, can cost effectively concentrate spent ADF back to its original dispensed mixture (glycol and water) while producing a process distillate with virtually non-detectable levels of glycol. These improvements and technological breakthroughs are the direct result of the Inland concentrators being selected for use at Oslo's new international airport at Gardermoen, Norway. Several million litres of spent fluids are concentrated at this facility which is owned and operated by Inland's European affiliate AeroGly Services AS.

In addition to this major breakthrough we have even bigger news. . . Our glycol recovery/recycling process, which is now being commercially evaluated in North America and Europe as a safe and effective option for the recovery and reuse of aircraft de-icing fluids, has now gained industry recognition as a viable method of de-icing fluid production. *(See Recovery Spent ADF for Reuse—Page 5)*

Inland

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Contact us at marketing@inlandgroup.ca

THE 2000/2001 DE-ICING SEASON AS REPORTED BY INLAND TECHNOLOGIES INC.

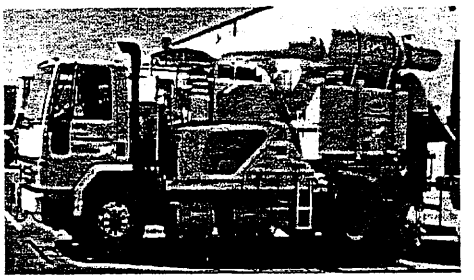
It just keeps getting better

This de-icing season, being one of the busiest on record, came at a time when Inland commissioned a total of ten (10) new glycol concentrators which effectively doubled our processing capacity compared with the 1999/2000 season. Prior to the end of 2001 processing season, Inland will have recovered and processed in excess of 7,000,000 litres of glycol concentrate (50% glycol / 50% water) from locations throughout North America and Scandinavian.

Inland's effective management programs, which included the separation and processing of over 100,000,000 million litres of water containing spent ADF, made these recovered glycol concentrate volumes possible. The remaining volumes of fluids were either further treated and properly disposed of at the customer's site or transported off-site for treatment and/or disposal by Inland.

Even more exciting to report, some of this glycol concentrate produced by Inland was further processed and certified as Type 1 aircraft de-icing fluid and successfully utilized at a North American airport by a North American carrier. Additional details of this will be published on the Inland's website this spring.

To assist with the collection of spent ADF throughout North American airports, Inland owns and operates a total of 28 glycol recovery vehicles (GRV's). These specially designed vehicles are equipped with powerful suction units capable of producing a vacuum of 25,000 CFM. In addition to being an efficient means of recovering high concentrated spent fluids, the effective use of GRV's helps to prevent the further generation of contaminated storm waters due to their powerful vacuum capabilities and built in demulsifying system. This process also provides enhanced safety for ground handling crews as dispensed de-icing fluids, if not collected, can produce very slippery conditions in and around gates and other areas where de-icing occurs.



Plans are in the works to further expand our GRV fleet, glycol concentrators and facilities for aircraft de-icing fluid production for the upcoming 2001/2002 de-icing season.

DID YOU KNOW... Inland supplies glycol recovery and environmental services at more airports than any other company in the world!

WHY YOU ASK??... (1) Because we understand and effectively respond to our clients needs. (2) We own and operate one of the largest fleets of glycol recovery vehicles, and most importantly (3) We have the most effective, efficient and environmentally sound means of removing glycol from spent fluids stream for further treatment/disposal.

For additional information please e-mail us at marketing@inlandgroup.ca.

Spent ADF Recycling

Inland's Glycol Concentrator

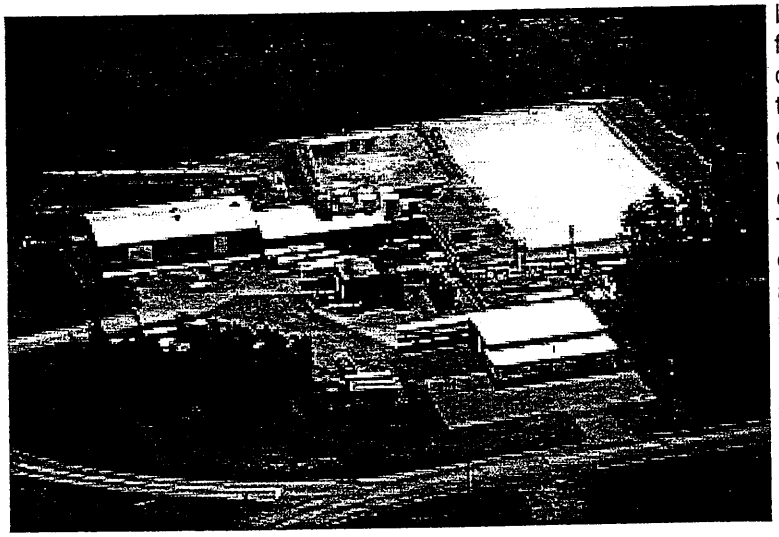
Inland's glycol concentrator technology is a state of the art system capable of producing a glycol / water mixture of equal concentration to that of dispensed de-icing fluids. These self contained skid mounted and modular units operate at costs significantly less than other distillation processes. Glycol concentrators use mechanical vapour recompression requiring no direct heating sources or distillation towers and produces zero gaseous emissions. A new and improved glycol scrubber can be added which virtually eliminates the presences of glycol in the process distillate.

The addition of a glycol polishing processes designed to remove all impurities collected with spent ADF is a proven method of producing "virgin" quality ethylene or propylene glycol solutions for reuse.

Biological Water Treatment of Glycol Effluent

The ability to biologically degrade ethylene (EG) and propylene (PG) glycols in aerobic environments is well-established. The manufacturers of ADF have sponsored much of the work completed in this area to demonstrate that their products are degradable.

Biological decomposition of the chemicals in this manner requires large quantities of oxygen, and the costs to furnish this oxygen are a major disadvantage to the process when high-strength wastes (i.e. high concentrated EG fluids > 3%) are involved. The process also has a high-energy yield and large amounts of cell mass are produced as a result.



Inland's wastewater treatment centre Debert, Nova Scotia, Canada. This treatment centre was specially designed to effectively treat glycol effluent biologically from several regional and international airports in Eastern Canada. Design capacity 15,000,000 gallons annually

In situations where regulators have forced airports to take steps to control de-icing waste discharges, the solution has generally involved collection, equalization to control mass and flow variation, and discharge to a publicly owned treatment works (POTW). This approach has been desirable because introducing the wastewater into a POTW waste stream overcomes problems with on-site treatment that include lack of available nutrients for effective biological treatment, low wastewater temperatures, and intermittent wastewater production. Most POTWs use aerobic biological processes. These processes effectively treat the waste, but large amounts of plant capacity are consumed as a result of trying to deal with spent ADF and other glycol wastes.

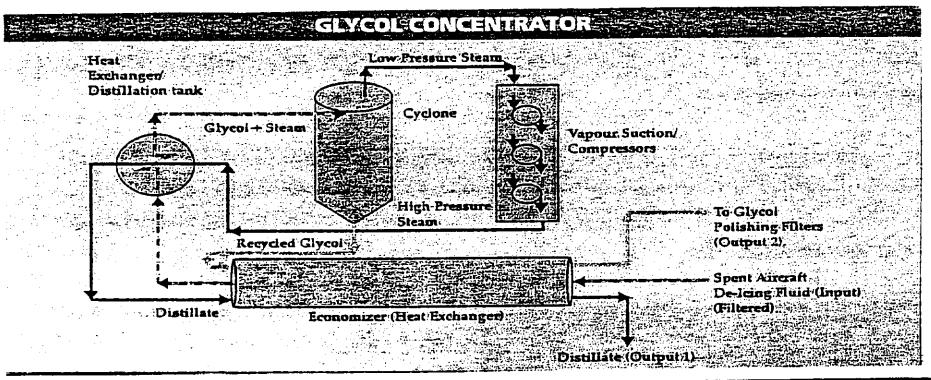
The Complete Solution

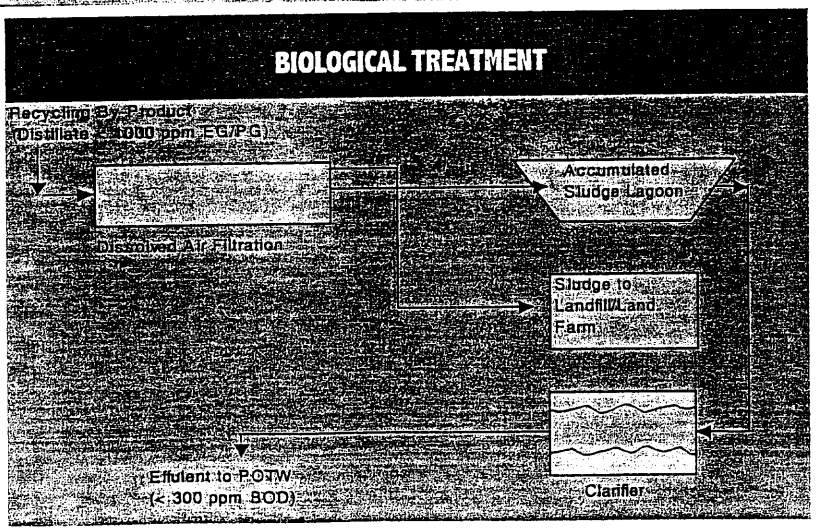
It is obvious that the ideal solution for glycol recovery and mitigation at airports is a combination of processes and operations. This involves a completé evaluation of all collection and recovery operations including source separation and collected fluid management. In order to save the airline community vast amounts of money, Inland has developed a comprehensive program which includes the collection, recycling, treatment and disposal of spent ADF at several North American locations.

This program typically includes utilization of airport infrastructure to manage and separate the collected fluids into high and low concentration streams. High concentrate ADF is recycled and the resulting product value used to off-set the cost of collection.

Inland has developed and successfully employed technologies that involve recycling and biological treatment. Utilizing scrubbing technology added to our glycol concentrator, a distilled water by-product is produced which contains as low as 100 ppm of glycol which is ideally suited for biological treatment. The first such facility where these low effluent parameters were required is currently operating at Oslo's new International Airport at Gardermoen, Norway. Several other facilities have been installed in Canada this season.

This combination of technologies, in cooperation with airport operations, produces a cost effective and stable solution for the disposal of all collected ADF contaminated fluids at airports.





Recovery of Spent ADF for Reuse

Quality control/assurance procedures are closely monitored by both in-house and third party analytical laboratories

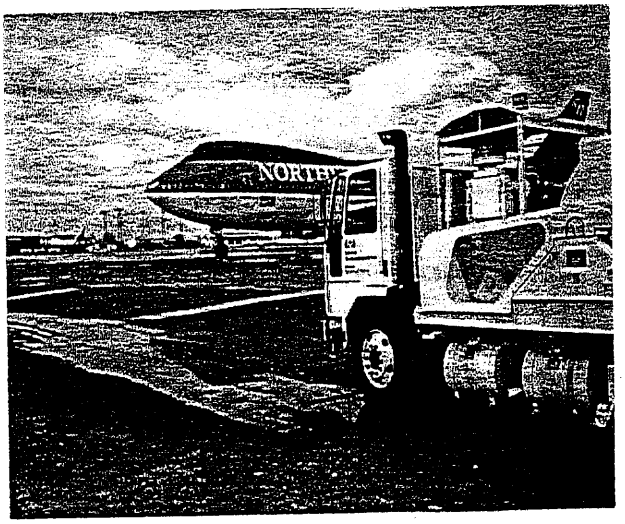
Inland's primary goal during the past few years has been the furthering development of its glycol concentrator technology into an effective means of producing ready to use Type 1 de-icing fluid. We are pleased to announce that Inland's de-icers are being commercially evaluated in North America and Europe after our products performance was determined to be as good as other commercially available de-icers.

The performance and success of the commercial trial of Inland's DuraGly-P Type 1 de-icer in North America will have a rippling effect throughout the industry both on the environmental recovery side and use as ADF. Official announcements of the use of this product, which includes extensive audits at quality control procedures and airside recovery and reuse of fluids, will take place this summer.

Markets for other uses of concentrated EG and PG are constantly being investigated. Inland has dedicated significant resources towards and development of ADF and other products and markets for recovered glycols.

What will the reuse of ADF mean to the Airline Community ?

Simply put, the opportunity curve for the recovery of spent ADF will be greatly enhanced at most locations where de-icing occurs. This should mean higher recovery rates whenever and wherever possible. As an example, the financial feasibility of collecting, transporting and processing of spent ADF at most airports, for use other than de-icing fluid, is presently 5% to 7% glycol mixed with water. As de-icing fluid the economics of collecting lower concentrations is real. This could mean much more contaminated water/glycol being recovered at no additional costs at most existing and potential airport locations served by Inland.



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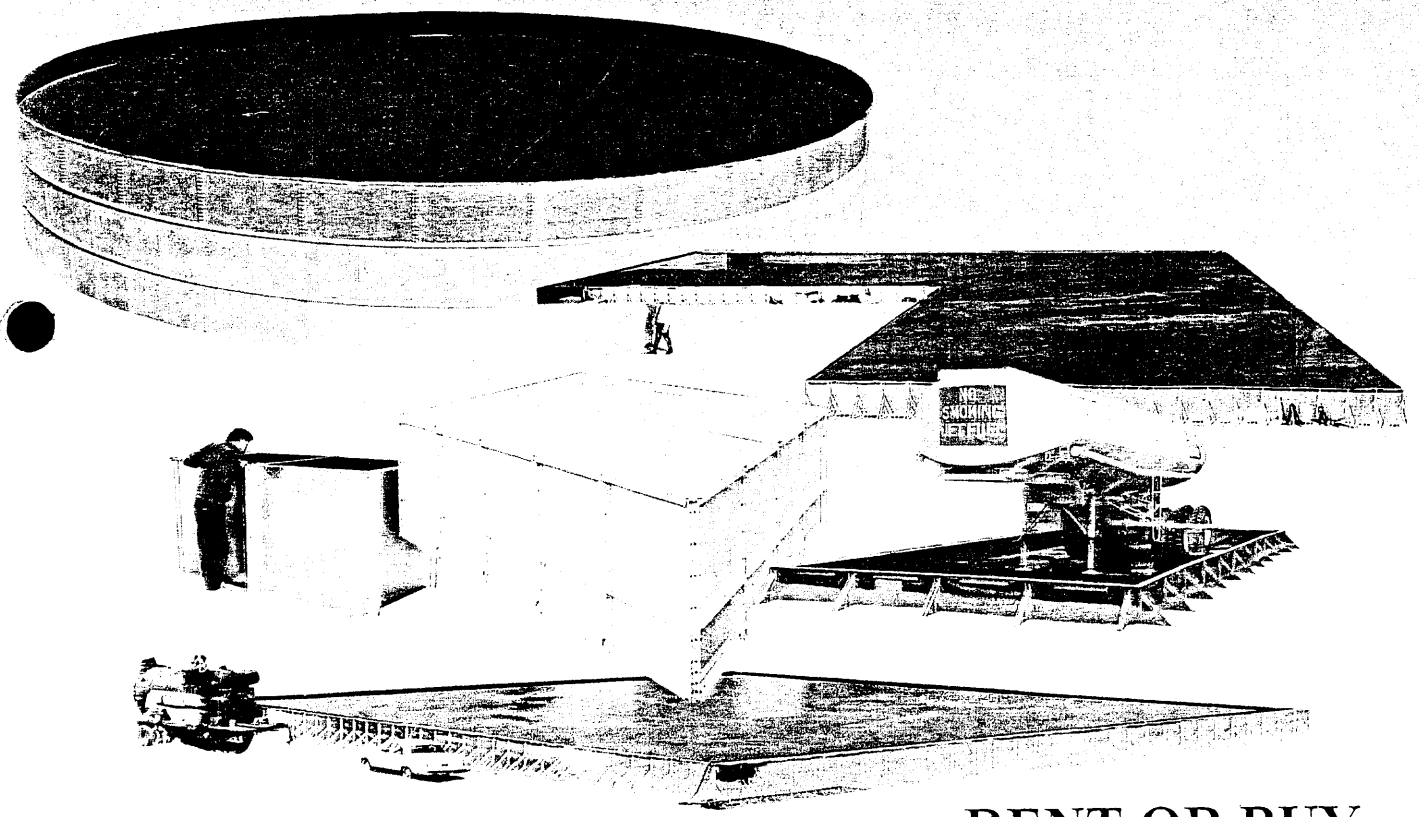

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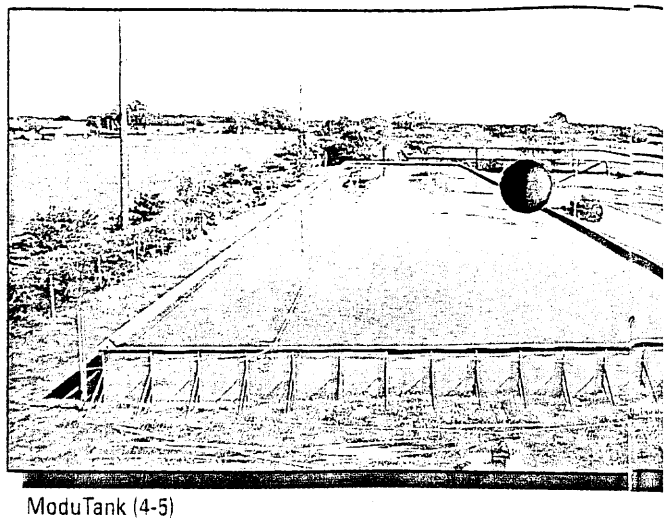
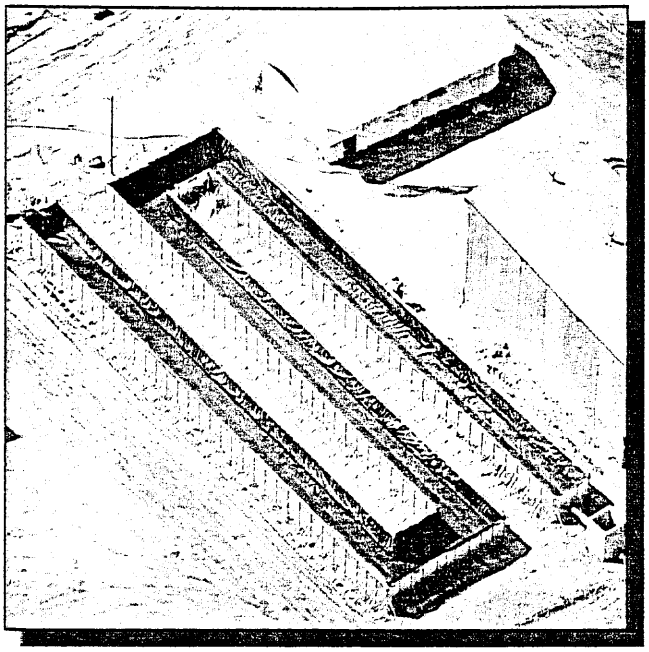
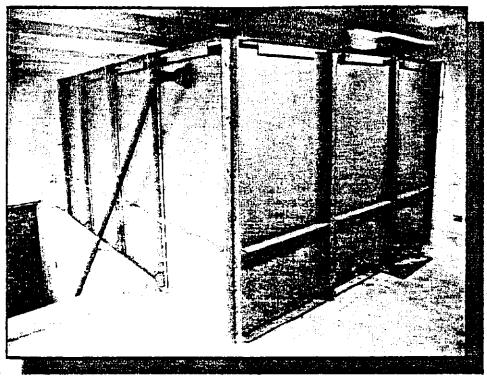


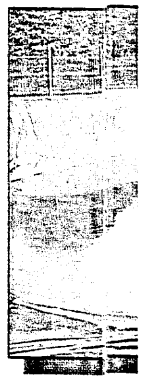
ModuTank (4-5)



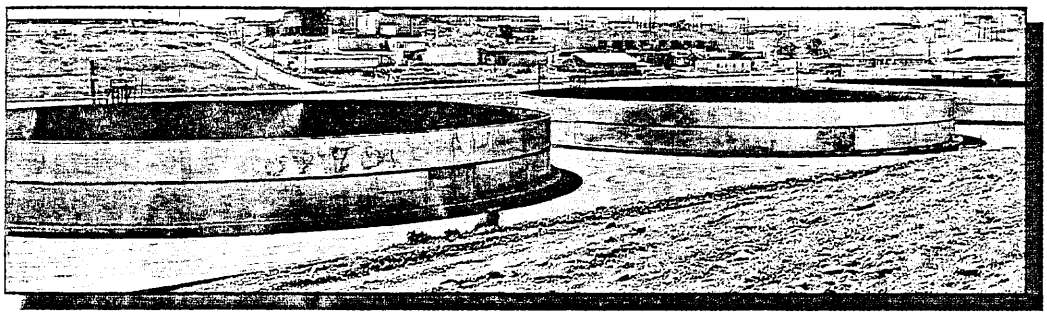
Special Shaped ModuTank (4-5)



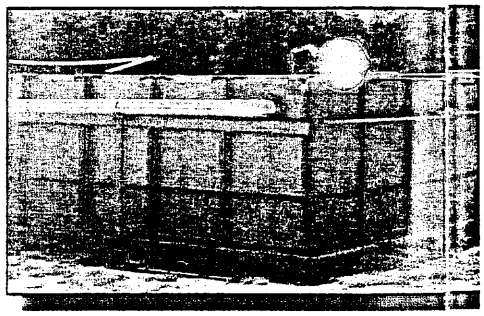
VariTank (10-11)



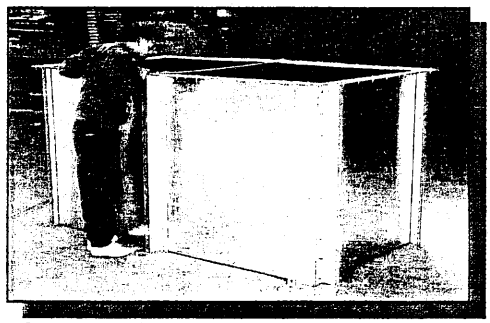
Ponds & Lin



Two Tier ModuStors Tank Farm



Combination VariTank (10-11) and EconoTank (5)



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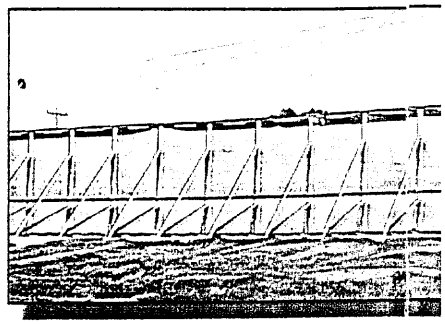
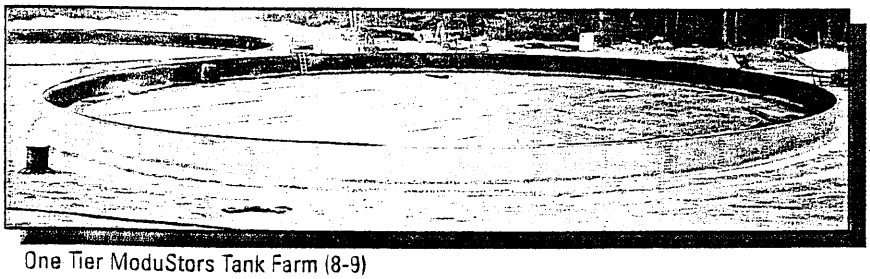
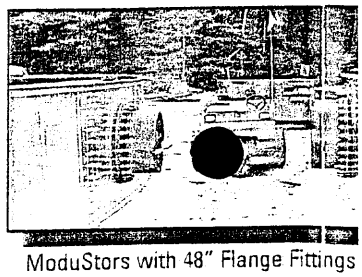


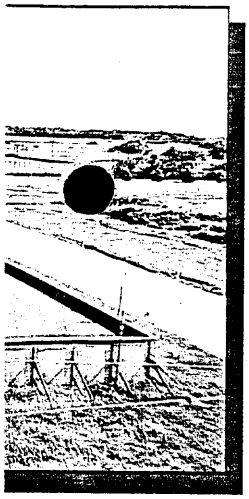
HiStor (13)

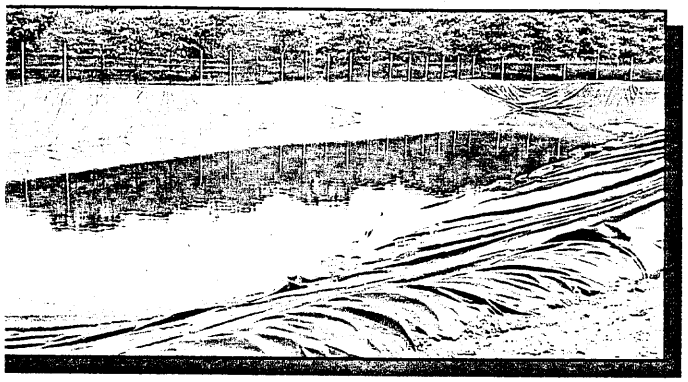


One Tier ModuStors Tank Farm (8-9)



ModuStors with 48" Flange Fittings





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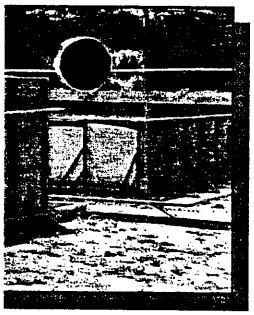

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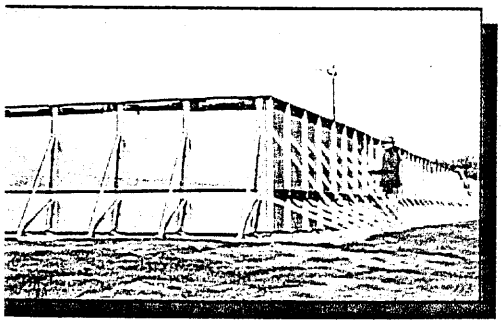
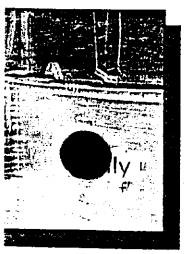




Since 1970, ModuTank Inc. and its affiliates have engineered and fabricated a unique family of above-ground liquid containment tanks. Low in cost, these modular tanks for indoor and outdoor locations are shipped K.D., are easily and rapidly assembled, and require little or no site preparation. The following pages fully detail these versatile systems.

Our tanks have been accepted and specified by engineering firms, consultants and environmental agencies, and purchased by Fortune 500 companies, State and Federal agencies, utilities and municipalities nationwide.

Our standard tanks can also be tailored to customized dimensions for special needs requiring such features as sumps, piping, leak detection, baffles and covers. Please contact us about your particular requirements. Our technical staff is experienced in solving unique and difficult storage problems.

RENTAL PLAN

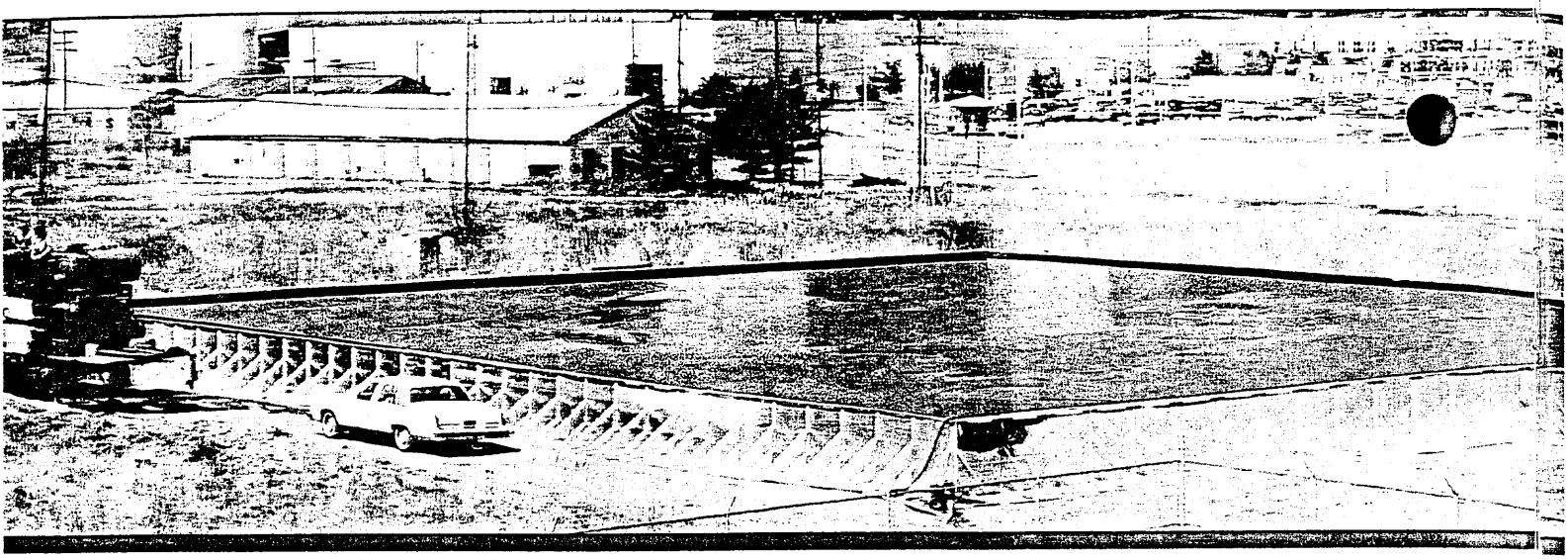
Our rental plan is tailored for shorter-term primary or secondary containment. It features low-cost, bolt-together EconoTanks and QuickStors in modular capacities from 20,000 to 1,000,000 gallons, with an option to purchase.

TABLE OF CONTENTS

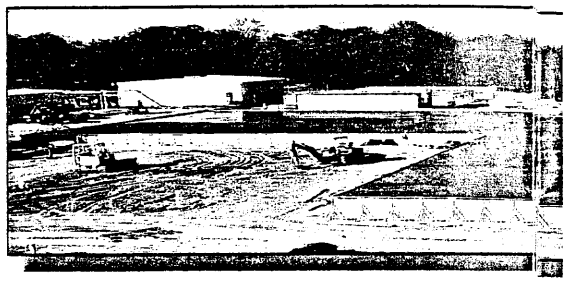
ModuTank™ Permanent or Temporary H.D. Tanks 4-5
EconoTank™ Short Terms Tanks - Rent/Buy 5
Fast Installation Step by Step ModuTank Installation ... 6-7
Overall Cost 7
ModuStor™ Round Tanks 8-9
VariTank™ These Tanks Fit Anywhere 10-11
Compakt™ For Small Capacity Needs 12
QuickStor™ Emergency / Short Term Tank 12
HiStor™ High Capacity Rectangular Tank 13
ModuTainer™ Secondary Containment 14
FracGard™ Frac Tank Secondary Containment 14
SpilGard™ Tanker Truck Containment Tank 15
TerraStor™ Earthen Material Temp. Containment 15
Piping 16
Leak Detection 16
Floating Covers 17
Baffles 17
Liners - HDPE 18
Field Coated Liners Sprayed in Place 18
Ponds & Liners Factory Fabricated & Field Installed 19
Land Fill Leachate 19
Ground Water Runoff 16
Above Ground Lagoons
Temporary Storage For Cleanup 20
Typical Case Histories 21-22
Applications & Installations 23-24

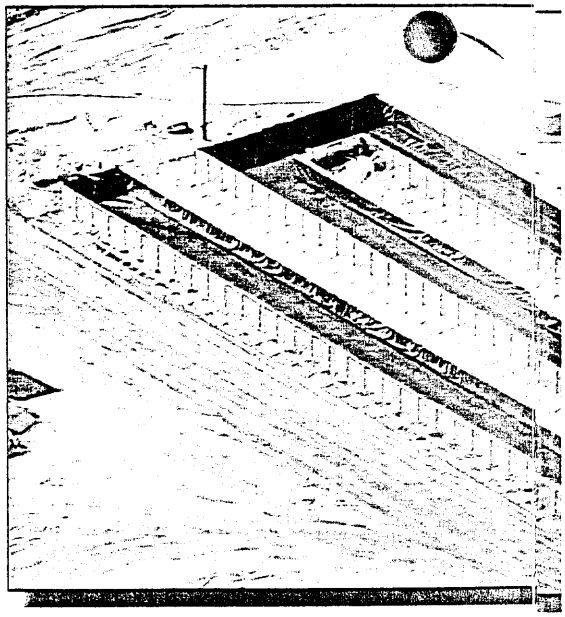
ModuTank

Permanent or Temporary H.D. Tanks



Low in Overall Costs, Little or no Site Preparation and Fastest Installation of any Tank System





ModuTanks are low-cost, versatile, heavy-duty storage tanks for environmental, industrial, commercial, agricultural and aquaculture applications. ModuTanks are economical alternatives to costly standard tanks, ponds or pits. Built for heavy-duty service to unlimited sizes, the modular tank is ideal for permanent or stand by storage.

LOWEST IN OVERALL COSTS

Per-gallon containment cost for any ModuTank or EconoTank size is below those of any equivalent storage system.

INSTALLATION SPEED

A typical 75' x 75' x 5'-0" high tank (200,000 gallons) can be completely installed on a prepared site by six unskilled laborers and a supervisor in about eight hours, using simple hand tools only. An easily followed step-by-step installation manual has been used successfully by hundreds of contractors to install these tanks. All parts can be comfortably handcarried by one or two workers.

ENGINEERED FOR SPECIFIC NEEDS

At no obligation, the ModuTank Inc. engineering service will consult with you on containment needs and help adapt ModuTank to your requirements.

MODUTANK COVERS

Floating covers fabricated from the same flexible membrane material as liners are available as options for creating totally enclosed systems. Covers, buoyed up by flotation logs, ride the fluid's surface and creates a practically vapor-free enclosure.

LINERS

Premium quality flexible membrane liners compatible with many liquid solutions handled by industry and for enviromental applications are available. They include: XR-5, HDPE, polyproplyene, Hypalon and PVC.

SEISMIC 4 DESIGN

A special ModuTank engineered to meet Universal Building Code Seismic 4 conditions is available. Its unique structural design has been certified by a registered professional engineer. Contact ModuTank Inc. for specifics.

PIPING

Inlet and outlet pipes can be over-the-top or through-the-wall and at the bottom. Bottom drains, sumps and accessory fittings are available.

MODUTANK SPECIFICATIONS

Wall panels are 16 gauge G90 galvanized steel. Support frames are 2" x 2" x 1/8" and 2" x 2" x 3/16" steel angle. Rails are 3" x 2" steel angle. Both are hot-dip galvanized or epoxy painted after fabrication. Stainless steel fasteners and tension cable system are supplied. A choice of fitted liners and floating covers in various gauges and materials is available.

SIZE RANGES

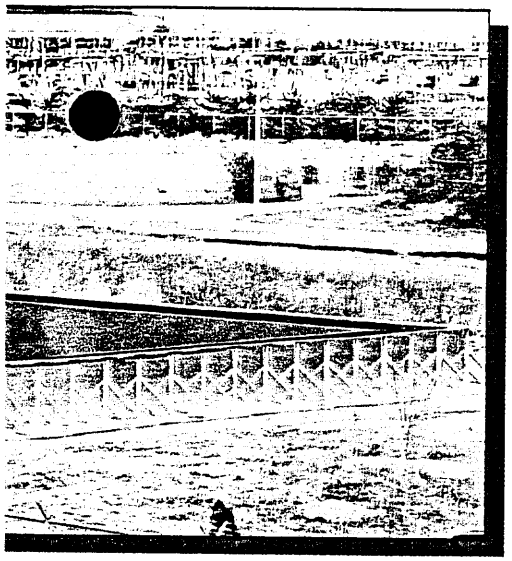
Any desired rectilinerar size from 4' x 4' upward based on 3'-9" long modules and 5'-0" wall height.

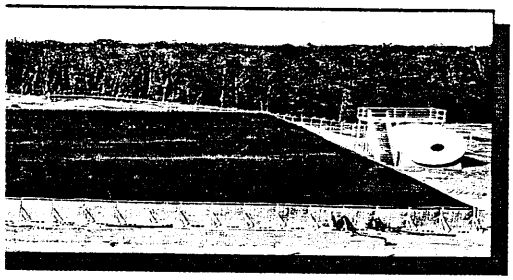
TYPICAL 5' HIGH MODUTANKS

GALLONS	DIMENSIONS (5'-0" deep)
8,000	15'-6" x 15'-6"
30,000	30'-6" x 30'-6"
50,000	38'-0" x 38'-0"
100,000	56'-9" x 56'-9"
250,000	90'-6" x 90'-6"
500,000	124'-3" x 124'-3"
1,000,000	173'-0" x 173'-0"

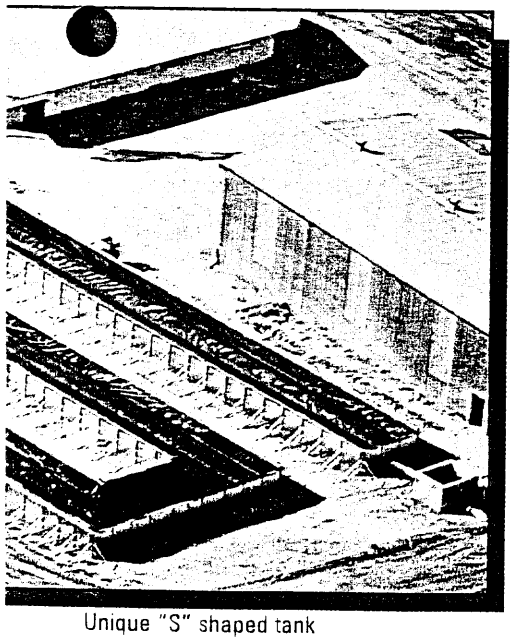
OTHER SIZES AND CONFIGURATIONS ARE AVAILABLE

EconoTank Short Term Use

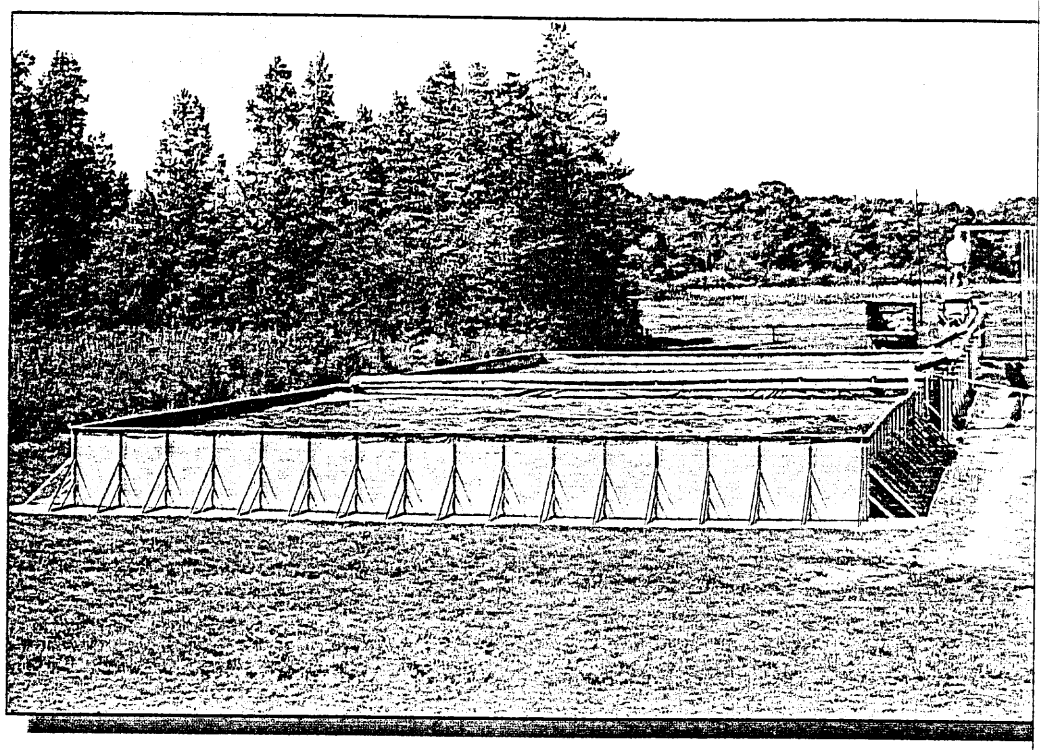




Unique "L" shaped tank



Unique "S" shaped tank



Engineered for Shorter Term Use and Low Containment Cost

Low-cost, heavy-duty EconoTanks offer versatile liquid storage for environmental, industrial, commercial and agricultural applications. Designed for short-term use – typically up to 18 months – the 4'-9" high EconoTank is available at per-gallon containment costs below those of equivalent storage systems. Additional cost savings can be relaized through ModuTank Inc.'s rental arrangement. As a result, EconoTanks are the economical alternative to standard tanks, lagoons, ponds or pits.

UNIQUE SHAPES

Virtually any shape utilizing right angles such as square, rectangle, "S" - "L" - "X," etc. can be assembled from ModuTank's unique, modular components. This capability is especially useful for installations with special flow requirements or irregularly shaped sites.

LOWEST IN OVERALL COSTS

Wall panels are 16 gauge galvanized stee. Support frames are 2" x 2" x 1/8" and 2" x 2" x 3/16" steel angle, hot dip galvanized after fabrication. Tension cables are galvanized steel. A 20 mil. polyethylene reinforced or laminated liner is standard.

TYPICAL 4'-9" HIGH ECONOTANKS	
GALLONS	DIMENSIONS (4'-9" deep)
50,000	38'-0" x 38'-0"
100,000	56'-9" x 56'-9"
300,000	94'-3" x 94'-3"
500,000	124'-3" x 124'-3"
1,000,000	173'-0" x 173'-0"

OTHER SIZES AND CONFIGURATIONS ARE AVAILABLE

RENT OR BUY

RENTAL PLAN

For short-term use, ModuTank Inc. offers a rental plan which offers substantial savings over outright purchase. Details of this cost savings plan will be furnished upon request. Purchase option is available. EconoTank rentals start at 50,000 gallons total capacity and go to 1,000,000 gallons or more. Special FracGard tank to enclose Fractanks is available at 24,000 gallons.

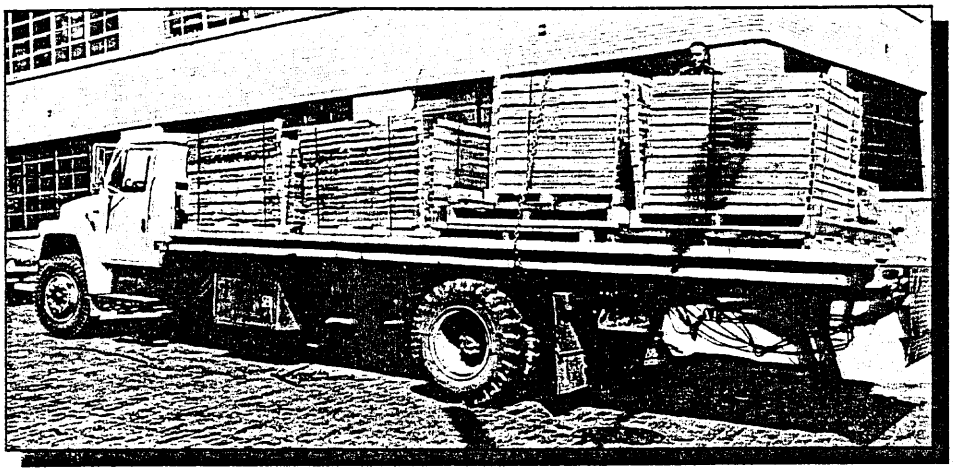
SIZE RANGES

Any desired rectilinerar size from 4' x 4' upward based on 3'-9" long modules and 4'-9" wall height.

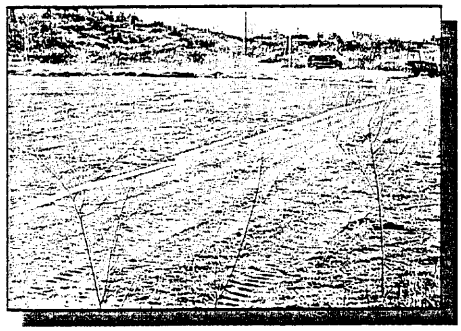
Fast Installation

Fast, cost-effective ModuTank and EconoTank installations are assured with compact modular components engineered for hand carrying and rapid bolt-together assembly using simple hand tools. A complete 1,000,000 gallon ModuTank or EconoTank can be shipped on a single flat bed trailer.

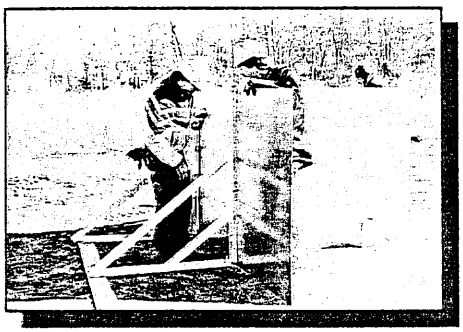
500,000 Gallon ModuTank Ready for Delivery



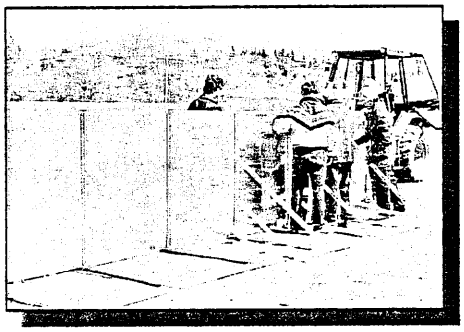
START...



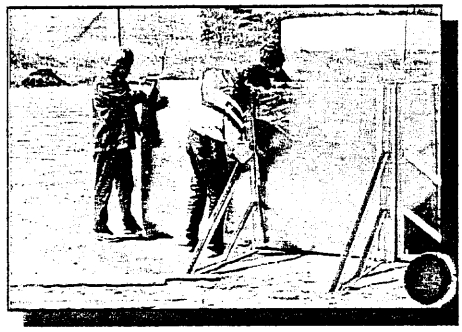
1 Graded site ready for tank



2 Assemble first corner

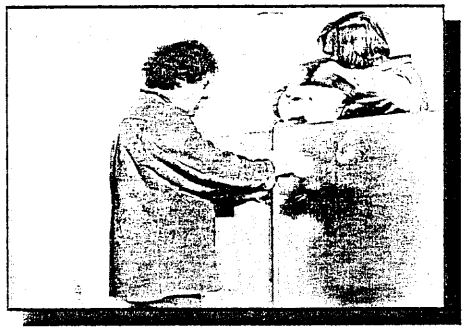


3 Assemble first wall

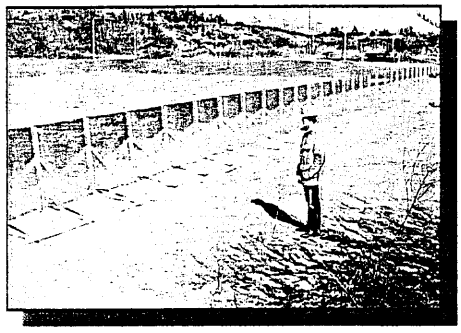


4 Assemble remaining corners and walls

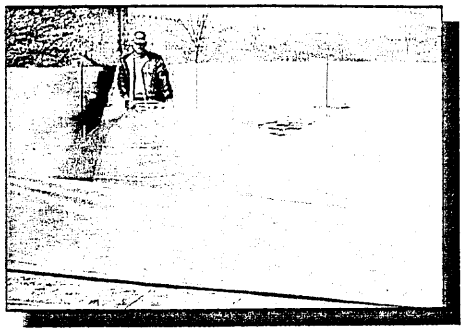
5 Attach tension cables



6 Tape seams

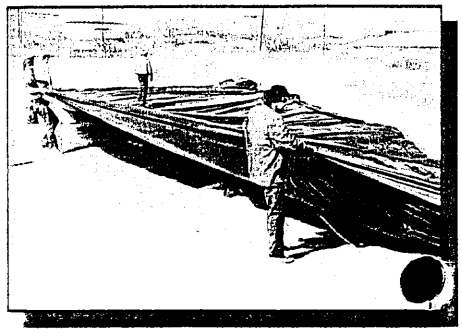


7 Completed tank ready for liner

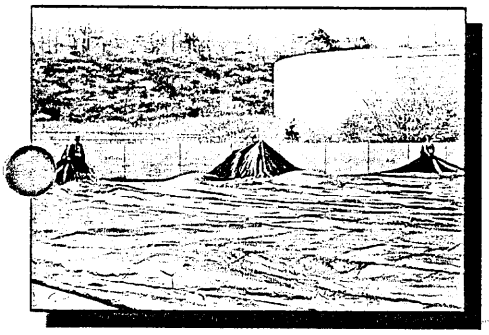


8 Layout protective underlay *(optional)*

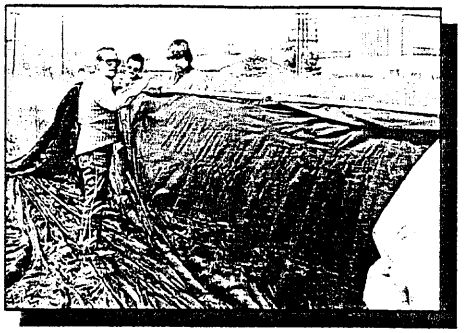
9 Roll out liner



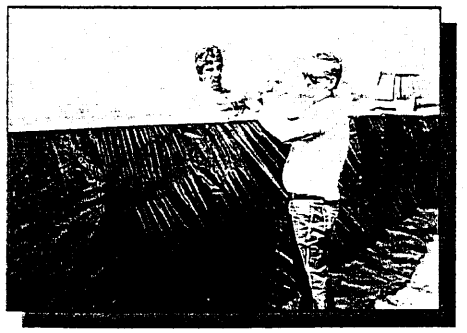
10 Unfold liner



11 Completed liner in place

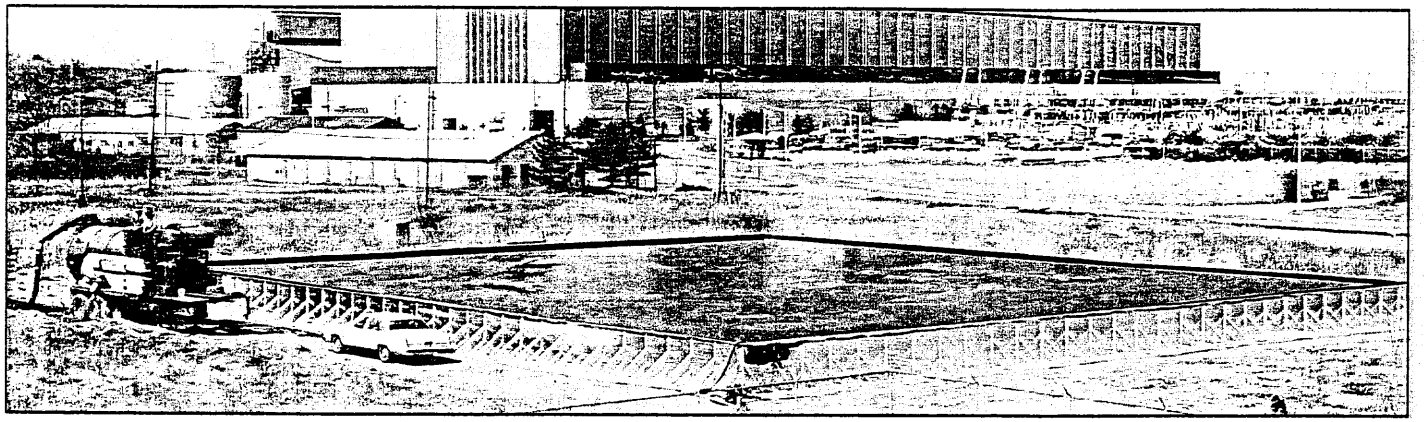


12 Attach liner to wall



13 Top rail completes tank

FINISH... 500,000 Gallon ModuTank Ready for Use In 1-1/2 Days



Overall Cost

Modular Tanks Offer Lowest-Cost Containment

MODULAR TANKS OFFER LOWEST-COST CONTAINMENT

Construction of low-cost tanks from compact mass-produced, modular components is at the heart of a breakthrough concept offering greater versatility and lower costs.

LOWEST IN OVERALL COSTS

Wall panels are 16 gauge galvanized steel. Support frames 2" x 2" x 1/8" and 2" x 2" x 3/16" steel angle. Both are hot dip galvanized after fabrication. Tension cables are galvanized steel. A 20 mil. reinforced polyethylene or 20 mil PVC is standard.

LOW-COST SHIPPING & OFF LOADING

Modularity is also integral to low-cost ackaging and shipment of rectangular nks. Modular components are strapped to standard skids for delivery on flat bed trucks. For example, steel components of a 2,000,000 gallon tank can ship on a single vehicle. Off-loading on location requires only a forklift; cranes or other heavy moving equipment are seldom needed. Steel components can easily be hand-carried by one or two workers.

LOW-COST SITE PREPARATION

Tank installation can be completed on prepared, compacted ground or on new or existing concrete or asphalt. Massive, special concrete footings are not necessary.

LOW-COST INSTALLATION

Steel components of our modular tanks are unloaded by forklift and manually carried to the installation site. Quick, bolt-together assembly with simple hand tools is at ground level, omitting rental charges for cranes and scaffolding. Labor costs are sharply reduced in two ways: (1) by employing unskilled work crews, and (2) by cutting installation time.

LOW-COST SPECIAL SHAPES

A single rectangular tank can be configured, from standard modular parts, to conform to the contours of oddly shaped sites. For example, assembled as an "L", a tank could be cornered around obstructions. Almost any asymmetrical configuration, with right angle corners, can be constructed. Purchaser eliminates the cost of a custom tank, yet receives a custom tank from low cost standard modular components.

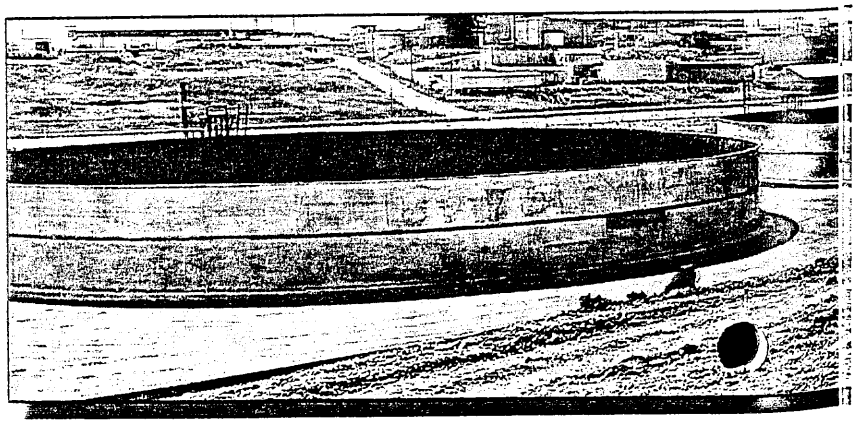
LOW-COST RECONFIGURATION

Our modular tanks knock-down quickly for compact storage or relocation. Modular sections can be added or subtracted to resize or reconfigure an existing tank into one or more new tanks. Only newly configured liner(s) and tension cables must be added.

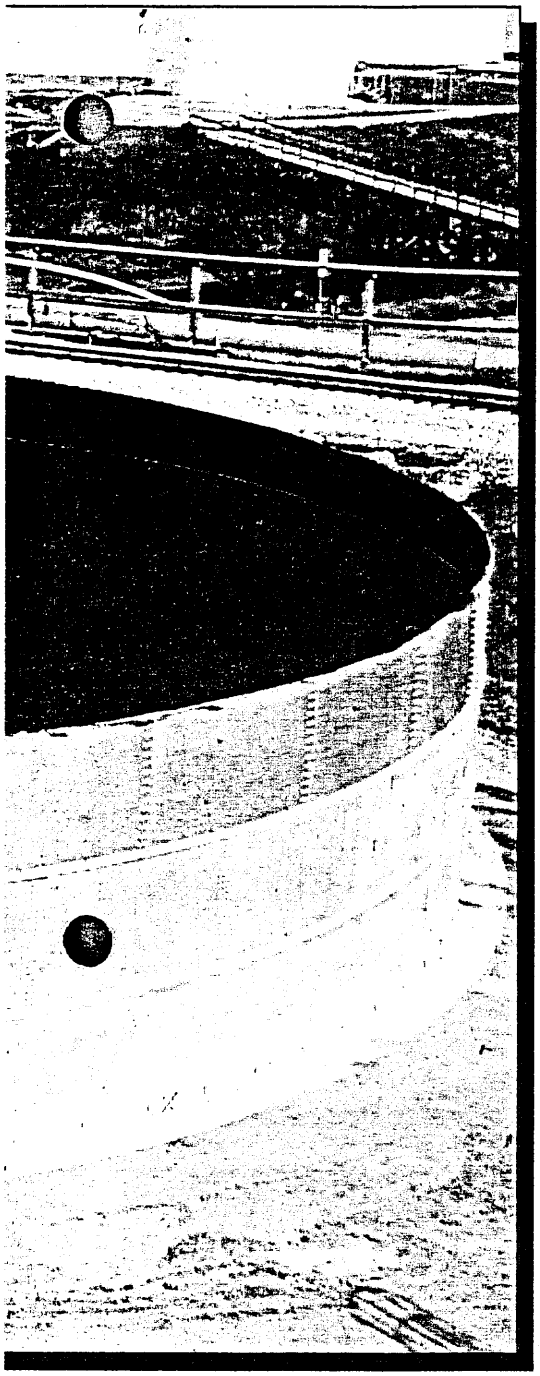
ModuStor

Permanent or Temporary H.D. Tanks

Three Tier 15' High ModuStor



Two Tier 10' High ModuStor



Low-Cost Round Bolted Steel Tanks Space Saving, Fast Assembly, Simple Site Preparation, Low Overall Cost.

ModuStor tanks are the ideal answers for many liquid storage applications, especially where space is limited. Available in a wide range of sizes from 10 ft. to over 200 ft. in diameter and from 4 ft. to 20 ft. in height. ModuStors are individually designed from standardized, modular parts to keep costs low.

Modular steel components are precisely fabricated in our shop to provide easy to erect tanks with volumes in excess of 1,000,000 gallons. All parts are bolted together in the field with no need to cut or weld sections. Based on simplified, efficient design, tanks are speedily assembled with unskilled labor using ordinary hand tools. For example, the prefabricated components of a 500,000 gallon ModuStor can be assembled on a prepared site by 5 supervised workmen in from 6 to 9 days.

COST RANGE

Standardized, easily handled modular steel components, produced in quantity, reduce overall ModuStor costs below those for welded steel counterparts. Depending on tank size and liner, ModuStor prices can be as low as 10¢ per gallon.

SITE

ModuStor tanks can be erected on any firm surface such as compacted earth, concrete, or macadam. Tanks can be anchored to a 4' wide concrete apron or for shorter term projects, they can be installed on gravel with unique corrosion resistant steel, base plates. Interior area can be flat, slightly pitched or dished to ease emptying.

ModuStor tanks feature portability. The bolted design allows simple disassembly for relocation to new site.

LINERS

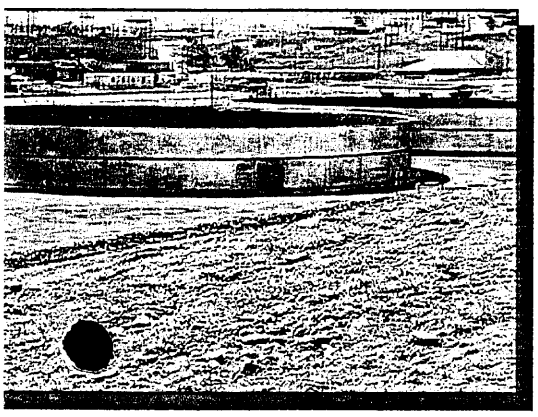
The large selection of premium liner materials available is chemically compatible with many commonly handled liquids. Lining materials include reinforced XR-5, polypropylene, Hypalon and PVC. HDPE is also available for tanks up to 10 ft. high.

PIPING

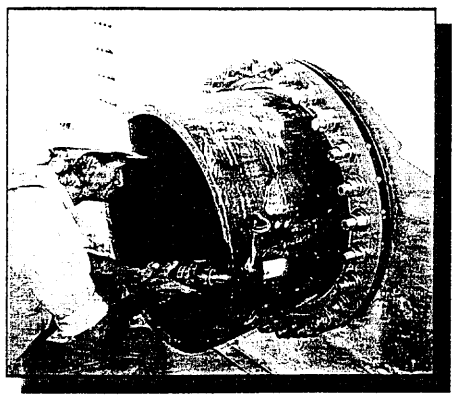
Input, output and level equalization piping can be attached to ModuStor tanks by bottom or through-the-wall connections. Wall openings can be precut at the factory.

GENERAL SPECIFICATIONS

Wall panels are G-90 mill galvanized steel sheet of varying thicknesses, ranging from 16 ga. to 10 ga. All girths are hot dip galvanized structural steel angle. Hardware is zinc plated steel, grade 5 or better.

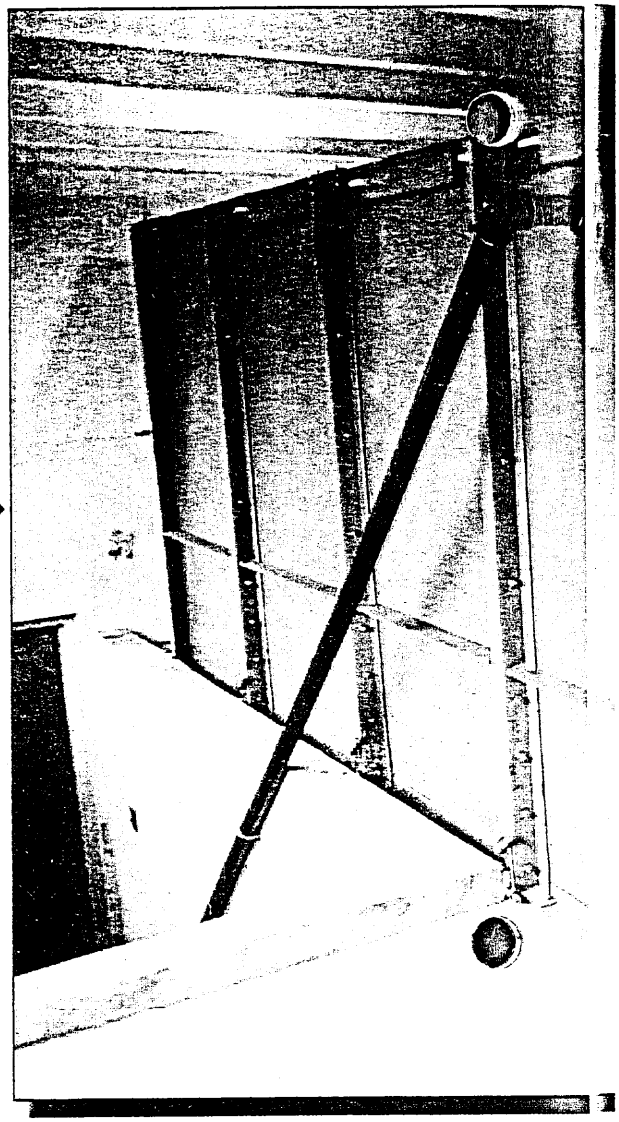


Over Flow Stand Pipe



30" Flange Fitting

VariTank These Tanks Fit Anywhere - Maximum Storage in



Modular parts hand carry through small openings and assemble anywhere indoors or outdoors

Hand-carried components bolt together rapidly in hard-to-reach locations such as basements, tunnels, upper floors, laboratories and utility areas. Unique system for low-cost fluid handling offers permanent or standby service indoors and out. In addition, VariTanks can be easily installed and quickly knocked down for relocation.

INSTALLATION SPEED
Free-standing VariTanks can be installed in half-a-day by two workers using simple hand tools. Little or no ground preparation is needed.

LINERS
45 mil reinforced polypropylene, 30 mil reinforced XR-5, reinforced FDA grade vinyl, PVC and Hypalon.

LEAK DETECTION SYSTEMS
Double liner/leak detection systems are available.

EPOXY COATED VARITANKS
Tanks for liquid chemical storage feature epoxy coated steel modular components.

PIPING
Inlet and outlet pipes can be positioned and installed as desired whether through-the-walls with bulkhead fittings, over-the-top, or through the bottom. Fittings for these connection methods are also available.

COVERS
Modular galvanized or epoxy coated steel covers with or without hatches are available as options. Floating covers are also available.

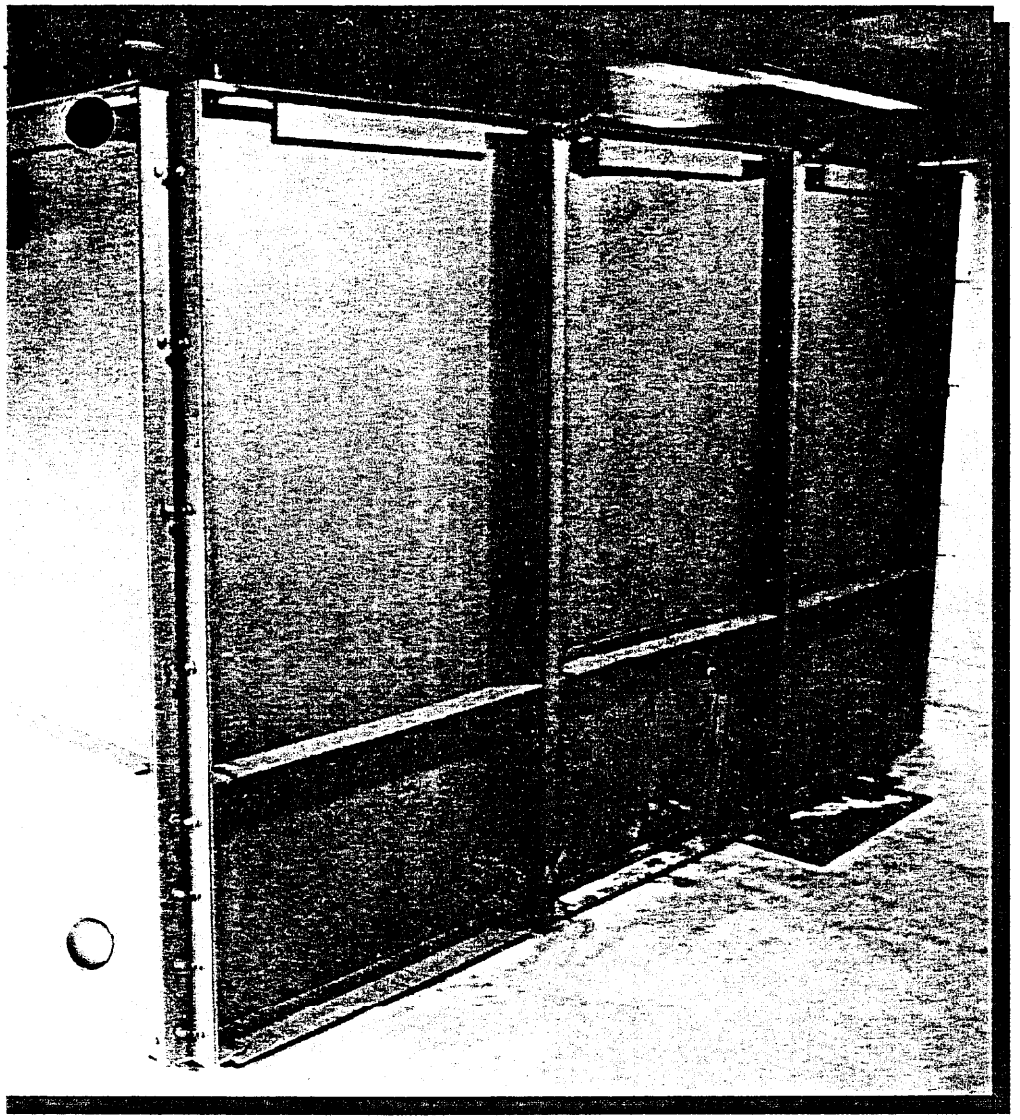
GENERAL SPECIFICATIONS
VariTanks are constructed of 16 gauge G 90 galvanized or epoxy coated steel wall panels, 3 x 2 x 1/4 steel angle support posts and rails, and high-strength bolts and nuts. Prefabricated stainless steel tension cables are included.

MODEL	GALLONS	SIZE (6'X3" High)	Wt.-lbs.
ES-202	2,000	7'-0" x 7'-0"	1,500
ES-203	3,000	7'-0" x 10'-6"	1,800
ES-204	4,000	7'-0" x 14'-0"	2,100
ES-303	4,500	10'-6" x 10'-6"	2,350
ES-304	6,000	10'-6" x 14'-0"	2,700
ES-404	8,000	14'-0" x 14'-0"	3,000
ES-405	10,000	14'-0" x 17'-6"	3,300
ES-505	12,500	17'-6" x 17'-6"	3,650
ES-606	18,000	21'-0" x 21'-0"	4,350

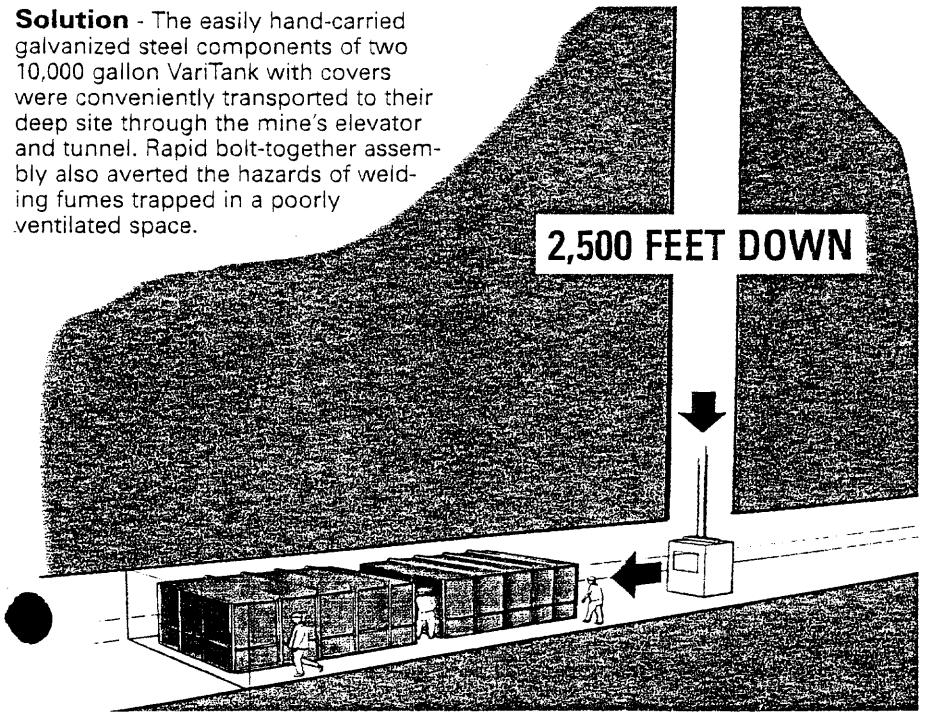
20,000 GALLON STORAGE 2,500 FEET BELOW GROUND*

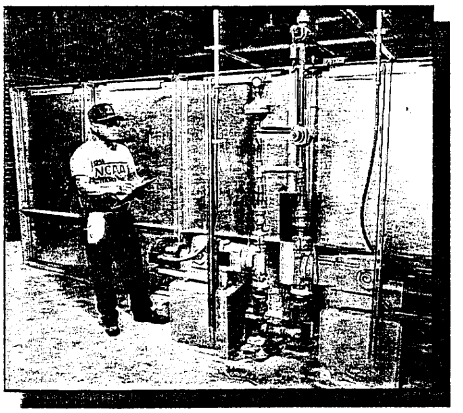
Problem - A salt mine chamber was excavated 2,500 feet below ground level to receive storage facilities for fuel oil and hydraulic fluid. The confined space was 8-ft. high and reachable only by a conventional shaft elevator.

Rooms with Low Ceilings

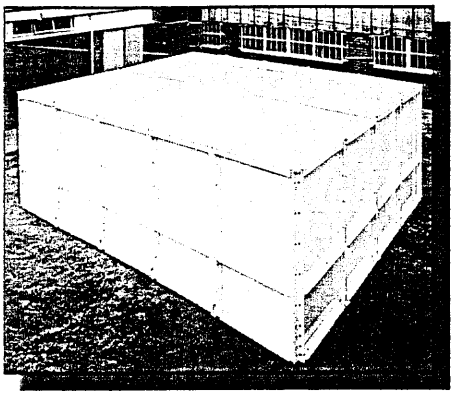


Solution - The easily hand-carried galvanized steel components of two 10,000 gallon VariTank with covers were conveniently transported to their deep site through the mine's elevator and tunnel. Rapid bolt-together assembly also averted the hazards of welding fumes trapped in a poorly ventilated space.

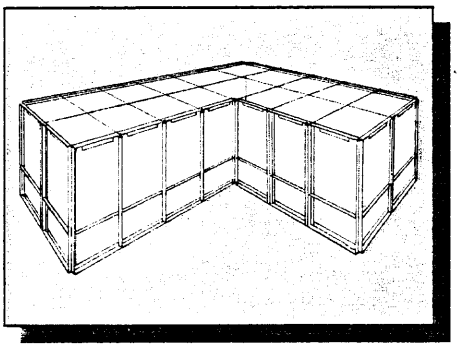




VariTank retrofit saves water treatment plants up to 30% in operating costs by converting dry alum to bulk delivered liquid alum.



Epoxy coated VariTank shown with typical cover.

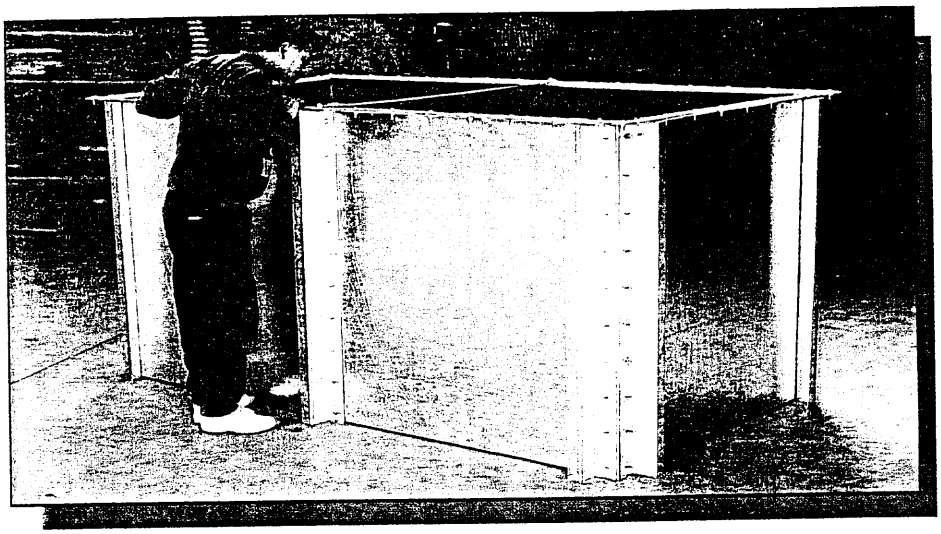


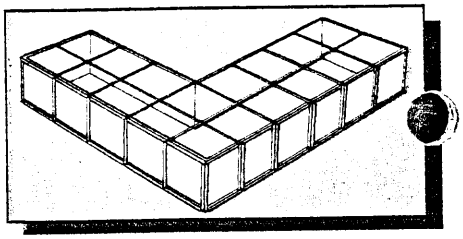
Special shapes are available for unique requirements.

Tank farm of galvanized steel VariTanks feature insullated wall and covers and manifold piping system.

ComPakt

Tanks for Extremely Tight Spaces





SPECIAL SHAPES - ComPakts can be assembled into "L"-"T"-"X" or almost any shape with right angle corners.

GENERAL SPECIFICATION - Wall panels are mill galvanized steel. Liner is 20 mil PVC or 30 mil XR-5.

ComPakt tanks are engineered for permanent or standby liquid storage indoors or outdoors. Available in capacities from 450 gallons to more than 15,000 gallons. They are assembled from modular steel panels and steel support posts. Panels and posts can be hand-carried by one or two workmen through doorways for rapid assembly in tight places.

LINERS - ComPakts are supplied with one piece fitted liners. A wide range of flexible membrane liners is available.

COVERS - Floating covers are available where total sealing of tank is necessary. Galvanized steel top covers are available.

PIPING - The ComPakt conveniently accepts bulkhead fittings for through-the-wall pipes. Bottom drains can also be installed.

INSTALLATION IN DIFFICULT LOCATION

A ComPakt tank, designed to replace a 4'x15'x 4' H. tank in an indoor concrete pit was manufactured, delivered and installed within hours.

QuickStor

Emergency or Short-Term Storage

QuickStor modular flat steel wall panels are designed for hand carrying and rapid bolt-together assembly. They are light in weight and can be transported in a pick-up truck, minivan or station wagon. A typical 5,600 gallon QuickStor can be readied for operation in less than one hour by two workmen using ordinary hand tools.

MEMBRANE LINERS

low-cost flexible PVC membrane liners are standard. A wide range of other liner materials can be specified. Tarp or floating covers are available.

PIPING

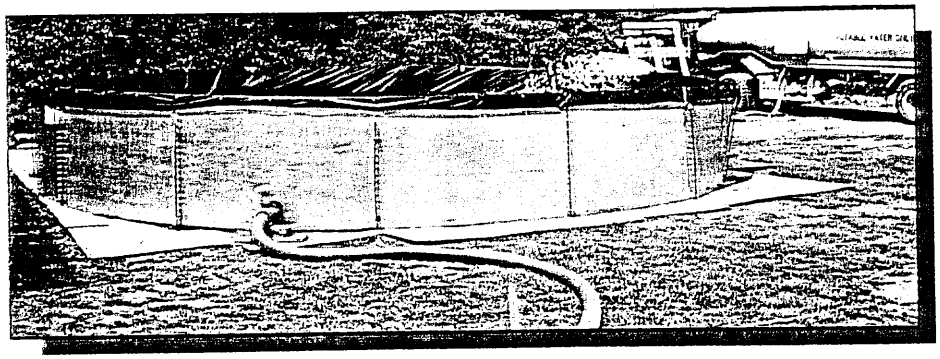
QuickStor tanks are designed primarily for over-the-wall loading and unloading. However, inlet and outlet pipes can be attached with through-the-wall bulkhead fittings, or bottom flanges.

QUICK SHIPMENT

ModuTank Inc. maintains an inventory of standard size QuickStor tanks for immediate shipment.

GENERAL SPECIFICATIONS

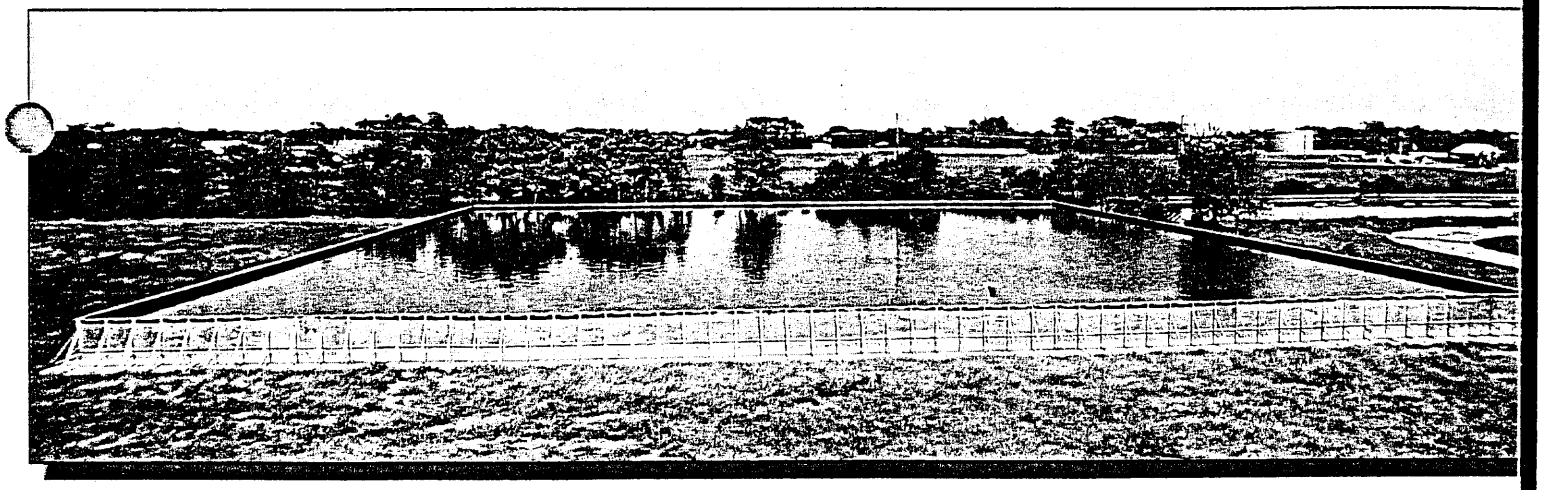
Modular 4' high flat wall panels are 20 gauge mil. galvanized steel. Reinforcing straps are 11 gauge mill galvanized steel. Steel rod anchors are included.



STANDARD 4' HIGH QUICKSTORS	
DIAMETER (Ft)	GALLONS (w/3" freeboard)
10	2,200
16	5,600
22	10,600
30	19,800
38	31,700

OTHER SIZES ARE AVAILABLE

HiStor 6'-3" High Bolted Tank



2,000,000 Gallon HiStor Sludge Tank

High-Capacity Standby or Permanent Storage

High-capacity HiStor tanks, featuring modular space-saving rectangular configurations, are the preferred choice for heavy-duty standby or permanent storage. Scaled to 6'3" in height, HiStors offer 30% more holding capacity than standard 4"9" high ModuTanks. They are the ideal configuration for dredges, skimmers etc. Designed for durability, long life and minimal maintenance, the HiStor is assembled from heavy-duty corrosion resistant components throughout. Support frames are anchor bolted to a concrete apron.

COST RANGE

Low cost bolt-together components and prefabricated membrane liners minimize installation time and reduce costs below those of comparable concrete or welded steel tanks. Depending on tank size and liner, HiStor prices can be as low as 10¢ per gallon.

INSTALLATION

Modular components designed for hand-carrying and simple bolt-together assembly assure quick installation by unskilled workers. An easy to follow step-by-step manual guides the crew through every aspect of HiStor tank installation.

The 2,000.000 gallon HiStor above, was installed on a prepared site by a team of eight workers and a supervisor in five days.

PIPING

Inlet and outlet pipes and other liquid-product handling equipment can be positioned and installed wherever desired with through-the-wall pipes. Bottom drains and Sumps can be fitted. Optional accessory fittings are available for these purposes.

LINERS

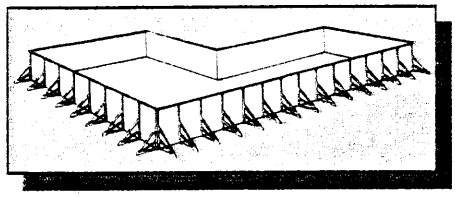
A full range of premium quality flexible membrane liners is available, including XR-5, HDPE, PPE and Hypalon. These materials are compatible with most corrosive solutions handled by industry.

COVERS

Floating covers are fabricated from reinforced membrane material. Covers, buoyed up by floatation logs, ride the fluids surface and produce practically vapor-tight enclosure.

GENERAL SPECIFICATIONS

Wall panels are 16 ga. G90 galvanized steel. Support frames are 3" x 3" and 2" x 2" structural steel angle; rails are 3" x 2" structural steel angle; both are hot-dip galvanized after fabrication. Stainless steel tension cables, plated bolts and anchors are supplied. A choice of fitted liners and floating covers in various gauges and materials is available.



SPECIAL SHAPES

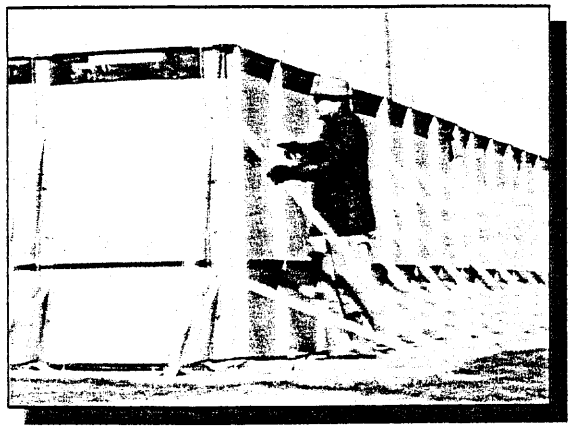
Virtually any shape utilizing right angles such as square, rectangle, "S" - "L" - "X," etc. can be assembled from HiStor's unique, modular components. This capability is especially useful for installations with special flow requirements or irregularly shaped sites.

TYPICAL HISTOR SIZES

GALLONS (Nominal)	DIMENSIONS (6'-3"H)
250,000	74'-0" x 74'-0"
500,000	105'-6" x 105'-6"
1,000,000	147'-6" x 147'-6"
2,000,000	210'-6" x 210'-6"

OTHER SIZES ARE AVAILABLE

Bolt-Together Assembly

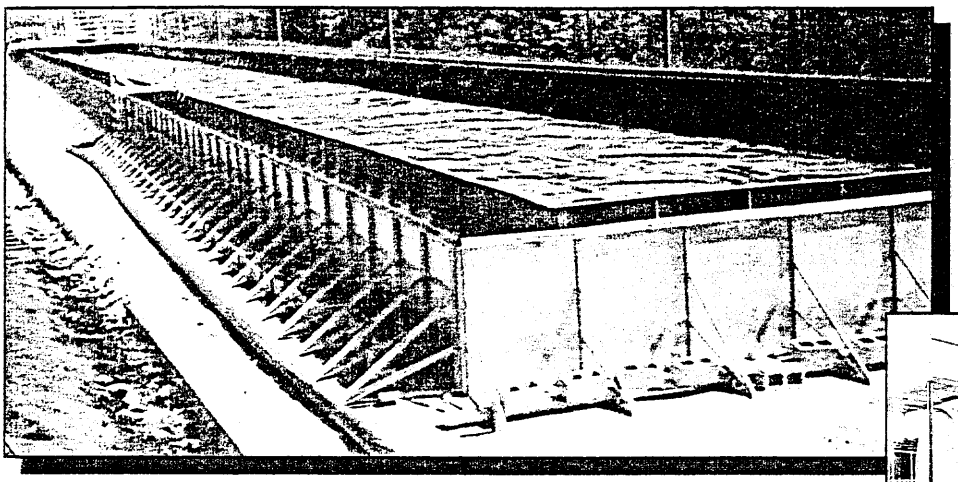


Corner of 2,000,000 Gallon HiStor

ModuTainer

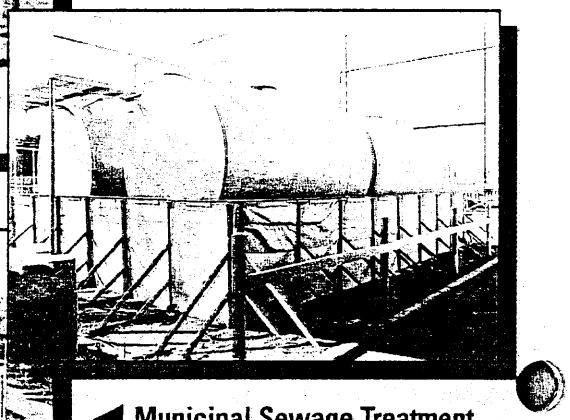
Low-Cost Secondary Containment

Low-cost ModuTainer systems in rectangular or round configurations are designed for erection around existing or new tank installations. All ModuTainer components are galvanized for corrosion resistance and are easily handled for rapid bolt-together assembly using ordinary hand tools. Modular parts can be installed on any firm, level site. Premium quality chemical resistant liners are available to meet industrial and environmental containment requirements.



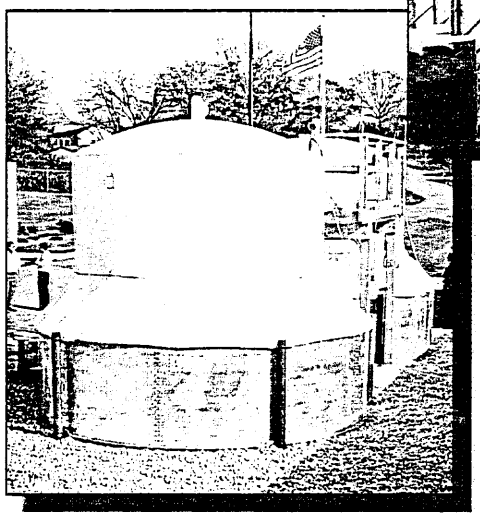
▼ Federal-Mogul Corporation, Lancaster, PA

This large metalworking operation sought a means for safeguarding four 5,000 gallon tanks holding hydraulic oils and lubricants from possible leakage. Their solution - a reliable, economical 23' x 30-1/2' chemically resistant, reinforced ModuTainer containment basin with membrane liner precision fitted to concrete saddles.



▲ Major Chemical Manufacturing Company

The challenge of a narrow, constraining site alongside a chemical plant structure was met by an HDPE-lined ModuTank for the primary storage of 900,000 gallons of corrosive hazardous wastes. Secondary containment was provided by a closely nested HDPE-lined ModuTainer. The total system was delivered under tight priority deadlines and rapidly installed with ordinary hand tools to meet critical operational schedules.

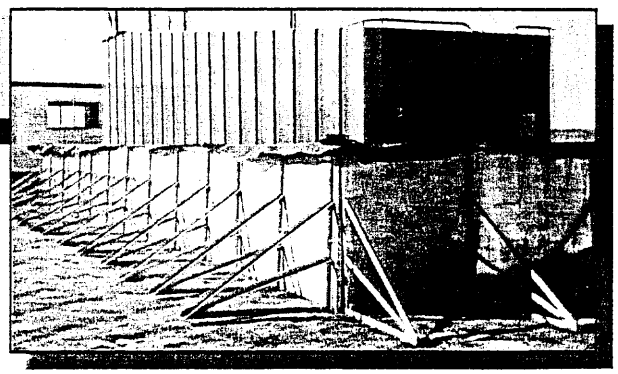


◀ Municipal Sewage Treatment Plant Valparaiso, IN.

Two, 11,000 gallon water treatment chemical tanks are fully protected by 15' dia. x 8' high ModuTainer containment basins engineered for long, maintenance-free service. The versatile, proven round dikes, installed four feet below grade, and their durable reinforced membrane liner, offer standby security with dependability and low costs.

FracGard

Low-Cost Rental Systems For Frac Tank Secondary Containment



To meet demand of regalutory agencies for secondary containment of Frac tanks, ModuTank Inc. has developed the FracGard for purchase or rental. FracGard capacity starts at 24,000 gallons to hold one standard size Frac tank. Larger FracGards are available. FracGard can be easily and rapidly bolted together from 3'9" W x 4'9" H. modular components using ordinary hand tools. Site preparation is minimal on compacted earth, concrete or macadam.

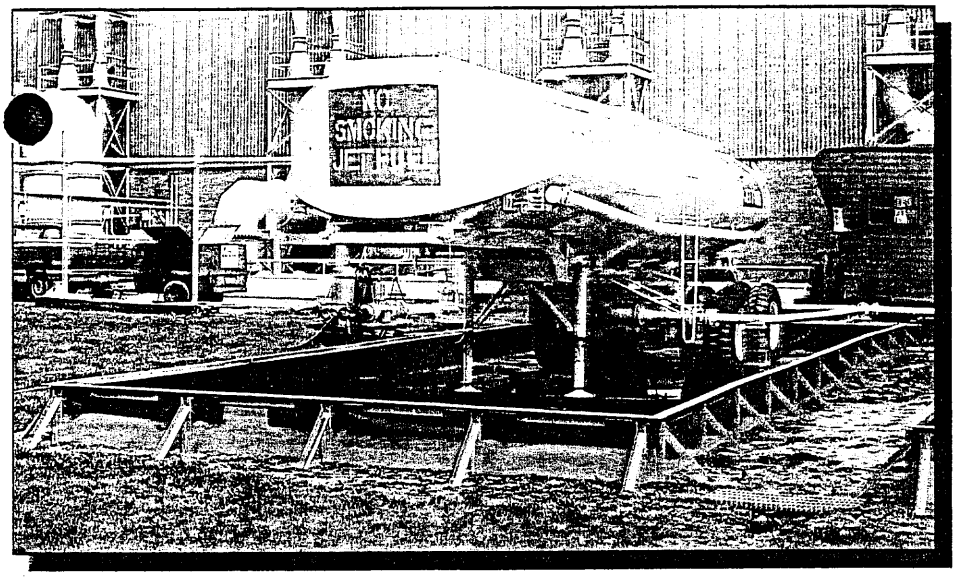
LINERS

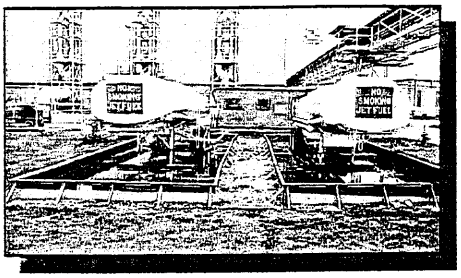
Full range of liners are available including XR-5, polypropylene, Hypalon, HDPE and PVC.

GENERAL SPECIFICATIONS

Walls are 16 gauge G-90 mil. galv. steel sheets. Frames are 2" x 2" x 1/8" and 3/16" angles, hot dip galv. Galvanized steel cables form part of the structure.

SpilGard





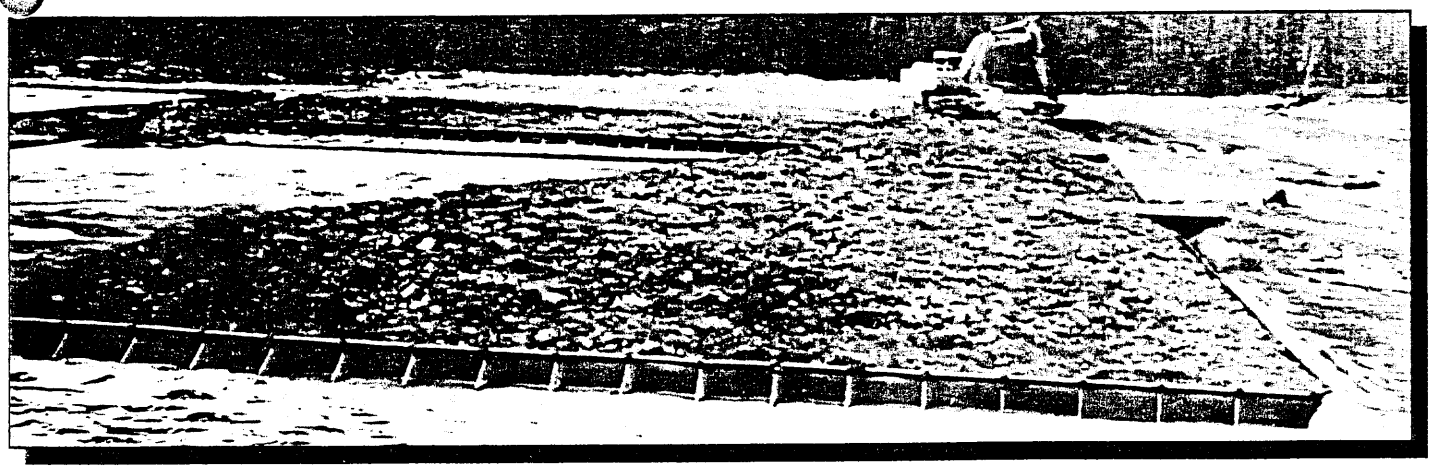
Tanker Truck Spill Containment

SpilGard systems are designed to contain accidental tanker truck spills at loading, unloading and storage points. Used as temporary or permanent safeguards at vulnerable sites, the SpilGard is accessed through a movable gate. Call for specifications of SpilGard's in various sizes.

INSTALLATION SPEED
SpilGuard modular steel components are designed for easy hand-carrying and rapid-bolt together assembly by unskilled workers following a step-by-step manual.

MEMBRANE LINERS
A wide variety of membrane liner materials is available including, XR-5, PPE, Hypalon and HDPE.

TerraStor



Temporary Containment System For Earthen Materials

TerraStor containment systems are cost-effective answers for the temporary storage and treatment of sand, clay and other earthen materials. TerraStor components are rapidly assembled in areas where berms or other retaining devices are impractical or too costly. All parts can be conveniently trucked to location and bolted-together by unskilled labor using ordinary hand tools. A typical half-acre TerraStor with sitebuilt earthen ramps for trucks access, is generally completed within a day.

LINERS
A full range of membrane liners includes, HDPE, PPE, XR-5, PVC and Hypalon.

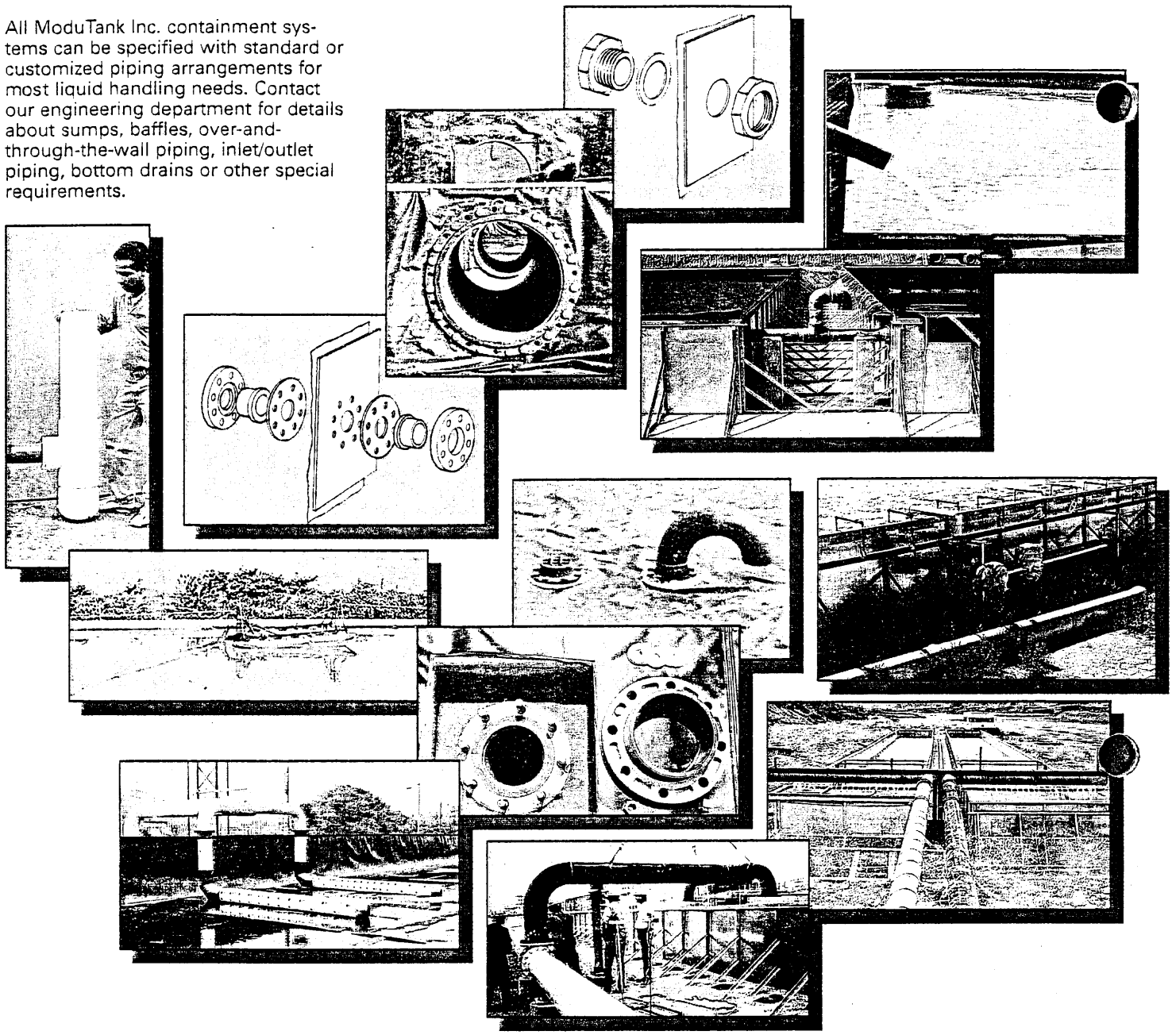
SIZES
Modular components allow assembly of any size containment based on a 3'-9" module, 2'0" high.

UNIQUE SHAPES
TerraStor's can be assembled into any shape with right angle corners such as "L" - "T" - "X" to fit unusual sites.

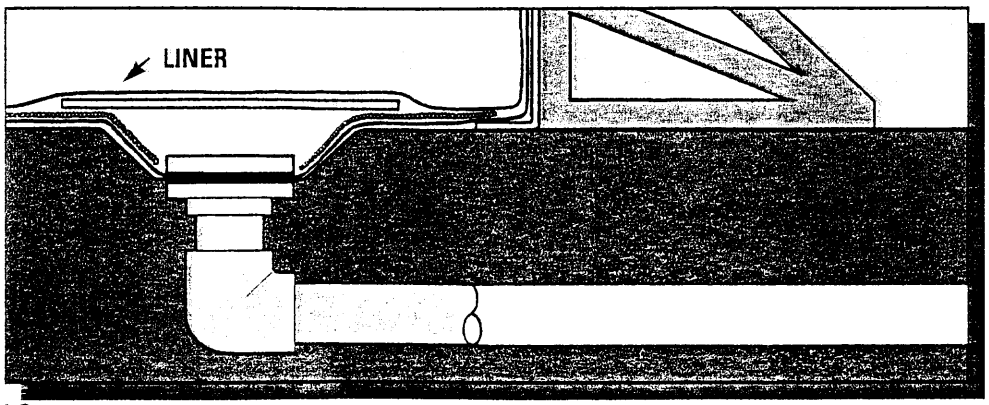
GENERAL SPECIFICATIONS
Walls are 20 gauge galvanized steel. Frames are 2" x 2" welded structural steel angle, hot-dip galvanized after fabrication. All fasteners are corrosion resistant.

Piping

All ModuTank Inc. containment systems can be specified with standard or customized piping arrangements for most liquid handling needs. Contact our engineering department for details about sumps, baffles, over-and-through-the-wall piping, inlet/outlet piping, bottom drains or other special requirements.

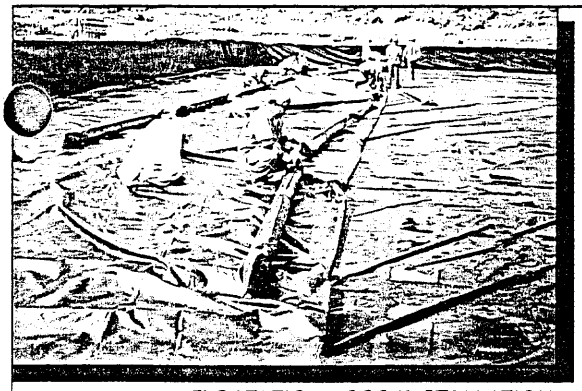


Leak Detection

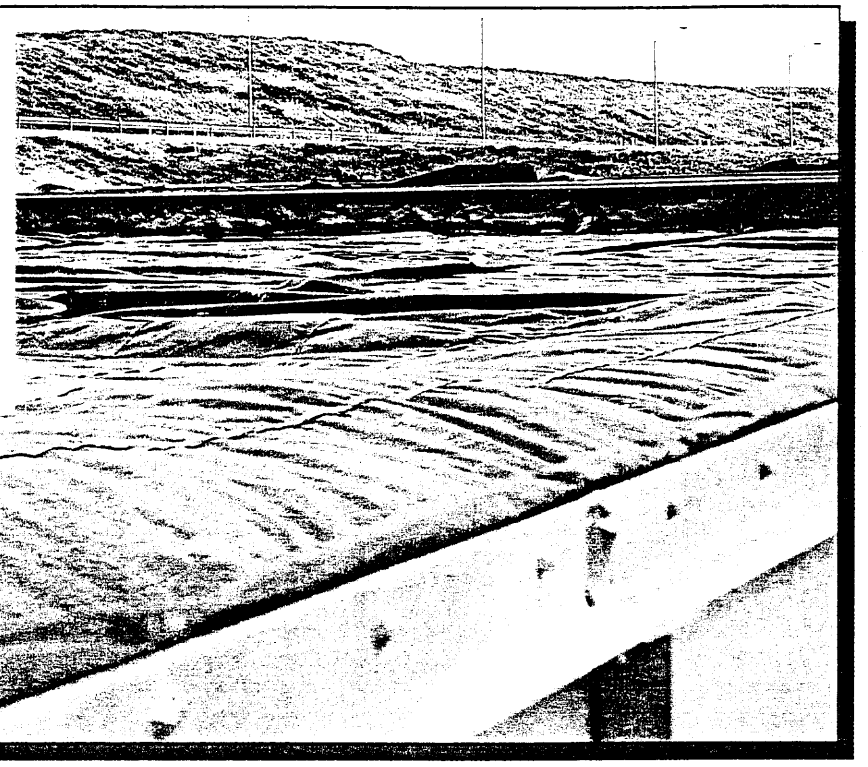


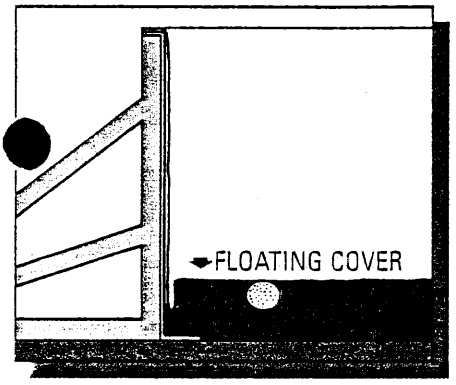
Double liners are available with leak detection connections to secondary liner at bottom or through-the-wall if tank is located on concrete pad.

Floating Covers

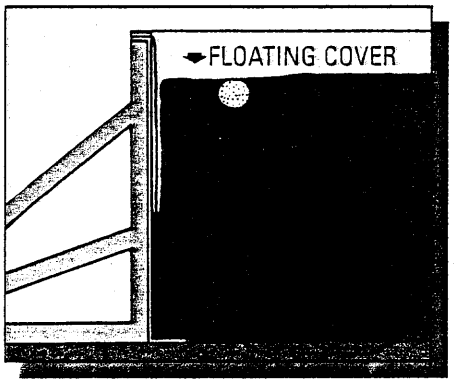


FLOATATION LOGS INSTALLATION





LOW FLUID LEVEL

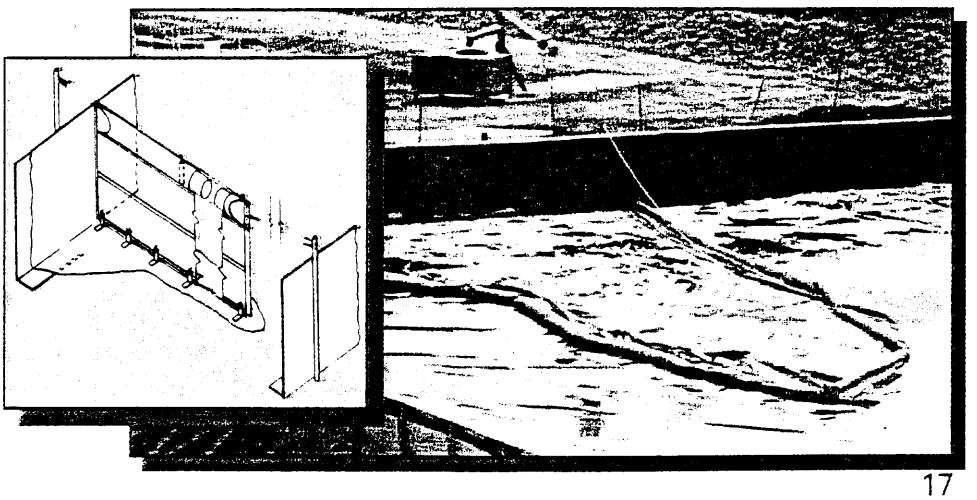


HIGH FLUID LEVEL

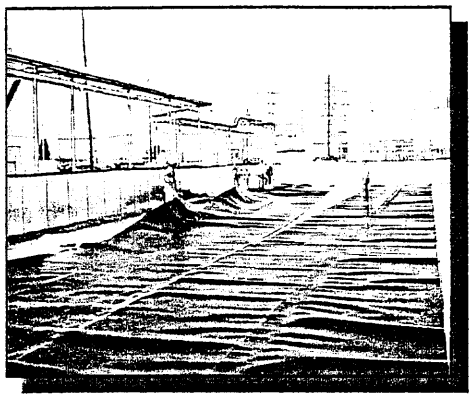
All ModuTank Inc. products can be provided with floating covers. Designed to ride on the surface of the contained liquid, covers rise and fall with liquid level. Floating covers can be made of the same material as the liner and contain built-in sleeves for floatation logs and weights. They offer an inexpensive, yet effective, means of protecting the liquid contained especially in larger tanks where rigid covers are not practical. In many applications, floating covers effectively eliminate undesirable headspace vapors.

Baffles

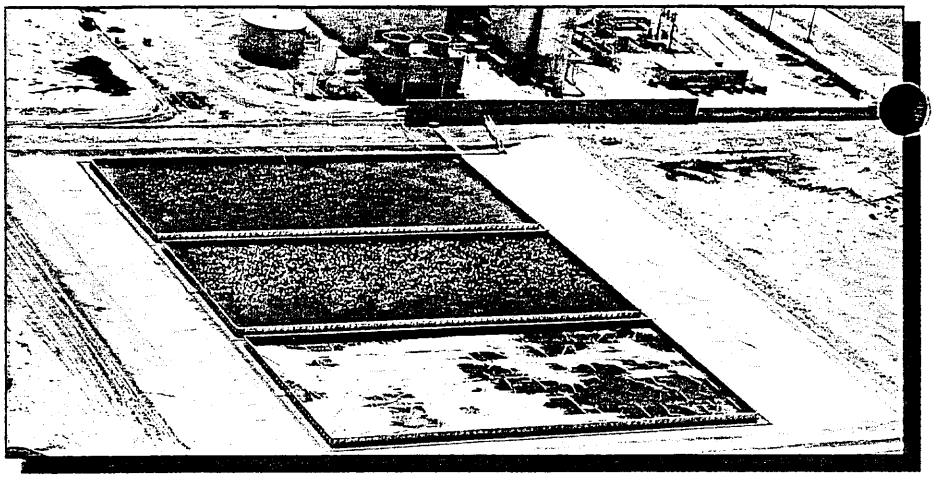
Inexpensive floating baffles can be added to any ModuTank Inc. tank. Multiple baffle systems, curved sections, flaps, as well as other special features can be built in to suit your specific needs. Materials are chosen for their long life and chemical resistance. Baffles are prefabricated for easy handling and rapid bolt-in installation. Built-in flotation logs and flexible construction allow the baffles to adjust to changing fluid levels. Ballast chains or weighted pipe in sealed pockets anchor the baffle's bottom edges.



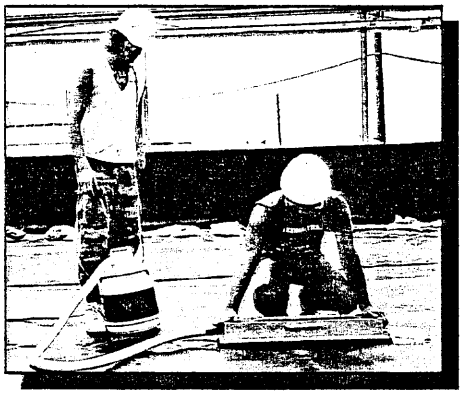
Liners - HDPE



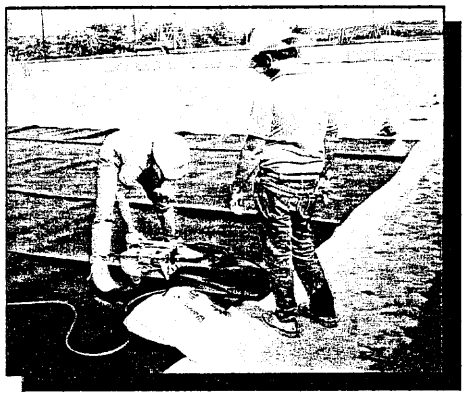
Spreading and aligning of 80 mil HDPE liner in preparation for on site seam welding.



Three HDPE lined seismic 4 ModuTanks totaling 3,300,000 gallons in use as evaporation tanks.



Liner seams are tested for leaks by vacuum, pneumatic, and tensiometer methods.

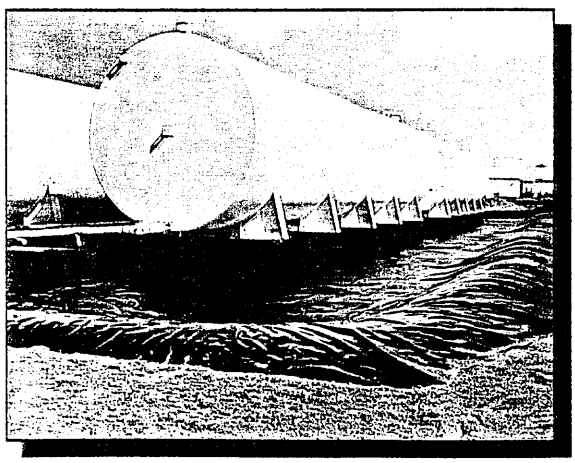


Double fushion welding of HDPE liner seams.

Double HDPE liners, each layer 60 mil or greater in thickness, sandwich a fluid's conducting medium which conveys liquid permeating the primary liner to a detection sump. Double liners without leachate provisions, as well as single liners in HDPE, are also available. ModuTank's modular tanks range in capacities to more than 2,000,000 gallons. Site-seamed fitted HDPE liners are installed by factory trained technicians using the latest state-of-the-art techniques including double fusion welding, hot wedge seaming and extrusion welding. Field seams are tested by vacuum, pneumatic, and mechanical peel methods to assure liner integrity. Manufacturer certifications can be provided for liner materials. HDPE lined ModuTanks accept various plumbing arrangements by means of inlet and outlet through-the-wall pipe fittings and flanges. Bottom drain and standpipe assemblies, as well as optional floating covers, are also available.

Field Coated Liners

Secondary Containment



Field coated liners are excellent choices for secondary containment, especially in existing installations with metal or concrete piers, pads and legs. Earthen, concrete or gravel substrate is covered with geotextile and sprayed with a liquid polymer forming a seamless, chemical resistant liner.

PHOTO: COURTESY OF FUTURA INC.

Ponds & Liners

ModuTank Inc. offers factory fabricated and field installed membrane liners for ponds and for new or existing tanks. Among the more widely used products available are:

HIGH DENSITY POLYETHYLENE
(HDPE) chemical resistant material in various thicknesses. A 20 mil. reinforced laminate is shop fabricated. Liners 60 to 100 mil. are field fabricated using state-of-the-art techniques including double fusion welding. All seams are tested by such methods as pressurization, vacuum, peel and tension..

XR-5
30 mil reinforced material formulated to resist chemical and environmental attack. Resistant to puncture and tear. Has long field life.

POLYPROPYLENE
45 mil reinforced liners have excellent mechanical and chemical resistant properties.

INDUSTRIAL GRADE HYPALON
36 mil reinforced, chemically resistant material.

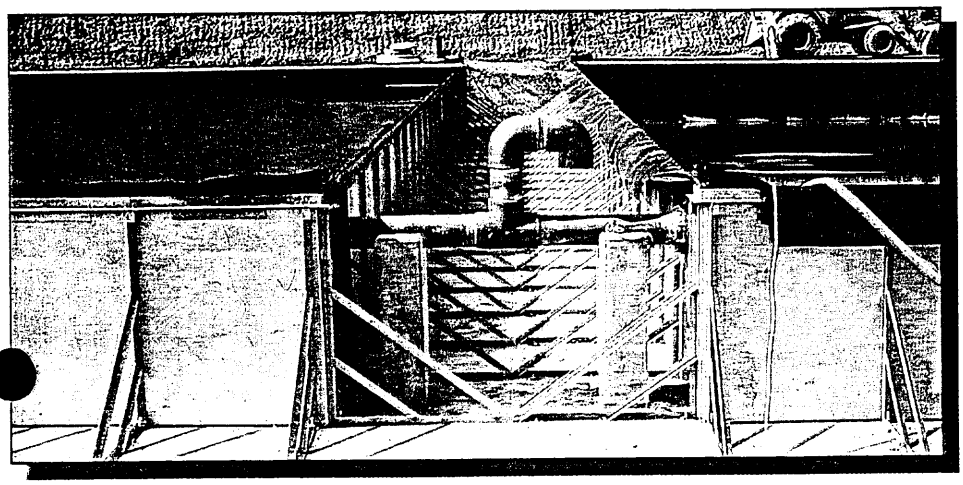
PVC (POLYVINYL CHLORIDE)
20 mil and 30 mil materials providing broad chemical resistance.

Other materials can be provided which meet requirements for high temperature, arctic environments, gasoline resistance, potable water etc.

Typical applications for membrane liners include: replacement liners for existing tanks; secondary containment barriers for hazardous waste; surface impoundments; spill containment, waste disposal; leachate collection, waste water treatment, and sewage lagoons; industrial and municipal storage and treatment ponds.

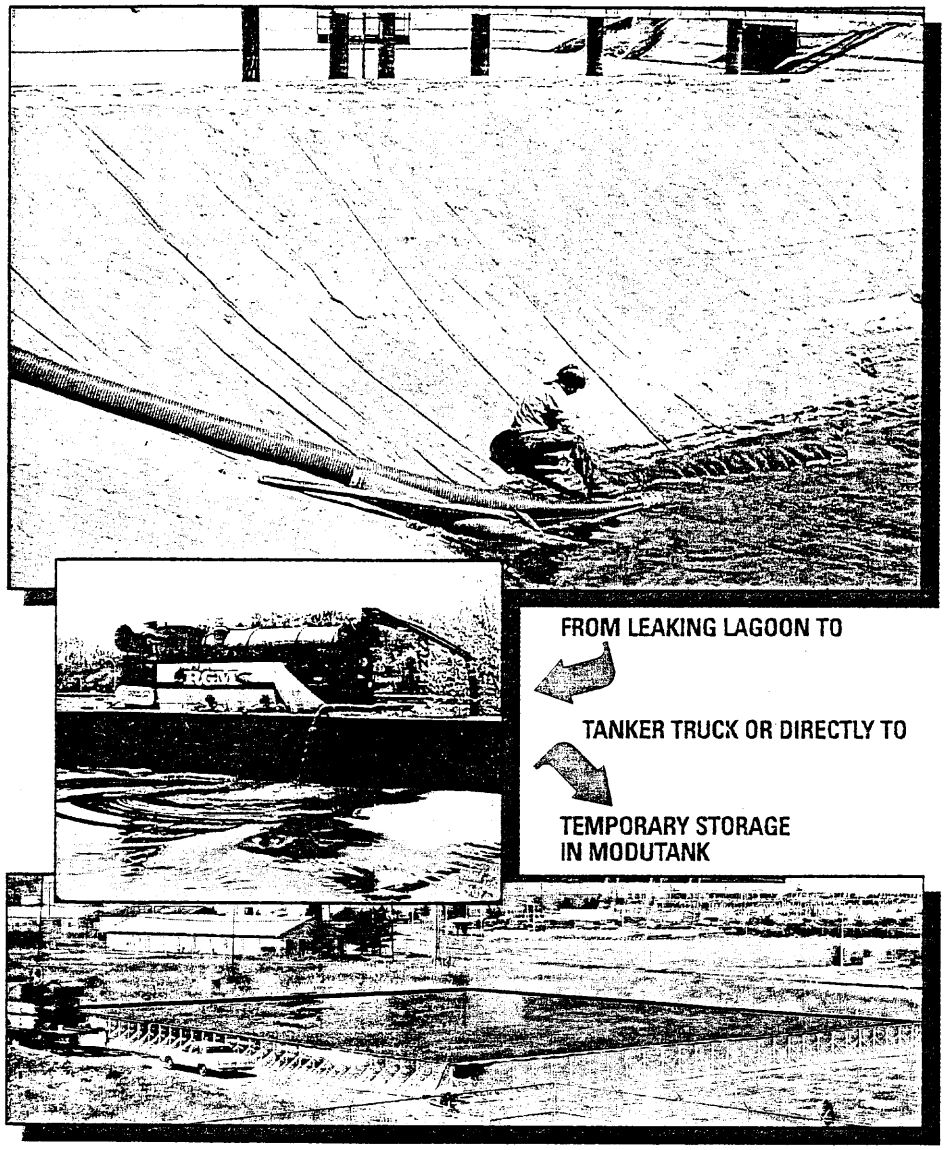
Factory fabricated liners are "accordion folded" and rolled to facilitate installation. They are packed in sturdy crates or wrapping to ensure undamaged arrival. All field seams are vacuum tested.

Land Fill Leachate



The low-cost, rapidly assembled ModuTank is well adapted for land fill leachate collection on a temporary, semi-permanent or long-term basis. Fitted with a double 60 or 80 mil HDPE liner with leak detection and floating covers, the facility can be flexibly configured for virtually any site in capacties up to two million or more gallons. Flanges, bulkhead fittings and other required piping connections can be specified as needed.

Above Ground Lagoons



Low-Cost Temporary Storage For Cleanup

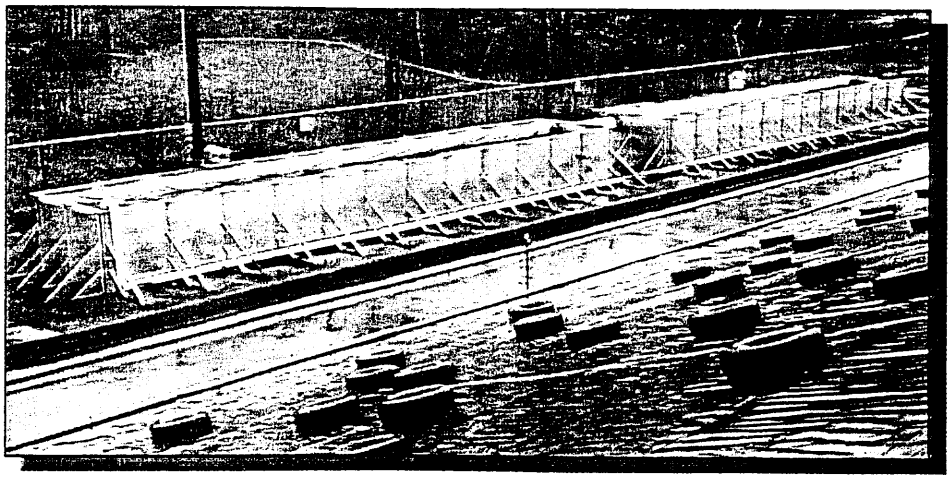
As a practical response to the closure or shut-down of existing ponds or lagoons for repair or replacement, ModuTank Inc. offers standby EconoTanks for the transfer and temporary storage of sludge, water or other liquids. While designed for temporary use, EconoTanks for this purpose can also be retrofitted later for longer-term general liquid storage.

- **ABOVE GROUND LAGOONS**
- **LOW IN COST**
- **RAPID BOLT-TOGETHER FROM INVENTORY**
- **QUICK SHIPMENT FROM INVENTORY**
- **EASY KNOCK-DOWN FOR STORAGE OR RELOCATION**

RENTAL PLAN

Our rental plan is tailored for shorter-term primary or secondary containment. It features low-cost, bolt-together EconoTanks and QuickStors in modular capacities from 20,000 to 1,000,000 gallons, and greater.

Ground Water Runoff



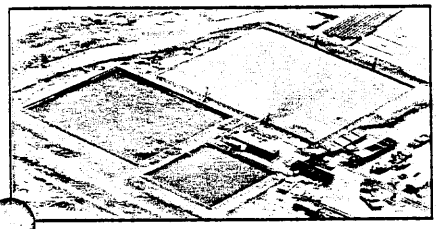
Serving as environmental safeguards, ModuTank Inc.'s heavy-duty, relocatable systems are available for the collection, holding and treatment of contaminated run-offs from rainfall or upwelling ground water. Equipped with suitable liners and inlet/outlet piping connections, these inexpensive tanks can be rented or purchased in an unlimited range of modular capacities and variety of rectangular shapes.

Typical Case Histories

Low-Cost Answer to Drilling Mud Pollution*

Problem - Drilling mud used to lubricate drilling bits during oil exploration was normally dumped into local waterways or otherwise discarded at the site after use. Increasing costs of the special muds and EPA restrictions against ground and water pollution necessitated practical containment for treatment and recycling.

ModuTank Inc. Solution - Three ModuTank storage tanks with Hypalon liners were installed - 500,000, 300,000 and 100,000 gallon units in respective capacities. Spent drilling mud is now pumped from the drilling rig to the larger collecting tank, and is introduced in measured volumes for settling in the mid-sized unit. The fluid then passes through a newly engineered treatment stage, and when processed enters the smaller tank, ready for reuse.



"Overnight" Response Curbs EPA Penalties*

Problem - Oil spillage into a local river was subjecting a New York State company to steep environmental penalties of $70,000. A proposed oil/water separation system installation was restricted by a narrow site between a building and roadway. Speedy resolution of the situation was essential.

ModuTank Inc. Solution - The company's consulting engineer phoned on Friday, requesting a budget price for a customized 34,500 gallon ModuTank with a fitted, reinforced, oil-resistant flexible membrane liner with integral baffles. The tank was ordered on Monday, shipped Wednesday, received next day, and fully installed in eight hours by five workmen with simple hand tools. By Saturday, the 19' x 53' ModuTank was fully operational in a tight location on a site requiring minimum preparation.

Urgent New Capacity in 48 Hours*

Problem - Existing capacity to safely contain contaminated wastewater was suddenly overwhelmed by a surge of new business. More storage facilities were needed virtually overnight to conform with environmental regulations.

ModuTank Inc. Solution - Within 48 hours of the order, the crisis was answered by a 155,000 gallon tank with a flexible HDPE liner, trucked by direct route to the trouble spot. Arriving in the morning, the prefabricated parts were easily unloaded by hand and the system was bolted together in about five hours by six workmen. Installed on an existing asphalt surface, the 68'-0" square x 4'-9" deep tank was in service that afternoon. The installation successfully answered the company's urgent needs for supplementary storage.

L-Shaped Tank Conforms to Irregular Area*

Problem - A major chemical company required 1,000,000 gallons of effluent emergency storage. The only available site was irregular in shape and could not accommodate the standard square or rectangular configuration.

ModuTank Inc. Solution - An "L" shaped ModuTank with double membrane liners was custom designed and nstalled on the site on a turnkey basis.

Temporary Storage for Site emediation*

Problem - Sludge from a coal liquification process contained in a claylined pond was leaking hydrocarbons into a waterway and was threatening the local ground water supply. A serious environmental hazard existed.

ModuTank Inc. Solution - The company's contractor recommended and specified two ModuTanks, with a total capacity of 330,000 gallons, for temporary storage of sludge during site remediation. Although the original plan was to scrap the tanks after they had served their purpose, the plan was changed. Impressed with the ModuTank's functional advantages and speed of installation, the utility assigned the contractor to disassemble the units, clean their oil-resistant flexible membrane liners, and warehouse them for future applications.

Relocation for Capacity Needed Elsewhere*

Problem - A government agency required a 500,000 gallon hazardous waste water storage tank for a Massachusetts Superfund site. At the same time a 300,000 gallon ModuTank purchased previously by the same agency was no longer needed at a Superfund in Ohio.

ModuTank Inc. Solution - The 300,000 gallon ModuTank was dismantled and shipped to the new site. Additional ModuTank components were supplied and the tank reconfigured to the 500,000 gallon capacity.

15 Tanks, Where Needed, As Needed*

Problem - An economical means of providing reusable, relocatable, easily assembled hazardous waste holding tanks was sought by a major waste treatment company.

ModuTank Inc. Solution - Fifteen ModuTanks, each having a capacity of 50,000 gallons were supplied to the company's various branch locations. These were then deployed as needed and subsequently relocated to other sites as required, thereby providing logistic flexibility.

Flexible Answer for Groundwater Runoff

Problem - Spent de-icing fluid flushed over aircraft at a major international airport posed a pollution hazard. A means of collection, storage and disposal was urgently required.

ModuTank Inc. Solution - A series of low-cost ModuTanks, with 1.2-million gallons in total capacity, was strategically stationed to safely contain the fluid. The first four of the facilities were shipped within 72 hours of the order and delivered to the site 24 hours later. Owing to their modularity, the ModuTanks were conveniently disassembled and later transported to other locales at the airport for similar service.

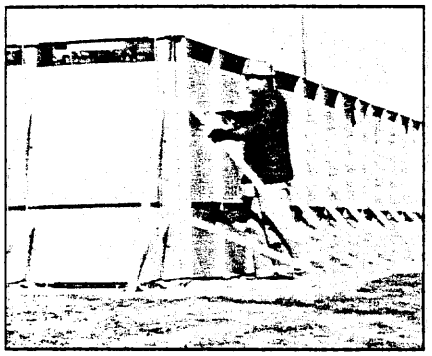
**Subject companies have requested their names be withheld to preserve confidentiality.*

Typical Case Histories

4,500,000 Gallons for Municipal Sludge Treatment*

Problem - A process for safely transforming municipal sewage sludge into organic fertilizer depended on durable, long-lived holding tanks. Equally important were cost-effectiveness, fast shipment, and quick and easy field assembly.

ModuTank Inc. Solution - During a three-phase, four-year program, the municipality installed three ModuTanks: one with 500,000 gallon capacity and two with 2,000,000 gallon capacity each. Both larger tanks were priced at less than 12¢ per gallon, and each were up and functional in under two weeks.



Resources for Leachate Collection*

Problem - Providing temporary leachate collection from land fills during treatment plant construction was a priority need. Supplying such facilities rapidly and at relatively low cost was equally crucial.

ModuTank Inc. Solution - Retained by a consulting company in behalf of two of its clients. ModuTank Inc. quickly manufactured and shipped the specified tanks: two 250,000 gallon facilities to each of two different locations. All four tanks were furnished with double 60-mil, HDPE liners with leak detection and HDPE floating covers.

Seismic 4 Tanks for Quake Survival*

Problem - Earthquake zones pose substantial hazards to containment systems which, accordingly, must be engineered and built to withstand the shock and stress of earth tremors. Such installations required tanks designed and manufactured to rigid Seismic 4 specifications.

ModuTank Inc. Solution - Meeting or exceeding all Seismic 4 requirements, 20 tanks in capacities from 30,000 to 1,100,000 gallons have been supplied. Our reliable, heavy-duty facilities are today in service in California, Utah and Washington, and Colorado.

3,000,000 Gallons in 8 Days*

Problem - Negotiations to purchase a large refinery were nearly concluded, but the buyer - a major remediation company - faced a critical snag. The plant's start-up was impossible without adequate effluent holding facilities on site. Containment was needed on a "crash" basis. With a pending threat of costly operational delays, the new owners turned to ModuTank for an immediate response.

ModuTank Inc. Solution - Within 8 working days, two 1,500,000 gallon tanks were manufactured, shipped and received. Within one week, the tanks were on line. Although purchased as "temporary" solutions, at last report 1-1/2 years later, both ModuTanks remain in successful service.

Secondary Containment Complexity Solved*

Problem - Two existing 15,000 gallon chemical storage tanks were mounted in tandem on concrete saddles over exposed ground. Immediately safeguarding the neighboring area against spillage from possible tank ruptures was the customer's preemptive concern.

ModuTank Inc. Solution - After a thorough study of the tanks' footing arrangements, a customized ModuTainer with 25,000 gallon capacity was installed. Without disturbing the 25-ft. long tanks' positions or operation, the ModuTainer's protective liner was precision-cut on site, then fitted and attached around the saddles with watertight seals.

Rental for Emergency Standby*

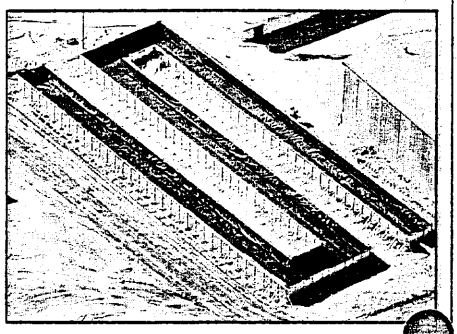
Problem - Large storms predicted for the fast-approaching stormy season could cause a possible overflow from a large hazardous waste storage pond.

ModuTank Inc. Solution - In less than 48 hours after receiving the rental order, a 1,000,000 gallon EconoTank was in shipment to the customer. Assembled near the waste storage pond to which it is linked by a pumping system, the facility secures the site by providing temporary containment for potential spillover.

Modular Shape Meets Process Criteria*

Problem - A demonstration project for innovative wastewater treatment process required two 800-ft. chlorine contact tanks, each handling a flow rate of one-million gallons per day. Linear tanks would be unacceptably long and less convenient to monitor.

ModuTank Inc. Solution - Cost-efficient S-shaped units were easily customized through the modular capabilities of ModuTank's flexible design concept. Two "folded" tanks were rapidly bolted together on location from prefabricated steep panels. Regarded as "ideal" for the demonstrations one-year phase, the tanks occupy readily-accessible compact sites adjoining the chemical handling building.

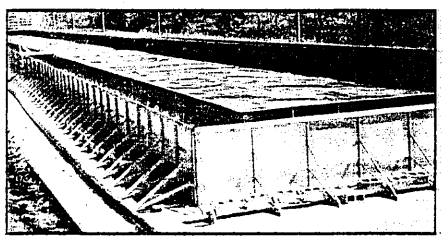


Tight Fit for Secondary Containment

Problem - The plant structures of a major chemical producer left an unusually narrow corridor for providing storage and secondary containment for 900,000 gallons of corrosive, hazardous wastes. Time was of the essence.

ModuTank Inc. Solution - Employing modular panels, a "form fit" ModuTank closely nested in a ModuTainer - both HDPE-lined - was simply and easily installed on the challenging site with ordinary hand tools.

With rapid bolt-together assembly, the facility was securely on-line to meet critical operating schedules.



**Subject companies have requested that names be withheld to preserve confidentiality.*

Applications & Installations

CHEMICAL STORAGE

Hydroflurosilicic Acid
Liquid Alum (Aluminum Sulfate)
Miscellaneous Organics
Phenolics
Phosphoric Acid
Plating Chemicals
Proteins
Sodium Hydroxide
Sodium Hypochlorite
Sulfuric Acid
Water Treatment Polymers

SEWAGE AND WASTE WATER

Brine
Chemical Processing Wastewater
Emergency Response and Clean Up
Food Processing
Industrial Sludge
Metal Processing Wastewater
Metal Recycling Wastewater
Mining Wastewater
Municipal Sludge
Municipal Wastewater
Oil & Gas Drilling Mud
Pharmaceutical Wastewater
Pipeline Purge Water
Plating Wastewater
Pump Test
Radioactive Runoff Water
SO2 Scrubber Feed
Storm Water Runoff
Textile Processing Wastewater

OTHER APPLICATIONS

Aeration
Anaerobic Digester
Aquaculture
Arctic/Antarctic Storage
Bioremediation
Cooling Tower Water
Earth & Solids Containment
Equalization
Evaporation
Fire Protection Water Storage
Irrigation Water
Land Application Sludge
Liquid Spill Containment
Oil/Water Separation
Potable Water
Secondary Containment Dike
Solar Energy
Thermal Storage

INDUSTRIAL COMPANIES

Advanced Microdevices
Aerojet General
Alcoa
Allied Corp.
American Banknote Co.
American Can Co.
American Cyanamid
American Natural Resources
AMFAC
Anheueser-Busch
Appleton Paper
Arco
Arizona Chemical
Armak
Asarco
Asea Brown Boveri
Ashland Chemical
AVCO
Baker Performance Chemicals
Bethlehem Steel Corp.
Bio-Gro Systems
Boeing
Borden Chemical
Brush Wellman
Burlington Industries
Canadian Harvest
Cargill
Cavenham Forest Products
Chevron
Chrysler
Coastal Corp.
Conoco
Consol Inc.
Coyne Chemical
Crown Zellerbach
Cummins Engine Co.
Davoe & Raynolds
De Gussa Corp.
Deere & Company
Digital Equipment
Dixie Equipment
Dow Chemical (Canada)
Dow Corning
DuPont
DuPont-Merck
E-Systems
Eagle-Pitcher Industries
Engelhard Corp.
Enviro-Gro Technologies
Essex Group
Estee Lauder, Inc.
Ethyl Corp.
Exxon
Federal-Mogul
Firestone
Ford Motor Co.
Frontier Refining
Gabriel
General Electric
General Motors
Geon
Goodrich
GPU Nuclear Corp.
Grow Inc.
GTE
H.B. Fuller
Henkel Corp.
Hilton Hotels
Holly Farms
Hooker Chemicals
Hughes Aircraft Co.
IBM
Inland Steel
International Flavors & Fragrances
International Paper
International Pigments & Colours
ITT
Johns Manville
Johnson Controls
Kaiser Aluminum & Chemical
Kennetech
Kerr-McGee Corp.
Kimberley Clark
Lake Electric
Laporte, Inc.
Lockheed
Loral
LTV Steel
Lubrizol
Mallory
Marathon Petroleum
Martin Marietta
McDonnell Douglas
Mobay Corp.
Mobil Oil Corp.
Monroe
Monsanto
Morton International
Naico
Nevamar
NL Industries
Noranda
Northwest Airlines
O.M. Scott
Occidental Chemical
Olin
Pepsico
Phillips Petroleum
Pilgrim's Pride
Polaroid
Polysar Energy & Chemical
PPG
Quantum Chemical
Questar
Revere Copper
Reynolds Metals
Rockwell International
R.R. Donnelley & Sons
Shell Chemical
Sonoco Products
Southern Pacific
Square D
Stauffer Chemical
Steelcase Inc.
Stone Container
SWS Silicones
T. Marzetti & Co.
Tandy
Teledyne
Tenneco
Textron
Thiokol
Thomas Betts Corp.
3 M Company
TRW
Turning Stone Casino
U.S. Steel
Unisys
United Technologies
Vulcan Chemical
Warner-Lambert
W.R. Grace
Westinghouse Corp.
Weyerhaueser
Witco Chemical
Xerox
York International

HAZARDOUS WASTE COMPANIES

Arecon
AWD Technologies
Bioremediation Inc.
Bird Environmental
Browning Ferris
Canonie Environmental
Carbon Air Services
Cecos International
Chemical Waste Management
Chempro Environmental
Clean Harbors
Conti Environmental
E.A. Science & Technology
Ecology & Environment
ENSCI
Enserch
Ensite
Envirogen
Environmental Solutions
ERM
Four Seasons Environmental
Geo-Con
Groundwater Technology
GSX Services
Handex
Haztech
Heritage Environmental
ICF Technology
ILWD
IT Corp.
Keystone Environmental
Kimmins International
Laidlaw Engineering
Law Environmental
Maecorp
Mathes Associates
Merit Environmental
Metropolitan Environmental
Moretrench
Ogden Environmental
OHM
Radian Corp.
React Engineering
Remcor
Rollins Environmental
Rust Remedial
Safety-Kleen
SCA Chemical Services
SEC Donahue
Sevenson Environmental
Tricil Environmental
USPCI
VFL Technology
Waste Management
Williams Environmental
Zecco Inc.

Applications & Installations Cont.

ENGINEERING/CONSTRUCTION/CONSULTANTS

Arthur D. Little, Inc.
Babcock & Wilcox
Batteile Memorial Institute
Bechtel
Blasland, Bouck & Lee
Brown & Caldwell
Brown & Root
Burgess & Niple
Camp Dresser & McKee
CH2M Hill
Chester Engineers
Consoer, Townsend & Associates
Dames & Moore
Dravo
Ebasco
Ecology & Environment Inc.
EG&G
Emcon
Engineering Science
Ensafe
ENSR
Fluor/Daniel
Gannett Fleming
Golder Associates
Guy F. Atkinson Co.
GZA Geoenvironmental
Halliburton Services
Harding Lawson
Holmes & Narver
Hydro-Search
ICF Kaiser Engineers
Jacobs Engineering
James M. Montgomery
Jim Baker Inc.
McLaren/Hart
Mercury Consolidated
Metcalf & Eddy
Michael Baker Jr. Inc.
Morrison Knudsen
O'Brien & Gere
Pacific Nuclear Services
PRC Environmental Management
Rizzo Associates
Roy F. Weston Inc.
Rust Engineering
SCS Engineers
URS Consultants
Woodward/Clyde
Zurn

UTILITIES & PUBLIC AUTHORITIES

Alabama Power (AL)
Alaska Power Authority (AK)
Alaska Village Electric (AK)
Alyeska Pipeline Service (AK)
Amador Water Agency (CA)
American Electric Power
Arkansas Nuclear 1 (AR)
Avondale Sewer Authority (PA)
Big Rivers Electric (KY)
Bridgeport Hydraulics (CT)
Bridgewater Power (NH)
Chelan County PUD 1 (WA)
Cleveland Electric Illuminating (OH)
CNG Transmission (WV)
Connecticut American Water (CT)
Consolidated Edison (NY)
Dayton Power & Light (OH)
Delta Diablo (CA)
Douglas County PUD (WA)
Downington Water Authority (PA)
Duke Power (SC)
Erie-Western Pennsylvania Port Authority (PA)
Florida Progress Corp. (FL)
Georgia Power (GA)
Hackensack Water Co. (NJ)
Hartford Water (KY)
Houston Lighting & Power (TX)
Jacksonville Electric Authority (FL)
Jersey Central Power & Light (NJ)
Knox-Chapman PUD (TN)
Le-Ax Water District (OH)
Long Island Lighting Co. (NY)
Lynden Water (WA)
Massachusettes Water Resource Authority (MA)
Mississippi River Transmission Corp. (MO)
Mobile Water Service (AL)
Montenay Power (FL)
Monterey Peninsula Water (CA)
Northeast Knox Utilities (TN)
Northeast Utilities (MA)
Northeast Pipeline Corp. (WA)
Northern States Power
Ohio Edison (OH)
Ontario Hydro (CANADA)
Pacific Gas & Electric (CA)
Panhandle Eastern Pipeline Co. (TX)
Philadelphia Water Dept. (PA)
Philadelphia Electric (PA)
Potomac Electric Power (DC)
Public Service Electric & Gas (NJ)
Public Service of New Hampshire (NH)
Rochester Gas & Electric (NY)
Santa Ana Watershed Authority (CA)
South Lake Tahoe PUD (CA)
Tennessee Gas Pipeline (TN)
Texarkana Water Utilities (TX)
Texas Eastern Pipeline (TX)
Texas Utilities Generating Co. (TX)
Virginia Electric & Power Co. (VA)
Washington Natural Gas (WA)

GOVERNMENT AGENCIES

Air National Guard (PA)
Dept. of Environmental Conservation (AL)
Dept. of Natural Resources (WI)
Massachusetts DEP
Maryland Environmental Service
NASA
New Jersey DEP
New York DEC
Oregon Dept. of Fish & Wildlife
Pennsylvania DOT
US Army (Corps of Engineers)
US Dept. of Energy
US Fish & Wildlife Service
US Forestry Service (USDA)
US Navy
VT Environmental Conservation Agency

RESEARCH FACILITIES

Anarctic Support Associates
Argonne National Laboratories
Brookhaven National Laboratory
Draper Laboratory
Los Alamos National Laboratories
National Science Foundation
North Carolina State University
Oak Ridge National Laboratory
Space Biosphere
University of Alaska
University of Arizona
University of Buffalo
University of California
University of Maryland
University of Mississippi
University of North Carolina
University of Washington
University of Wyoming

MUNICIPALITIES

Brookhaven, New York
Cortez, Colorado
Danville, Kentucky
Dearfield Beach, Florida
Decatur, Illinois
Glasgow, Kentucky
Glouchester, Massachusetts
Haledon Boro, New Jersey
Hanover County, Virginia
Ipswich, Massachusetts
Jones Borough, Tennessee
Joplin, Missouri
Klamath Falls, Oregon
Medina, New York
Middletown, New York
Mishawaka, Indiana
Monroe Township, New Jersey
New Shoreham, Rhode Island
New York City, New York
North Glenn, Colorado
Olathe, Kansas
Pittsville, Maryland
Richmond, Kentucky
Salisbury, Maryland
San Diego, California
Sedalia, Missouri
Sheboygan, Wisconsin
Sheffield, Alabama
Summit County, Ohio
Syracuse, New York
Valparaiso, Indiana
Wayland, Massachusetts
Winchester, Kentucky
Xenia, Ohio

ModuTank Inc.
41-04 35th Avenue, Long Island City, NY 11101

ADDRESS CORRECTION REQUESTED

APPENDIX C

LETTER OF SUPPORT FO THE UNDERTAKING

October 01, 2001

Department of the Environment

To Whom It May Concern:

In order to meet the guidelines established by CEPA with respect to protecting the environment from harmful release of glycol into our natural waterways, airports across Canada have established Glycol Mitigation Plans. Each plan is specifically tailored to meet the demands of individual airports. Airline operators and Service Providers involved in de-icing operations are all voluntary participants in these plans. Glycol mitigation is tracked on a regular basis and corrective measures are implemented to address any immediate issues. Yearend meetings are held to review the success of the plan and recommendations for change are tabled. In recent years we have had to deal with increased volumes of effluent, which require costly collection and disposal methods. As a result, one such recommendation has been to implement on site glycol recycling at airports. Airport Authorities in Ottawa, Vancouver, Halifax and St. Johns are supporting our efforts to put this technology in place. To meet this objective we enlisted the services of Inland Technologies who have developed a proven method for removing glycol from effluent captured during the de-icing process. In most cases the distillate produced in this process is below the CEPA guideline of 100PPM. The remaining high concentrate is then sold to secondary markets for reuse.

In my capacity as both chairman of the AOC De-icing Sub Committee for Airports and Manager, System De-icing for Air Canada I fully support this initiative. Not only do airlines operating in Canada receive the benefit of reduced disposal costs - more importantly it has enabled us to establish a means for improving glycol waste management. By securing local sanitary agreements to compliment this process we significantly reduce glycol handling and trucking operations. Reuse of the processed fluid means less glycol concentrations requiring treatment. I remain committed to supporting on site recycling of glycol given the obvious economic and environmental benefits.

Yours truly,

Lou Grenier – Manager, System De-icing & Winter Operations Air Canada

APPENDIX D

ADDITIONAL APPROVALS AND PERMITS REQUIRED

Appendix D

Applications for the following approvals and permits for the proposed Inland Glycol Concentration Facility are presently in progress:

1. Environmental Approval in accordance with the Activities Designation Regulation - Nova Scotia Department of Environment and Labour.

2. Approval for Distillate Stream Discharge into the Sanitary Sewer System - Halifax Regional Municipality.

3. Building and Development Permits - Halifax Regional Municipality.

4. Engineering Street Services Permit - Halifax Regional Municipality.

APPENDIX E

OPERATIONS MANUAL

OPERATING AND MAINTENANCE MANUAL

AIRCRAFT DEICING FLUID CONCENTRATOR

INLAND TECHNOLOGIES CANADA INC.

Revision #7
August 3, 2001

Table of Contents

1.0 DESCRIPTION OF SYSTEM AND OPERATING PRINCIPLES 1

1.1 Introduction 1
1.2 Overview of System Operation 1
1.3 Operating Sequences 3
1.4 ADF Concentrator - Component Details 4
1.4.1 Plate Heat Exchanger 4
1.4.2 Cyclone 4
1.4.3 Heater Tank 5
1.4.4 Concentrate Pump 6
1.4.5 Distillate Tank 6
1.4.6 Distillate Pump 6
1.4.7 Economiser 7
1.4.8 Desuperheating System 7
1.4.9 Desuperheating Pump 8
1.4.10 Blowers 8
1.4.11 Secondary Cyclone 9
1.4.12 Feed System 9
1.4.13 Feed Valve 10
1.4.14 Air Venting 10
1.4.15 Safety Valve 10
1.5 Control Loops 10
1.5.1 Blower Speed 10
1.5.2 Plate Level 11

2.0 PRE-START CHECKS AND DAILY MAINTENANCE 12

3.0 START- UP AND OPERATION 14

3.1 Desuperheating Pressure Control 15
3.2 Vent Condenser 15
3.3 Distillate Discharge Rate Control 15
3.4 Distillate Recirculation Rate 16
3.5 Concentrate Discharge Rate 16
3.6 Stopping 17

4.0 SELECTION OF OPERATING PARAMETERS 18

5.0 ALARMS AND RESPONSE 23

6.0 TROUBLESHOOTING 26
6.1 Plate Heat Exchanger Level Cannot Be Maintained 26
6.2 Cyclone High Level 27
6.3 Stalling 29
6.4 Low Distillate Level During Heat Up 30
6.5 Low Level in Distillate Tank During Operation 31
6.6 High Level in Distillate Tank During Operation 31
6.7 High Glycol Concentration in Distillate 32
7.0 MAINTENANCE 33
7.1 Preventive Maintenance 33
7.2 Maintenance of Components 34
7.3 Cleaning of Heat Exchangers 34
7.4 Calibration of Flow Transmitters 35
8.0 SPARES LIST 37

Appendix 1 – ADF Concentrator with Scrubber

1.0 DESCRIPTION OF SYSTEM AND OPERATING PRINCIPLES

1.1 Introduction

The Aircraft Deicer Fluid (ADF) Concentrator uses a thermodynamic cycle known as vapour recompression to produce glycol of marketable concentration from dilute ADF recovered from the tarmac at points where aircraft deicing is carried out. ADF, as sprayed, consists of approximately 55% ethylene or propylene glycol plus minor amounts of inhibitors and surfactants. The recovered glycol is scavenged from the tarmac through gravity drains or by vacuum trucks. It is diluted by precipitation which it contacts on the surface of the aircraft or the tarmac and will also carry contaminants including dissolved runway deicing salts, grit, traces of fuel and lubricating oils, and other debris. The scavenged material is sorted according to its approximate concentration and stored in tanks until it is processed. This concentrator unit is designed to process 1000 litres per hour of feed at 10% glycol, producing glycol at 50% and clean water containing less than 1% glycol. The feed concentration can vary from 5% to 20%, requiring different operating parameters and producing at different rates.

1.2 Overview of System Operation

The initial heat-up of the ADF concentrator uses electric resistance heaters. Distillate, which is the clean water separated from the previously treated ADF feed, is heated and the heat transferred to the initial fill of feed liquid (dilute ADF) until all liquid in the entire system is at 95 to 97 °C. The blowers are then started to begin the vapour recompression cycle that drives the process. Shortly after start-up of the blowers, the heaters are turned off and the cycle works entirely from the heat of the recompressed steam, which is produced by compressing the steam evaporated from the feed liquid in the blowers. Recompressed steam at approximately 5psi pressure enters the heat exchanger and condenses at its equilibrium temperature of 109 °C. As it condenses, it heats the feed ADF, causing it to boil. The boiling point of the ADF would be somewhat higher than the steam temperature if the pressures were equal, but the differential pressure causes the steam to be hotter, making the heat flow from the steam to the ADF as the steam condenses. The heated ADF, steaming and foaming, flows from the plate heat exchanger to the cyclone where liquid fraction falls to the bottom of the cyclone while the steam carries out through the top of the cyclone to the blowers. The liquid in the bottom of the cyclone is either withdrawn as concentrate or recycled to mix with the feed stream as it enters the plate exchanger.

The steam from the cyclone is compressed by passing through three regenerative blowers connected in series. Desuperheating nozzle sprays a small quantity of hot distillate into the steam line at the blower inlets to keep the temperature within the required limits of operation of the blowers and convert the heat produced by the blowers (heat of compression and friction losses) into useable latent heat (steam). A secondary cyclone recycles excess desuperheating liquid to the plate heat exchanger-feed side, and helps to reduce glycol carryover to the distillate. The distillate from the plate heat exchanger and the concentrated glycol from the cyclone are both directed through a heat exchanger - economiser that simultaneously uses the energy from both discharge streams to heat the feed stream in an energy efficient counter current flow arrangement. The feed stream is filtered to remove grit and oil prior to being heated.

The thermal balance of the vapour recompression cycle is such that the system operates more easily and at a higher rate with lower infeed concentrations than at higher infeed concentration when yielding the same final concentration. The reason for this is the difference in the ratio of sensible to latent heat requirement at the different concentrations. Incoming feed must be heated to the boiling point (sensible heat requirement) and then the appropriate mass of water must be evaporated (latent heat requirement) to bring the remaining liquid to the desired concentration. At higher concentrations, there is less water to be removed by evaporation for a similar incoming volume. Therefore, there is less total steam production per litre of feed and the concentrator is required to work more efficiently. This means that any infeed temperature reduction due to cycling or thermal losses due to leaks or poor insulation can cause serious reduction in capacity or stall of the thermal cycle. In normal operation, the only energy input to the concentrator is the blowers. In the compression of the steam, not only is the pressure raised, but the temperature is raised to the superheat range by the heat of compression and the inefficiency of the blowers, which occurs as friction and adds to the total heat of the steam. The energy added to the steam is used to evaporate the desuperheating water, adding its mass to the total steam flow and making the steam mass flow condensing in the plate exchanger higher than the mass of steam that is being produced in the plate exchanger. This is necessary since the latent heat of evaporation of the feed liquid at the lower temperature and pressure is higher than the latent heat of condensation of the steam at the higher temperature and pressure. When operating in balance, the concentrator consumes only about one-tenth of the energy that would be used to boil off the liquid if the process was done by simple heating and evaporation.

The automation system uses a PLC and a PC interface to provide the operator access to operating data and allows keyboard access to control all automated aspects of the process.

1.3 Operating Sequences

The ADF Concentrator has the following modes of operation:

1. PRE-HEAT-The PRE-HEAT cycle raises the temperature of the unit and the fluid contents from ambient to a temperature near the boiling point in preparation for start of the blowers. The system uses the electric heaters H1 and H2 for this heat up, transferring the heat to the plate exchanger by the distillate in the system. Distillate is circulated using the distillate pump P2 during this cycle to ensure that the hot distillate completely warms the machine. This mode is entered upon selecting "start" and will continue until the PRE-START begins as the set point temperature is reached. The feed valve CV-1 opens at the beginning of the sequence and completely fills the plate heat exchanger and the cyclone up to its low- level switch LS-5. The concentrate pump P3 is used to circulate the feed from the cyclone to the plate through the heat up. An automatic timed heat up is available that will start the heat up cycle based on a date and time and hold it at a pre-set temperature but it will not allow advance to PRE-START until a zero code is entered in the menu. This allows the machine to be ready to start when the operator arrives for work.

2. PRE-START - The PRE-START mode is the phase, initiated on achieving the start temperature pre-set in the parameters, in which the blowers start but the heaters remain on. As the blowers ramp up to speed, a pre-set differential pressure is maintained until the cycle is established and the heaters shut off. This typically lasts from 5 to 20 minutes and terminates when the unit switches to RUN based on achieving a pre-set temperature at TC-5.

3. RUN is the operating mode of the unit during which it will accept feed and discharge distillate and concentrate of predetermined concentration under automatic control with a minimum of operator intervention.

4. SHUT DOWN is the controlled shutdown of the machine that prepares it for its next start by accumulating distillate and emptying concentrate prior to stopping.

1.4 ADF Concentrator - Component Details

This section describes the components of the concentrator and how they work. The reader should reference drawing B-401–Rev.8 Flow Diagram to see the relationship and identification of the components.

1.4.1 Plate Heat Exchanger

The heat exchanger is manufactured by Alfa Laval. Details on its assembly and maintenance are found in the Alfa Laval manual. This is used to boil the feed (ADF) using heat from the condensing of the compressed vapour (steam). The unit consists of a series of 109 vertical stainless steel plates held tightly in a structural frame. The plates are formed and gasketed to provide alternating chambers for steam and glycol between them. The total heating surface is about 1,000 square feet. In operation, the feed level is maintained at about 700 mm which is about ½ full. This is an apparent level because as the glycol solution boils, the plate fills with foam from the generation of steam bubbles. The foaming glycol passes into the top of the cyclone. The condensing steam (now called distillate) is discharged to the heater tank in the bottom of the cyclone.

Level of ADF in the plate heat exchanger is measured by a differential pressure transmitter (DPT-1). This signal displays on the operator screen and is also used as the process variable in the control loop that operates the feed control valve CV-1.

The temperature of the steam and ADF in the plate can be observed by temperature indicators TI-6 located on the steam inlet and TI-7 located on the ADF outlet. The normal range should see the steam temperature about 3.5° to 5°C higher than the ADF temperature. TI-9 located on the feed line will indicate the feed temperature of the feed leaving the economiser and entering the plate. In balanced operation, this temperature should be in range between 80° and 90°C.

1.4.2 Cyclone

The cyclone is the vessel used to separate the steam from liquid in the foam that is generated by the plate heat exchanger. The foam enters tangentially at the top of the cyclone and is subjected to high centrifugal force due to the rotational flow that is induced. The steam, being lighter, escapes to the centre where it travels vertically through the discharge toward the blowers.

The liquid impacts the wall of the cyclone and runs to the bottom where it is collected for discharge or recycled to the plate with the incoming feed.

The concentration of the liquid that is being collected at any instant is calculated automatically by comparing the temperature and pressure measured at the top of the cyclone (using temperature transmitter RTD-1 and pressure transmitter APT-2) with theoretical values for glycol solutions at the boiling point. This value is displayed on the operator screen as concentration and is used to determine if the glycol in the base of the cyclone should be discharged (above minimum concentration) or recycled (below minimum concentration) to the plate exchanger by combining it with the feed stream from CV-1.

The cyclone has a high and low level switch. The high level switch (LS-4) will alarm and stop the blowers immediately upon sensing level since it indicates a potential for the liquid being carried forward to the blowers. The low level switch (LS-5) will indicate on the screen immediately if the level falls below its position but the alarm will indicate only after a delay if the level is not regained within 2 minutes. This is to prevent the concentrate pump P3 from running dry without causing an alarm every time the concentrate discharge is cycled. This switch is also used to control the concentrate discharge valve SV-5 so that it opens when the level reaches the switch with a 15 second time delay to prevent switch chattering.

The cyclone has a bottom temperature sensor TC-5 located low in the vessel to give the temperature of the liquid collected in the base. This is used to determine the readiness of the unit for start-up when in the pre-heat mode. The cyclone is provided with drain and clean-out connections to allow it to be drained and cleaned. A sight tube (ST) is provided to observe the level in the cyclone.

Auxiliary connections to the cyclone provide for the recycle of recovered liquid from the blower #1 suction line (from drip-leg) a connection to the feed line through valve V19 which is kept closed during operation but which can be opened to allow the content of the plate to be drained or pumped through the cyclone at the end of the run or for cleaning purpose.

1.4.3 Heater Tank

The heater tank is directly below the cyclone and uses the same cylinder to form its walls. While it appears to be part of the cyclone, this appearance is deceiving since they are not connected. The heater tank houses the start-up heaters H1 and H2 which are 12 and 18 kW, 600V electric heaters used to raise the temperature of the unit until balanced vapour recompression can be established. It has a level switch (LS-6) to disallow the heater function if they are not covered with liquid preventing them from burning out. There is a time delay incorporated in the level switch function to prevent nuisance tripping of the heaters from turbulence. The heater tank collects the condensed steam from the plate exchanger. The inlet and outlet are arranged to keep it full. The liquid from the heater tank is called distillate and it discharges through valve V17, strainer and steam trap T-1 to the distillate tank.

1.4.4 Concentrate Pump

The concentrate pump P3 draws from the cyclone through strainer and valve V18. It is a magnetic coupled centrifugal pump with a Kynar plastic casing. It is used to recirculate concentrate to plate the plate heat exchanger through solenoid valve SV4 or to pump concentrate out through solenoid valve SV5 and the economiser- heat exchanger. This pump operates continuously whenever SV4 or SV5 are open. A flow transmitter FT3 located in the concentrate line after the economiser allows the control system to display and totalize the concentrate discharge flow.

1.4.5 Distillate Tank

The distillate tank is a surge vessel, consisting of a lower tank and upper vent chamber that holds the distillate between the heater tank and the distillate pump P2. It is equipped with three level switches, LS-1, LS-2, and LS-3, which indicate high, medium and low level, respectively. The distillate tank has a vent chamber coupled directly and mounted above it. It is vented to atmosphere. High level switch LS-1 is mounted on the upper tank. A sight glass is provided for level observation and the tank has a drain valve and temperature indicator TI-5.

The vent condenser, where used, is a stainless steel coil of tubing used to re-condense flashing vapours in the upper tank. This uses a side-stream of feed liquid as coolant and is manually regulated by adjusting a valve on the supply line to give effective results, reducing emissions of steam and other condensable gasses such as ammonia.

The level in the distillate tank is controlled by LS-2, the medium level switch. This switch, operating through a time delay circuit, switches valves SV1 and SV2 to select discharge or circulation of distillate. LS-2 level is commonly called operating level.

1.4.6 Distillate Pump

P2 runs continuously, re-circulating or discharging distillate through the economiser in both cases. The stream of distillate from the economiser is discharged when the distillate tank is above medium level (LS-2) or re-circulated to the distillate tank through the heater tank when the level is below LS-2. This provides a constant heat source in the economiser to the incoming feed, regardless of the distillate production rate or cycle. A flow transmitter FT-2 measures the distillate flow, displaying it on the operator screen. The discharge flow is totalled and recorded but the re-circulated distillate flow is provided for reference only. The re-circulating flow should be adjusted to approximately 13 litres per minute by adjusting valve V9. The distillate discharge flow can be adjusted by setting valve V6 and can be left

wide open but the best operation is achieved if it is set to provide a flow rate slightly in excess of the distillate production rate. This is determined by observing the frequency with which the distillate goes into re-circulation once the concentrator is operating at normal capacity. Recycling at intervals of less than five minutes indicates that the V6 is open too far. High level in the distillate tank indicates that it is not open far enough.

1.4.7 Economiser

The economiser is an arrangement of concentric tubes with the outgoing concentrate in the inner tube, the incoming feed stream in the annular space between the inner and middle tube and the distillate, outgoing or re-circulating, in the space between the middle and outer tube. This is arranged in a series of eight 12-foot runs. This allows simultaneous recovery of heat from distillate and concentrate in a counter-flow arrangement for the highest possible feed temperature increase.

The economiser is sensitive to water hammer in the distillate system. This can cause the collapse of the centre tube of the exchanger. To overcome this, a time delay is used to prevent the closing valve from closing until the opening valve is opened with flow established when SV1 and SV2 are switched. An air chamber shock absorber (standpipe) is also used to minimise the water hammer. It is essential that the stand- pipe be drained monthly to ensure their continued effectiveness. (See section 7.1)

1.4.8 Desuperheating System

The desuperheating system has two purposes. Its primary function is to inject sufficient distillate mist to keep the steam cool in the blowers. As vapour is compressed, its temperature increases. The result is superheated steam, which in the case of this unit would be at a temperature that is higher than the operating limit of the blowers. The mist is sprayed into the steam stream before and after each blower to keep the steam at its saturation temperature (110°C at 5 psi for example). The mist is produced by spraying the liquid through fine nozzles at 85 to 90 psi so that the particles will be small, allowing them to evaporate quickly and minimising any potential for erosion on the blower blades. The desuperheating water flow rate is fixed in excess of requirements by the size of the nozzles and the pressure of the diaphragm pump P-4.

The second purpose of the desuperheating spray is that it changes the equilibrium balance of the steam with reference to its glycol content, as the excess spray absorbs any residual glycol vapour, allowing it to be removed with the liquid. This results in significant reduction of glycol traces in the distillate.

1.4.9 Desuperheating Pump

The desuperheating pump is a Yamada air operated diaphragm pump (P4) connected to the distillate tank. This pump is supplied with air through a regulator that should be set at 85 to 90 psi. The air supply is always on with the operation of the pump controlled through action of the solenoid valve SV3 on air supply line which will open when any of the blowers reaches temperature indicating the requirement for desuperheating. This normally operates continuously after start-up. The suction of the pump is connected to the distillate tank. The pump is located within 1 ft of the low-level switch LS-3 to ensure a positive or minimum negative suction head. A strainer of min. 20 mesh on the suction side and filter on the pressure side of the pump are used to protect the desuperheating system from particles that may be in the distillate. This will require element replacement occasionally indicated by a pressure drop on the filter. That pressure drop should be less than 5 psi between PI-9 and PI-5. The desuperheating nozzles are extremely fine and must be protected from particles that can plug them.

1.4.10 Blowers

The three blowers are connected in series to achieve the total recompression required to gain adequate steam temperature. The blowers are AMETEK Rotron regenerative blowers powered by 20 hp, 3,600 rpm electric motors operating from variable frequency drives. The blower speed is controlled automatically from the control system to maintain a set differential pressure measured as the difference between pressure transmitter APT-1 located on the steam line at the entry to the plate exchanger and APT-2 located on the cyclone. Both of these values are displayed on the operator monitor as the differential pressure. Note that these are absolute pressure transmitters, which means that they do not reference the atmosphere but give the pressure above a perfect vacuum. When the unit is not operating, therefore, they will indicate atmospheric pressure (approx. 14.7 psi) and should read the same within 0.1 psi. The blower speed controls respond to the same pressure signal but the relative speed of each blower is adjustable by selecting a percent of the speed signal to which it will respond on the parameter page of the operator monitor. This allows the loads on the three blowers to be balanced. The balance is indicated by comparing the amperage draw of each motor as displayed on the monitor. Individual speed control can also be used to select operating conditions that minimise vibration or to reduce the speed of a blower that is running warmer than normal. Blower temperatures are monitored by the thermocouples mounted at their outlet ports (TC-2, TC-3, and TC-4). The blowers "must never exceed" temperature of 140°C, the manufacturer has recommended as absolute limit.

The blowers have drain valves on the bottom of each casing: V36, V37, & V38. These drains should be opened and all liquid released prior to starting the blowers. Blower #3 has its drain connected to a steam trap (T-2) which will continuously remove any liquid to the cyclone during operation. The blowers are insulated to prevent heat loss during operation.

1.4.11 Secondary Cyclone

The secondary cyclone is located in the steam line after blower #3. The purpose of the secondary cyclone is to remove liquid from the steam, draining it through V-25 to the feed side of the plates. The liquid results from excess desuperheating spray and contains glycol absorbed from the steam. The glycol enriched distillate drains from the cyclone through the steam trap T-3 to the feed line. This distillate typically contains more than 5% glycol. The drip leg on the suction line before entering the blower #1 performs the primary separation of the glycol mist carried over from the primary cyclone and the first desuperheating spray serving as the first stage distillate purifier. The drip leg drains by gravity to the primary cyclone through valve V-35.

During start-up heating, steam escaping through the top of the plate heat exchanger may condense in the secondary cyclone. If this is allowed to accumulate, level in the distillate tank will gradually fall during heat up what may cause the heating chamber to reach its low limit. To prevent this, a procedure described under section 8 of the pre-start checks connects the secondary cyclone to the distillate tank, for start-up only, to return this distillate to the distillate tank.

1.4.12 Feed System

The feed system of the unit provides filtered dilute ADF solution at 55 to 60 psi. This consists of a feed pump, pressure tank and filters. The filters should be monitored to ensure pressure at the entry of the economiser (PI-14) of at least 50 psi. Low pressures indicate plugged filters and may reduce the ability of the feed system to maintain level in the plate. The pressure pump should have its pressure controlled on-off switch adjusted so that the pump runs continuously during normal operation, cycling only if the feed rate is very low. This mode of operation avoids frequent stops and starts, which are hard on the pump, and provides the maximum consistent pressure, about 60 psi. The pump must cycle at low flows to prevent it from operating dead-headed, which would cause it to overheat. Feed pump, pressure tank and set of filters are not part of skid mount equipment.
The feed stream flow rate is measured using FT-3 flow transmitter. The flow rate is displayed on the operator monitor screen. A thermocouple TC-1 measures the outlet temperature of the feed and this value is also displayed. PI-12 indicates pressure at the control valve inlet. This should be about 2 to 5 psi during operation when the control valve is wide open and it will rise to the feed pump discharge pressure when CV-1 is closed.

1.4.13 Feed Valve

The feed control valve CV-1 is a ½" Powers globe control valve with equal percentage trim. It responds to a 4-20 milliamp signal from the control system analog output, which is converted by an I/P transducer to a 3 psi (closed) to 15 psi (open) air signal to operate the valve. The valve stem moves upward to open the valve. A maximum feed flow is established by a parameter setting to limit the flow into the unit so that the stability of the control is improved.

1.4.14 Air Venting

An automatic air vent AAV is provided at the high point of the steam inlet to the plate exchanger. This will vent air and mist during pre-heat and start up until air has been eliminated, after which it should stay closed. A manual air vent V23 is provided on the distillate line between the plate exchanger and the heater tank. This can be opened manually to vent air that may accumulate during operation but is normally not used.

1.4.15 Safety Valve

An ASME approved safety relief valve located on the steam line near its entrance to the plate exchanger provides protection against overpressure. This valve will relieve at 10 psig or 24.7 psia. The valve is located so that it serves the entire system. No valves exist between the heater tank and the safety valve, so that it can effectively protect the heater tank, plate exchanger, cyclone, blowers, secondary cyclone, and steam piping. The distillate tank is vented and requires no safety valve.

1.5 Control Loops

1.5.1 Blower Speed

The control system continually monitors the differential pressure between the cyclone and the heat exchanger steam side. The system will continually adjust the speed of the drives by examining the deviation from the desired operating differential pressure set point. The greater the error, the greater the system response.

Each of the drives may be throttled back from the "100%" speed calculated by the PID control block, through the parameter screen, with speed adjustments of 100%, 95%, 90% being typical adjustments for blowers 1, 2, and 3. The system will automatically compensate for the reduced loading that may be assigned to blowers 2 and 3.

During start-up conditions, the system will slowly adjust the internal operating set point, allowing the drives to approach full speed over a prolonged time span.

If the heat exchanger plate is in danger of running dry, the system will make additional temporary adjustments to the internal copy of the differential pressure set point, until the heat exchanger level is restored. A similar strategy is used if the cyclone pressure should drop below 11 psia. This will introduce a small stall into the system.

1.5.2 Plate Level

Plate level is maintained by examining the deviation from the desired operating set point. The mode of control is strictly proportional. That is, if the plate level is at the set point +10%, there will be no signal sent to the control valve, CV1. If the plate level is at the set point -10%, then the control signal will be at 100%, (to a maximum output flow defined in the parameters). There is a strictly linear relationship between level and control valve position.

The infeed flow limit parameter will restrict the maximum infeed rate to that specified in the parameter screen.

2.0 PRE-START CHECKS AND DAILY MAINTENANCE

Prior to starting the concentrator the following checks should be done:

1. Confirm path from feed tank to unit and from unit to concentrate tank (valves external to unit).
2. Check feed concentration and record. Adjust parameters as necessary.
3. Check pressure indicated by APT-1 and APT-2. They should read approx. 14.7 psia and within 0.1 psi agreement before the machine is started. If the difference is greater than 0.2 psi, the instruments should be checked and faulty replaced.
4. Check level in distillate tank to ensure that the level is near the top of the bottom section. This will ensure enough distillate to keep the electric heaters covered during the start-up cycle.
5. Drain the plate heat exchanger to allow a fill with fresh feed. Drain through the 1.1//2" ball valve at feed inlet flange and discard to a recycle tank. The primary cyclone level should also be checked. It should be at or near the low-level switch.
6. Confirm position of manual valves. - All drains closed, all other valves open except feed control valve, 1" valve between primary cyclone and the plate feed line (V-19).
7. Confirm that compressed air supply to the control valve is available.
8. Connect a hose from the drain valve DV23 at the bottom of the secondary cyclone to the drain valve DV21 at the bottom of the distillate tank, close the manual valve V25 that drains the secondary cyclone to its trap, and open the two drain valves V23 and V21. This allows condensation from the secondary cyclone to return to the distillate tank during heat-up.
9. On initiation, the unit will fill and pre-start automatically. Before the blowers start, drain each blower and return the drain from the secondary cyclone to its trap by opening the valve V25 to the trap and closing the drain valves V21 and V23 that are connected by the hose.
10. Open valve V9 controlling the rate of distillate recirculation to achieve a flow rate 14 to 15 l/min.

During operation, the operator should monitor the following:

1. Listen for abnormal sounds that could indicate bearing wear or other component failure.
2. Watch for leaks from all components that could release glycol to the drainage system.
3. Respond to alarms as indicated by the computer screen.
4. Check glycol concentration in the discharge streams (distillate and concentrate) periodically to ensure that the concentrator is operating within its prescribed limits.
5. Periodically check levels, temperatures, and flows for correlation with the displayed values.
6. Listen for water hammer when distillate solenoid valves close. Water hammer from this source can collapse the economiser tubes if it is not stopped. (Drain standpipe)
7. Check pressure before and after desuperheating filter to ensure minimum desuperheat pressure on the spray nozzles 85-90 psi at outlet pressure gauge PI-5.
8. Check feed pressure (50 psi minimum) on PI-14 after feed filters.

Make notes of any variances, observations or suggestions for improvement.

3.0 START- UP AND OPERATION

The start up and operation of the system is controlled by the PLC, requiring only initiation by the operator. Intervention is available to change operating limits and set points (see section 4.0). The operator will normally work with the screen that has a pictorial display of the unit. A completely manual run mode is also available to qualified operators, through a passworded screen that resembles the system flow diagram drawing, which can control all automated components individually using the computer mouse. **It is cautioned that manual operation may defeat some of the interlocks that exist in the automatic program and should only be attempted by operators who have a complete understanding of the process and equipment. It is important to monitor the concentrator closely when operating in "manual" and to return all components to "automatic" before leaving that screen.**

Automatic operation is initiated by selecting the start button on the operating screen using a left click of the mouse. The heat exchanger level should be set at 500 mm for start up and between 500 and 900 for operation unless experience dictates a more appropriate setting. The system will automatically go through a fill and heat-up cycle. This may also be selected as a time delay start with the operator selecting the time at which heat-up is to start and the temperature to which the unit will rise in preparation for start (97°). The heat-up should be generally scheduled to begin about two hours ahead of intended operation. To start the unit from the automatic heat-up sequence, the operator must enter a zero in the hold temperature block.

When the temperature in the cyclone reaches the "start-up temperature" (parameter controlled), the blowers will start and the cycle will begin. **Before the blowers start (at 2-3 degrees below start temperature), the operator must open the drain on all blowers to allow any accumulated condensate to be released.** Failure to drain the blower at start-up may result in the motor tripping out at high load and could result in damage to the blower. Air will be vented automatically through the thermostatic air vent at the top of the steam line feeding the plate heat exchanger.

The temperature at which the heaters shut off is determined by parameters. It is important to the economy of the operation that the heaters do not run for long after the blowers start, in order to keep the electrical demand charges minimised. The closer the system is to boiling point before the blowers start, the shorter the time that simultaneous operation of heaters and blowers will occur.

Blower speed is controlled automatically to maintain the desired differential set point. During normal operation with all three blowers set to run at the same percent speed, it is natural for a particular blower to run hotter and with a higher current draw than the blower before it. To achieve a more balanced load on the three blowers, parameters are provided to force the blowers to run at slightly different speeds while still maintaining the set point. For example: blower#1 would be set to run at 100% speed, blower#2 set to 98% speed and blower#3 set to 95% speed. This would tend to balance the load between the blowers. Observation and experience will dictate the best settings to use under different circumstances. See section 4.0.

3.1 Desuperheating Pressure Control

To control the desuperheating pressure, adjust the air supply regulator located near the pump. Open to achieve 85-90 psi on the pressure gauge PI-5 after the pump. This should be checked daily during normal operation and any time that blower temperature rises above normal.

3.2 Vent Condenser

The distillate tank is equipped with a vent condenser to minimise the venting of steam and odours into the room. This uses a portion of the feed stream, recirculated through the filters and the condenser coil by the feed pump, to cool and condense the flash steam. The valve on the 3/8" copper supply line should be opened until the best effect is achieved.

3.3 Distillate Discharge Rate Control

The rate of distillate discharge is controlled by valve V6, which can be manually adjusted. This valve can be left wide open but the best operation will be achieved if it is set to give a flow slightly in excess of distillate production rate. If the concentrator is operated with this valve wide open, the frequency at which it goes into distillate recirculation may be so high that the effect is to cool the distillate tank. This in turn will result in cooler feed being delivered to the plate because the economiser cannot work as efficiently in long periods of recirculation. The distillate flow rate should be set so that it is always greater than the distillate production flow rate but does not cause recirculation to occur at intervals less than five minutes. The valve adjustment is sensitive and the operator should make small changes when adjusting. It is always better to have V-6 too far open rather than too far closed if the adjustment is difficult. If the high level is reached on the distillate tank, it indicates that V-6 must be opened further. If the unit is going into recirculation at intervals

less than five minutes it indicates that V-6 is open too far. Proper balancing of this flow helps to keep the feed temperature constant and the concentrator operating at a steady rate. If the unit is to be left unattended for a period of time, the recirculation cycle time should be checked to ensure that it is in the range of 5 to 10 minutes at steady operation. Remembering that it is better too far open rather than too far closed.

When adjusting this valve, it may be useful to refer to the theoretical discharge rate, which can be calculated from the feed flow rate as shown on FT-1 and the initial concentration. For 50% concentrate, the theoretical distillate rate is equal to the feed rate multiplied by (1-2 x % feed concentration/100).

3.4 Distillate Recirculation Rate

The distillate recirculation rate can be adjusted manually by throttling valve V-9. On units that are piped to allow this flow to be measured by FT-2, the rate should be set to approximately 80% of the infeed rate, or 13-15 litres per minute. If the unit has been piped so that the recirculation rate of the distillate cannot be measured, open valve V-7 3/4 turn.

3.5 Concentrate Discharge Rate

The rate of concentrate discharge is controllable by manually adjusting valve V-10. This valve can be left wide open but best operation is achieved if it is set just in excess of the concentrate production rate so that a steady flow of concentrate is available to assist in heating the infeed in the economiser. This is not as critical as the distillate flow but will have a stabilising effect if it approaches a balanced condition. The flow rate is too high if the cyclone level falls frequently below its level switch. Operators may find that they can throttle V-10 (or V-11) to achieve a rate that is in balance with production such that the level is kept low but the low level switch cycling is very slow. It is most important to always keep this valve opened at least a little further than required so that the level in the cyclone does not build. The theoretical concentrate production rate at 50% concentrate production is equal to the feed flow rate multiplied by the percentage feed concentration divided by 50.

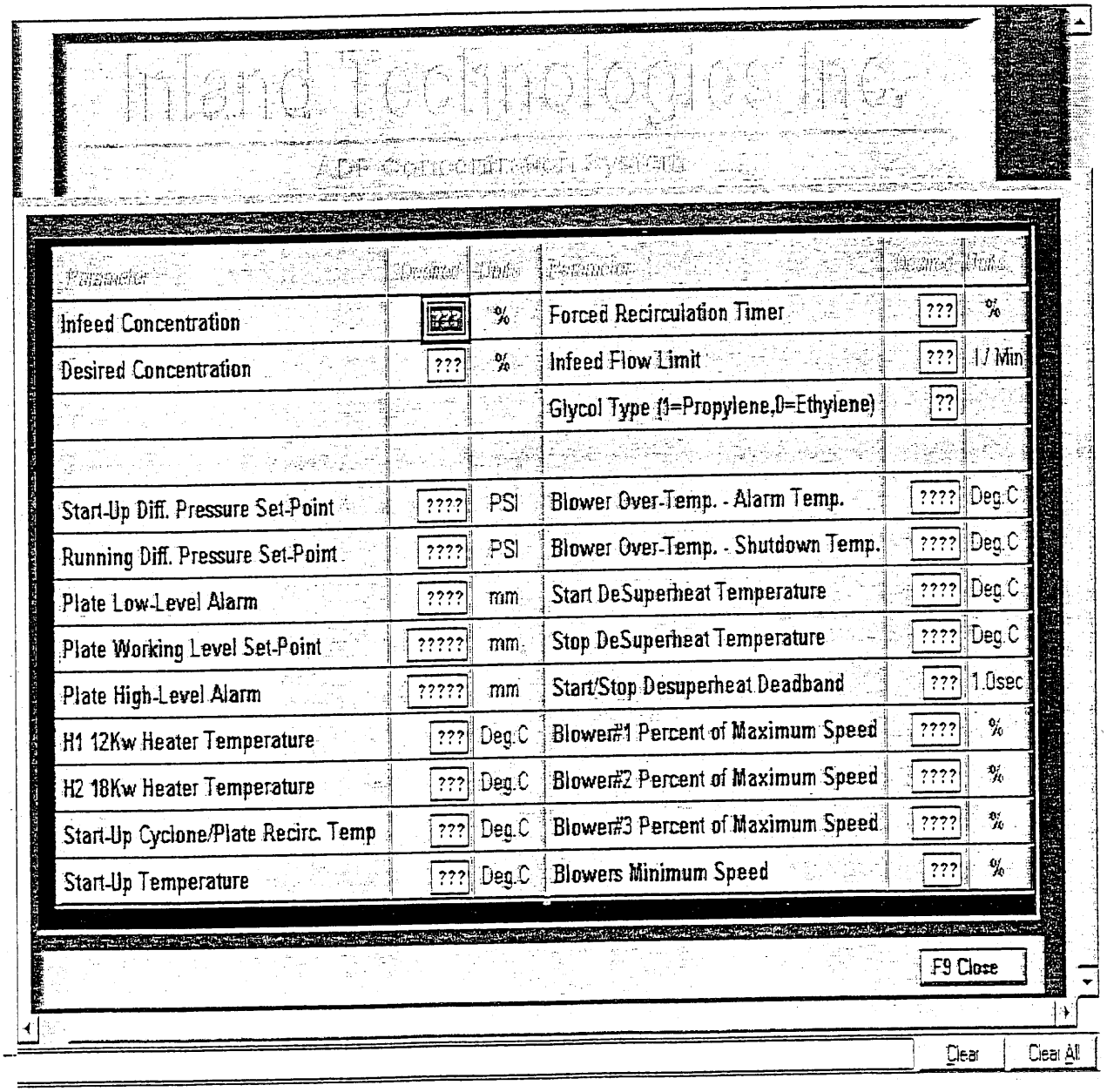
3.6 Stopping

The process is terminated by selecting the "stop" button on the screen. This will develop a distillate level suitable for the next start-up, stop the blowers, and pump down the concentrate in the cyclone if its concentration is in range. As much concentrate as possible should be removed at the end of each run so that the concentrator is starting with a high percentage of dilute feed at the beginning of the next run.

An emergency STOP button is located on the side of the control panel next to blower #1. This button will stop all controlled outputs, including pumps and blowers. It should not be used as a maintenance safety since it leaves power on all instrumentation circuits.

4.0 SELECTION OF OPERATING PARAMETERS

Various operating parameters are provided for control and monitoring of the concentrator. These parameters can be accessed by the "Set Parameters" selection on the main menu - or- by the "Parameters" selection on the concentrator display screen. The screen which is used to view/modify these parameters is shown below:



The white box to the right of the parameter description displays the current value of the parameter and is also where you can enter a new value. To enter a new value select the box in which you wish to enter a new value in with the mouse - or with <Tab> key (box you are working on will be highlighted in blue). Delete the old value and type new value - press <Enter> key.

Some of these parameters are protected and can only be changed by a person who has logged in with the proper level of security. Those parameters shown in the lower right part of screen are freely accessible by anyone.

Once the unit is in stable operation, adjustments should be made carefully with small changes, observing the effect of each change. In general, increasing the operating differential pressure can increase the concentration of the concentrate. Decreasing differential pressure will **lower** the concentration.

The following will give indication of the effects of the parameters and what their normal range of settings should be.

- Infeed Concentration - Input the value obtained from the refractometer test of the feed.

- Desired Concentration - This will select the range of concentration over which concentrate will be discharged. It is not an accurate value as it depends on the calculation of instantaneous concentration, which is only an approximation. It is a useful reference value; however, the control system uses it to determine the discharge cycle. While the nominal setting is 50%, this value should be adjusted upward or downward as required until the refractometer reading of the concentrate is in the required range.

- Start-Up Differential Pressure Set-Point - This is the differential pressure set point that the blower controls use to regulate the blower speed during start-up. It is normally 4.5 psi. This should be lowered if the blowers reach overload (high current) conditions during start-up.

- Running Differential Pressure Set-Point - This is the set point for the differential pressure during operation. This is a sensitive parameter and should be adjusted carefully with small changes that allow the results of a small change to be observed. This is normally in the range of 4.8 to 5.5 psi. Increasing the differential pressure raises the steam temperature and allows better heat transfer. It therefore has the effect of raising the throughput and the concentration level. It also will cause the blower speed to increase with increase in power consumption. Lowering the

pressure differential slows the blowers, drops the steam temperature, and reduces throughput. Lowering the differential pressure excessively can cause the heat exchanger to "stall" when it reaches a point that the boiling point of the ADF in the plate exchanger is so close to the steam temperature that no heat transfer takes place and the throughput reduces to a point that it cannot retain the thermal cycle.

- Plate Low-Level Alarm - This is the plate exchanger level at which the low-level alarm will activate, usually indicating that the feed system cannot supply enough feed. This would normally be set 200-300 mm. below the operating level.

- Plate Working Level Set-Point - This is the operating level set point in the plate that the feed valve will attempt to satisfy. It is normally set between 700 and 900 mm but may vary depending on feed concentration, foaming characteristics that may vary with the type of glycol and cleanliness of the feed, or other factors. Increasing the level will cause improved heat transfer and more foaming over to the cyclone. This can result in too much feed going through at too low a concentration, which will tend to flood the cyclone with low concentration. Too low a level can result in too little foam carryover in which case the feed will boil until it reaches a very high concentration but will not pass through to the cyclone and the system will appear to "stall". This can also result in fouling of the plate exchanger surfaces if it boils at a low level without a good circulation and develops a "scum line". Operating experience must be developed to define the factors that can optimise this parameter.

- Plate High-Level Alarm - This is the level at which the alarm will alert the operator to plate high level. This would be normally 200 mm. to 300 mm. above the operating level set point.

- H1 and H2 Heater Temperature Settings - These settings determine the temperatures below which each of the start-up heaters will operate. Above this temperature in normal operation they will remain off but if the temperature of the unit falls due to an upset condition, they will come on to assist the recovery of the thermal cycle. These will typically be set from 97°C to 101°C.

- Start-Up Cyclone/Plate Recirc. Temp. - This is the temperature at which the circulation from cyclone to plate using the concentrate pump will be initiated. Typically set at 70°C.

- Start-Up Temperature - The temperature at which the blowers will start as the unit heats up to temperature. This is normally at 96°C to 97°C. If this is set too low, the blowers will have a difficult time getting the cycle started. If it is too high, the heat-up time will be excessive.

- Forced Recirculation Timer - The percentage of time that the infeed valve CV-1 will be shut-off to allow for cyclone content recirculation. This parameter is used to assist in raising concentrate values and is normally set at 30%. This parameter has no effect once concentrate values are at the desired set point.

- Infeed Flow Limit - This parameter restricts the amount of infeed to the heat exchanger through CV-1. The normal setting is 20 litres/minute.

- Glycol Type - This parameter selects the type of glycol base in the ADF being concentrated. There are two glycol curves programmed into the controller. Select ethylene or propylene.

- Blower Over Temperature Alarm - This determines the temperature at which the operator will be alerted to a blower rising above normal temperature. It may indicate overloading or it may indicate lack of desuperheating water. This is normally set at 120°C to 125°C.

- Blower Temperature Shutdown - This is the temperature at which the blowers will shut down. This is done to protect their components from damage. The suggested range is 125°C to 130°C. The **never to exceed temperature** specified by the blower manufacturer is 140°C

- Start and Stop Temperatures and Deadband for Desuperheater Operation - These parameters define the temperature at which the desuperheating solenoid valve SV3 will open and close. This will normally open as the blowers reach operating temperature and would only shut off if the system stalled. The system must shut down when in stall or when the blowers are off to prevent sub-cooling of the steam or filling the blowers with distillate. This responds to whichever blower has the highest temperature.

- Blower #1, #2, #3 Maximum Speed - This allows the speed of each blower to be selected as a percentage of the maximum control input. This is used to balance the blower loads. Each blower contains progressively denser steam as it proceeds to compress on it way through the system. The horsepower required by each machine

at any given speed varies directly as the density. Typical settings for balanced load are Blower#1 - 100%, Blower#2 - 92%, and Blower#3 - 87%. The amperage draw of the blowers are displayed and can be used to verify the balancing of the load. Some load or speed combinations may be found to cause harmonic vibrations. If this occurs, a slight change in speed parameters can usually stop it.

- Blower Minimum Speed - This is the minimum speed below which the blowers will not operate. This is used to avert damage by operating the drives and motors in a range where cooling may not be effective. The normal setting is 10%. There is no reason for the operator to change this.

5.0 ALARMS AND RESPONSE

The PLC control system in conjunction with the PC based monitoring system provides monitoring of various operating conditions and parameters to alert the operator of alarm conditions.

These alarm messages are displayed individually at the bottom of the main operating screen at the time they are triggered. Also a list of all alarms which have been triggered can be displayed using the "Alarm Summary" function from the main menu screen. These alarms range in the level of severity from an information type of message to a fault, which would cause machine shutdown.

Below is a listing of the alarms presently set-up:

- ***Plate Exchanger High-Level***
  Level in the plate exchanger has exceeded the high level set point entered on the parameter screen. This will be a normal occurrence during pre-heat and pre-start. It should not occur during normal operation. Check the feed flow rate to see if is indicating. Check the position of feed valve CV1 to ensure that it is indicating closed and that the air signal from the I/P is 3 psi. If the problem persists, close feed any valve on feed supply line to stop the feed and eliminate this as a source.

- ***Plate Exchanger Low-Level***
  Level in the plate exchanger has fallen below the low level set point entered on the parameter screen. This is an indication that the infeed flow rate is insufficient to meet the demands of the plate exchanger. Check filters and condition of feed Valve CV1 to determine if it is open. Check feed pressure on the pressure gauge PI4. Reduce operating differential pressure.

- ***Cyclone High-Level***
  Level in cyclone has been detected as being too high (upper limit switch in cyclone LS-4). Blowers will stop. Cyclone level should be lowered by pumping contents to concentrate discharge and selecting "STOP" on operator screen. This will empty cyclone. The concentrator will then have to be restarted normally.

- *Distillate Tank High-Level*
  Level in distillate tank has been detected as being too high (upper limit switch in tank LS-1). Increase distillate output flow-rate by opening valve V6 (if it has been throttled) to attain a higher flow rate. Confirm rate of distillate flow on screen FT-2. If the level does not recede, reduce differential pressure to slow the machine. Check for correct operation of distillate pump P2 and observe pressure at PI-9 (should be 20 psi.)

- *Cyclone Low-Level*

  Level in cyclone has been detected as being low (LS-5). This should correct as the control system cycles through its normal discharge sequence. Check for sufficient level to keep the concentrate pump from starving. Slow concentrate flow if necessary by throttling V11.

- *Heating Chamber NOT Full*
  Indicates that heating chamber is not completely full (limit switch LS-6 in tank not made). The concentrator will not start and heaters will not operate if this fault has been detected.

- *Emergency Stop*
  Indicates that the Emergency Stop button has been pressed. Take appropriate action.

- *Blower #1 Over-Temp*
  Blower#1 temperature has reached or exceeded the Over-Temp alarm parameter value. This alarm signals that blower temperature could be approaching the shut-down parameter value.

  The control system will respond by decreasing speed of blowers by 25%. It should be investigated and corrected and/or increase the Blower Over-Temp alarm value if it determined that the temperature is normal and safe for the operation.

- *Blower #2 Over-Temp*
  Blower#2 temperature has reached or exceeded the Over-Temp alarm parameter value. This alarm signals that blower temperature could be approaching the shut-down parameter value.

The control system will respond by decreasing speed of blowers by 25%. It should be investigated and corrected and/or increase the Blower Over-Temp alarm value if it determined that the temperature is normal and safe for the operation.

- ***Blower #3 Over-Temp***
  Blower#3 temperature has reached or exceeded the Over-Temp alarm parameter value. This alarm signals that blower temperature could be approaching the shut-down parameter value.

  The control system will respond by decreasing speed of blowers by 25%. It should be investigated and corrected and/or increase the Blower Over-Temp alarm value if it determined that the temperature is normal and safe for the operation.

- ***Blower Drives NOT "Ready"***
  System has detected that at least one of the variable frequency drives is not working properly. Check the individual drive displays in drive electrical panel for fault messages.

6.0 TROUBLESHOOTING

This section will aid the operator and maintenance personnel in finding the causes of certain. It cannot be a complete list but covers the problems that are most often encountered.

6.1 Plate Heat Exchanger Level Cannot Be Maintained

This condition is characterised by plate level unable to maintain set point or a steady relationship with set point over an operating period. It typically occurs as gradually falling level that cannot be maintained. The feed flow (FT-1) with the control valve 100% open should be a minimum of 17 litres/minute (equivalent to 1000 litres/ hour). Below this rate, the unit will be starved if operating at normal pressures and concentrations. If the rate is continuous at 17 or more and the level is falling, the differential pressure set point can be reduced slightly until the level begins to rise. Check that minimum feed flow parameter is set at 20. If the flow rate of 17 litres/minute cannot be achieved, the following steps will isolate the problem.

1. The most common cause of this problem is inadequate feed pressure, usually resulting from dirty filters or supply pump failure. Check that the feed pump discharge pressure (PI-14) is in the range of 55 to 65 psi. If it is not, observe the pump operating cycle and pressure and pressure ranges. It should start at 45 to 50 psi and stop at 65 psi to 70 psi with the pump running continually when the flow is above 10 litres per minute. If the pump is OK, go to 2.

2. Check the pressure drop across the filters by observing the pressure on the filter gauges. If the pressure drop is excessive at full flow, the filter bags may have to be changed. **NOTE: pressure drop variations are only meaningful if there is flow. No pressure drop may be observed across a plugged filter or other component unless flow is established.** The pressure on outlet pressure gauge should be a minimum of 50 psi when the control valve CV-1 is wide open. If the pressure on PI-14 is OK, go to 3.

3. Check the pressure at PI-12 located upstream of the control valve. This should read about 3 to 5 psi minimum with the valve wide open. If not, connect a washer hose to drain valve DV5 located between the economiser and the control valve. Close the control valve. Open DV5 and measure the time required to run off a 4-litre- quantity of feed. Calculate the flow rate in litres per minute by dividing the time in seconds into 240. This should be slightly greater than the rate displayed on the screen with the control valve CV-1 wide open. If a second person is

available during the timing, he should watch the flowmeter reading on the monitor during the test. If the rate at DV5 is less than 17 litres per minute with 50 psi at PI-14, it indicates that the economiser is fouled. If the flow is greater than 17 litres per minute and the meter agrees, the control valve is suspect. Proceed to 4. If the flow transmitter reading does not agree but reads significantly lower than the test flow, it may be fouled and require cleaning or it may be damaged.

4. Check the control valve CV-1 to determine if it is getting a signal to open wide. This is indicated by 15 psi on the control air pressure gauge. If the pressure is less than 15 psi, check the control output on the screen to determine if it is requesting 100% output. If it is and the signal to the valve is less than 15 psi and the air supply to the I/P transducer is over 20 psi, adjustment of the I/P span may be necessary.

   If the air signal to the valve is correct, check the valve action by manually setting the valve position from open to close. From the full open to full closed position, the valve stem will rise about 3/8". It is possible that flow restriction can occur by fouling of the control valve.

5. Check the pressure at DV-6 after the CV-1 with the control valve open and then closed. A pressure gauge on a washer hose is useful for this and similar checks. The variation in pressure open-to-closed should vary no more than 2 psi. Higher variation would suggest plate fouling.

6.2 Cyclone High Level

Cyclone high level generally indicates that the discharge of concentrate is not keeping pace with the infeed. It may come to the operator's attention as an alarm that will shut down the unit or the operator may observe it on the sight tube. If the concentration is at an acceptable level, go to 1. If the concentrate is not at an acceptable level, go to 7.

1. Level in cyclone is high or rising and concentrate strength is good - Check concentrate flow indicated on the screen (FT-3). This should be indicating about 9 litres per minute. If there is no flow, go to 2. If flow is low, go to 6.

2. Check that P-3 is operating. If not, check that control signal is requesting operation. The operation of the pump can be determined by observing the rotation of the cooling fins on the motor. If the pump is on, go to 3.

3. Check that solenoid valve SV-5 is indicating open. If it is not, the problem may lie in the control system. If it is calling to open but has no flow go to 4.

4. Check manual valves to ensure that the concentrate has a clear path to its destination tank. If so, go to 5.

5. Check that the solenoid valve is operating. This can usually be observed by watching the flow from partly opened drain valve DV-14 as the valve SV-5 is opened and closed from the screen. No variation in flow or no flow indicates the valve is not operating.

6. Low flow in the concentrate system may indicate that the recirculation loop is starving the discharge. This can be increased by throttling valve V-16 until the discharge flow is adequate. V-16 must not be closed completely as it is required to circulate the cyclone back to the plate when the concentration falls. The low flow can also result from a restriction in the discharge line including the bottom of valves V4, V5, V10, V11, or any filter installed after the unit. Fouling of the economiser is possible but most unlikely. The low flow could result from fouling in the Y strainer on the suction of pump P3.

7. If the concentration is not acceptable and the cyclone level is rising, it suggests that the recirculation system is not keeping up with requirement. Confirm that the pump P3 is on as in step 2 and check that the solenoid valve SV-4 is showing "on" on the screen. It may be cycling on so it will have to be watched for a few minutes. If it is not on or cycling on, the problem is in the control system and the inputs and outputs must be checked by a qualified PLC technician. If the valve is cycling on it may not have adequate flow rate, indicating that V16 may be closed too far. This condition may also be occurring because the level in the plate is too high, resulting in excessive carryover to the cyclone at lower concentration than the recirculation can handle. Try reducing the plate exchanger level set point. Increase the value for forced recirculation.

6.3 Stalling

Stalling is used to describe the phenomena that is observed when production of distillate and concentrate drops off significantly or stops during operation when most conditions are near normal. The thermodynamic balance of this system is very delicate and it is subject to upset and imbalance. Stalling generally has been observed when running feed of relatively high concentration (+14%) and is certainly more apt to occur as the feed concentration rises. At stall, the boiling point of the ADF in the plate exchanger has reached a concentration that is at or near the temperature of the steam that is being supplied so that the heat transfer and production of steam is minimal, or the feed has cooled and upset the thermal balance.

Causes include:

- Differential Pressure too low. Solution: select higher differential pressure and note the response.
- Air in the steam. Air is most apt to enter during start-up or if a leak occurs between the plate and the second blower where the pressure is normally negative. Modest amounts of air can vent through the trap after the heater but occasionally, it is beneficial to blow off some steam and air by opening valve V23 to purge air from the plate.
- Cold feed. Feed entering without proper heat up due to irregular distillate flow, irregular concentrate flow, economiser fouling, feed surges, or other cause will tend to quench the action of the plate, causing steam production to fall and throughput to drop off. If feed temperature is cool or cycling cool, this can happen. The solution is to get the unit to a balanced condition by increasing differential pressure, switching on the heaters if the distillate temperature falls below 80°C (ref. TI-5), and adjusting the distillate recirculating flow rate (monitoring FT-2 with SV-2 open adjust V9) to a value that is approximately equal to the average infeed rate as displayed on FT-1. It may also help to reduce the feed flow limit parameter. This helps to recover the feed temperature and balance.
- Feed rate too erratic. If the feed rate is not reasonably consistent, thermal cycling can cause the problems described previously. Control parameter adjustment may be required or filters may need changing.
- Loss of heat through insulation failure. At high levels of feed concentration, above 15%, the machine will become more sensitive to thermal loss. Poor, missing, or wet insulation can contribute to heat loss that can cause the heat balance to be lost.

The operator must exercise judgement in determining the form of stall that is being experienced before initiating action. Changes should in general always be made slowly,

one parameter at a time in small steps, so that the effect of each can be observed before complicating the analysis by bringing in too many factors. By observing trends as they develop and acting to arrest them in an organised manner can often avert major upset. The temperature indicators on the unit are particularly useful for this analysis since they give information that is not all available on the screen. In particular, observing the temperature difference between TI-6 (steam temperature) and TI-7 (ADF boiling temperature) is useful. This is the temperature difference across the plate exchanger and should normally be in the range of 6°F to 8°F or 3.5°C to 4.5°C., which is nominally obtained at 4.5 to 6 psi differential at 50% concentration. The specific temperature relationship for ethylene and propylene glycol for various concentrations and temperatures and steam temperatures at various pressures are included in the appendices.

6.4 Low Distillate Level During Heat Up

Low distillate level during heat up can be a problem because the recirculating distillate is used to fill the plate and transfer heat from the electric heaters. The circulation keeps the heating chamber full so that the heaters will be kept immersed. If the level falls below LS-6, they automatically shut off to protect against burn out. During heat up, low level can be caused by steam migrating through the unit and condensing in places where it cannot be returned to the heater tank, such as the blowers. This will occur if the heater hose is not connected from DV23 (open) to DV21(open) with V25 closed. It can also happen if heat up is initiated without having adequate distillate in the system or if the automatic heat up and temperature hold feature is used for excessively long periods.

If the low level does occur during heat up, check to ensure that valves DV23, DV21, V25 and V17 are positioned correctly and, if the heater tank is too low for operation, add a modest amount of water to the distillate tank. Use warm water if available since cold water addition will slow the start up and cause pop-ups.

6.5 Low Level in Distillate Tank During Operation

Low level in the distillate tank during operation indicates that the unit is not producing distillate and that it is being drawn down by desuperheating requirements or that the distillate discharge cycle is functioning when it should not. This could be caused by failure of LS-2 (Compare its position indicated with the sight glass and LS-3) or could be caused by SV-1 failed open. To check for SV-1 failed open, with SV-1 showing closed, close V9. If the flow indicated by FT-2 continues, SV-1 is leaking or failed open.

6.6 High Level in Distillate Tank During Operation

High level in distillate tank can occur during operation if the discharge of distillate does not exceed the production rate. This is most apt to happen if running feed under 5%. Open valve V-6 if it is throttled. Check that the distillate flow is normal, typically in the 13 to 15 litre per minute range as indicated by the screen when SV-1 is open. If the flow is in this range and the level persists high, it is necessary to reduce the differential pressure slightly to cut back on the throughput. Brief excursions to high level should be monitored to ensure that the fault corrects but they are of no concern unless the condition persists or the tank nears overflow.

If the flow is not adequate or if there is no flow, check that the pump is on by observing the motor cooling fan and if that is OK, check the solenoid valve SV-1. When the valves switch to open SV-1 and close SV-2, there will normally be a period of a few seconds where both are open, giving a higher than normal flow for a brief time. If this does not drop back after a few seconds, SV-2 may be failed open. Test for this by closing V6 when the solenoid SV2 is deactivated. If any flow remains as indicated by FT-2, it indicates that SV2 has failed open or is leaking.

6.7 High Glycol Concentration in Distillate

Normal concentration in the distillate should be typically 0.5-1% for ethylene and 2-3% for propylene glycol, for all standard equipped units except unit#1 which is not equipped with a secondary cyclone, and will normally have a 1% to 1.5% distillate concentration when processing ethylene glycol. Higher levels can indicate that the vent condenser coil is leaking feed into the distillate tank or that the secondary cyclone is not draining properly.

To check the vent condenser coil, close feed supply to the coil and see if the situation improves over a period of 15 minutes.

To check the secondary cyclone draining, close V25 and open valve DV23 (**carefully as this is hot and under pressure**) and collect the distillate until it blows steam. Steam should begin to blow before more than one litre is collected if the drain trap is functioning. A quantity of as much as 30 to 40 litres may be collected if the trap has failed, eliminating the capability to remove and recycle the glycol laden distillate at this point. If there is excessive liquid in the secondary cyclone, the trap T-3 should be checked.

If everything previously noted checks out OK, confirm that the check valve V26 is functioning.

7.0 MAINTENANCE

Observe safe practices in performance of all maintenance functions.

The ADF concentrator is designed to operate with a minimum of routine maintenance. It is important that the operators report any observed problems or variances so that maintenance can be initiated as soon as problems are recognised in an effort to minimise any negative impact.

7.1 Preventive Maintenance

Operating experience will dictate revisions to the maintenance schedule. The suggested schedule is as follows.

Daily

- Observe and report variances per instructions.
- Keep area of unit dry and clean. Floors wet with glycol solution are slippery and dangerous.
- Check desuperheating supply pressure (85-90 psi). Check a pressure drop across the filters and change bags and cartridges if necessary.
- One shot of grease into the grease fitting on each blower bearing housing. Use only compatible grease of correct type.
- Check blowers for steam leaks and adjust packing gland if necessary.

Monthly

- Visually check calibration of level and pressure displayed readings against actual to determine if calibration is necessary.
- Review previous month's operating record and compare performance to norms.
- Inspect blower coupling for wear and alignment (visual).
- Drain standpipe. The standpipe provides hydraulic shock absorption. If it is allowed to fill with liquid, they lose their ability to cushion changes in pressure. The resulting water hammer, or hydraulic shock, can seriously damage components. Drain by disconnecting at the union and removing.
- Clean all "Y" strainers.

Annually

- For annual maintenance refer to Inland Maintenance Procedure IMP006, Rev. 01/2000 or later.

7.2 Maintenance of Components

Components should be serviced in accordance with manufacturer instruction and good trade practice.
Replacement parts should be from original manufacturer or approved alternate. All components removed from service should be tagged noting the unit # and location from which they were removed, the date of removal, the problem if known, and whether or not the unit has been serviced and is ready for reuse. Components that are not serviceable should be clearly marked, kept clear of spare stock and serviced as soon as possible. Useless components should be discarded. Any spares used in maintenance procedures should be replaced as soon as used unless the removed component is suitable for immediate rebuild.

7.3 Cleaning of Heat Exchangers

The plate heat exchanger and the economiser will require periodic cleaning. This should be performed at least annually or more frequently if heating performance or pressure drops indicate.

The plate heat exchanger can be dismantled for cleaning as described in the Alfa Laval maintenance manual and Inland Maintenance Procedure IMP004, Rev.00/1999 or later. If the plates are removed, the steam side will generally be found relatively clean with little attention required. The glycol side will carry a scum film that can be removed by pressure washing, chemical cleaning, brushing, or some combination thereof. Be sure that any chemical cleaner to be used is approved for use in consideration of the gasket and plate material. Use extreme caution when handling plates so that they do not become bent, scratched, or have their gaskets damaged. Gaskets should last several years in this application.

The plate exchanger (glycol side) can be cleaned without disassembly by filling with an approved chemical cleaning solution and using air agitation. The chemical solution can be pumped into the plate through Quick Connect Hose Coupling furnished at the feed flange and discharged through the same Quick Connect Coupling set at outlet to the primary cyclone elbow. Before any flushing is started out, insert a special designed bulkhead between the flange on the piping connecting heat exchanger and cyclone to prevent chemical overflow into the cyclone. In the flushing process, make sure that sensing tube to the level transmitter is always closed or disconnected. Usually, when the plate is filled, allow a period of soaking, then circulate chemical by a pump with flow rate up to 150 USGPM. For the flushing success, it may be of benefit to reverse pumping and discharging ports in coarse of flushing. Combining a burst compressed air injection with circulation of

chemical may increase an efficiency of the flushing. Make sure that pressure in the heat exchanger never exceeds 100 psi. Exercise extremely high caution with the chemical and in particular where the air is venting since there may be carryover. Repeat as many times as required, dispose of the wash chemical responsibly, and flush the unit thoroughly with water.

Piping and the economiser can be cleaned in a similar manner. Early experience indicates that the feed line will require more frequent cleaning than the other passes. Flush the line to be cleaned with water, then add chemical solution and blow through. Bi-directional alternating flushes will be most effective. The distillate pass in the heat exchanger should be cleaned carefully without the air burst in order to protect the centre tube in the exchanger from external pressure or shock that could potentially collapse it. Pressure in the distillate pass should never exceed 20 psi.
For detailed Plate Heat Exchanger flushing procedure see IMP007/2001, Rev.00/2001, or later.

7.4 Calibration of Flow Transmitters

Any flow transmitter can be checked at site by closing all destination valves except one boiler drain and running a stream through the boiler drain into a 4 litre container while measuring the time to fill. The flow should be established and steady during the fill. Divide the number 240 by the time in seconds that it takes to run off the 4 litres to find the flow rate in litres per minute. Compare with the displayed value.

If there is significant variation, the transmitter should be replaced. Calibration can be accomplished in the software of the PLC but this is undesirable since it will not be valid if a transmitter is replaced.

Danfoss electro-magnetic flowmeter is maintenance free, very precise instrument. Flow tube chamber of the instrument must be fully filled by the liquid all the time what is achieved by the installation in the lowest point of the piping-mostly U shaped. For detail information on the flowmeter, see Danfoss product manual for MAGFLO® Electromagnetic flowmeters Sensor type MAG1100 and signal converter type MAG2500 and MAG2500 (or MAG5000 on newly assembled ADF Concentrators). To achieve PLC and flowmeter setting compatibility, a value of 30 LPM will be set for the flowmeter max. flowrate setting. Caution: The instrument is powered with 110V and access to instrument wiring is permitted to a certified electrician only.

Power supply to the instrument has to be switched off while performing any maintenance job.

Burkert Paddle Wheel Flowmeter is installed on the concentrate and distillate line. That is ½" FNPT brass body instrument with output 4-20 mA for flow range set @ 0-30 LPM. The instrument is factory calibrated with water at 20°C and velocity of 2 m/s. A so known "specific fitting factor K" for that calibration condition is factory set at 117,6 (pulse/litre). Burkert flow meter is less accurate than Danfoss magnetic flowmeter especially if measured liquid density and viscosity is different than those of water. To change "fitting factor" K for a liquid other than water, a special control (operator) unit is needed. Calibration of the Burkert flowmeter practically represents a finding of K factor for each particular liquid other than water. This procedure may be performed in many different ways. This is one example how to find out K factor for the concentrate:

Establish constant circulation flow of the concentrate of about 8 to 11 LPM shown on the control unit display or computer screen. Use an accurate, calibrated flowmeter (so known "master meter") installed in serial with that being calibrated. If in a steady, stable flow the following was found: existing fitting factor K (pulse/litre), Qm (LPM)-flowrate indicated by master meter, Q (LPM)-flowrate indicated on the computer screen or control unit of the flow meter to be calibrated, than a new fitting factor in first approximation will be calculated and set for the calibrated flowmeter as:

$$K\,c = (V/Vm) \times K$$

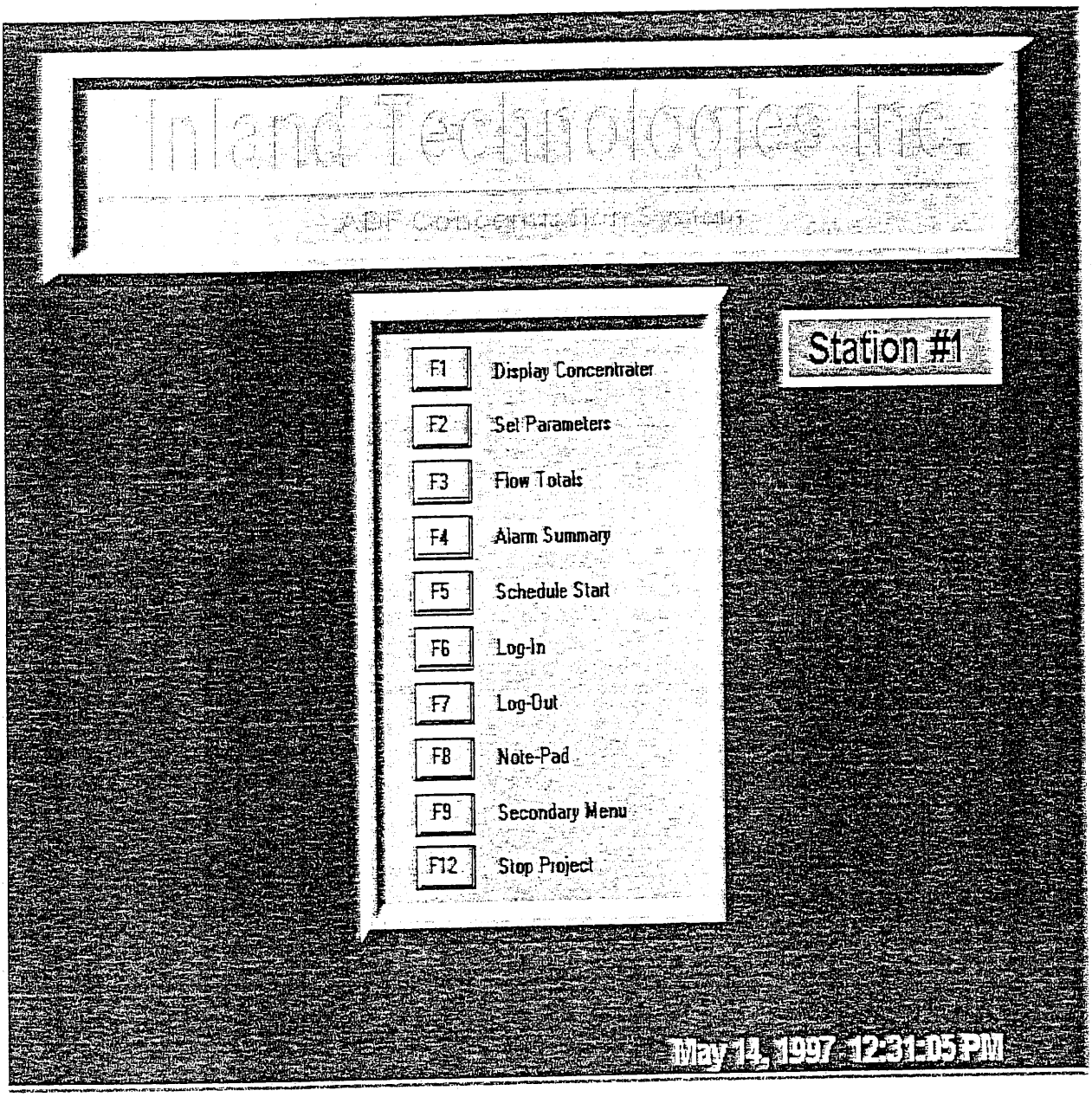
8.0 SPARES LIST

The minimum number of items to be kept on each facility spare parts shelf is defined by the document: Minimum Spare Parts Stock, #IMP 002, Rev. 01/2000 or later.

The following should be stocked in Truro as fleet spares:

1.	1	Rotron blower assembly
2.	1	Flowmeter
3.	4	Desuperheater nozzles
4.	1	Desuperheater pump
5.	1	Set of steam traps
6.	3	Absolute pressure transmitter
7.	1	Differential pressure transmitter (cyclone level)
8.	1	Powers Control Valve
9.	1 set	Alfa Laval plate gaskets
10.	1	Automatic Air Vent
11.	1	Pressure Relief Valve
12.	1	18 KW Flanged Electrical Heater
13	1 set	Repair Spare Parts for Little Giant Pump

The spares list should be reviewed periodically based on the number of units in service and maintenance experience.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F2 Set Parameters
F3 Flow Totals
F4 Alarm Summary
F5 Schedule Start
F6 Log-In
F7 Log-Out
F8 Note-Pad
F9 Secondary Menu
F12 Stop Project
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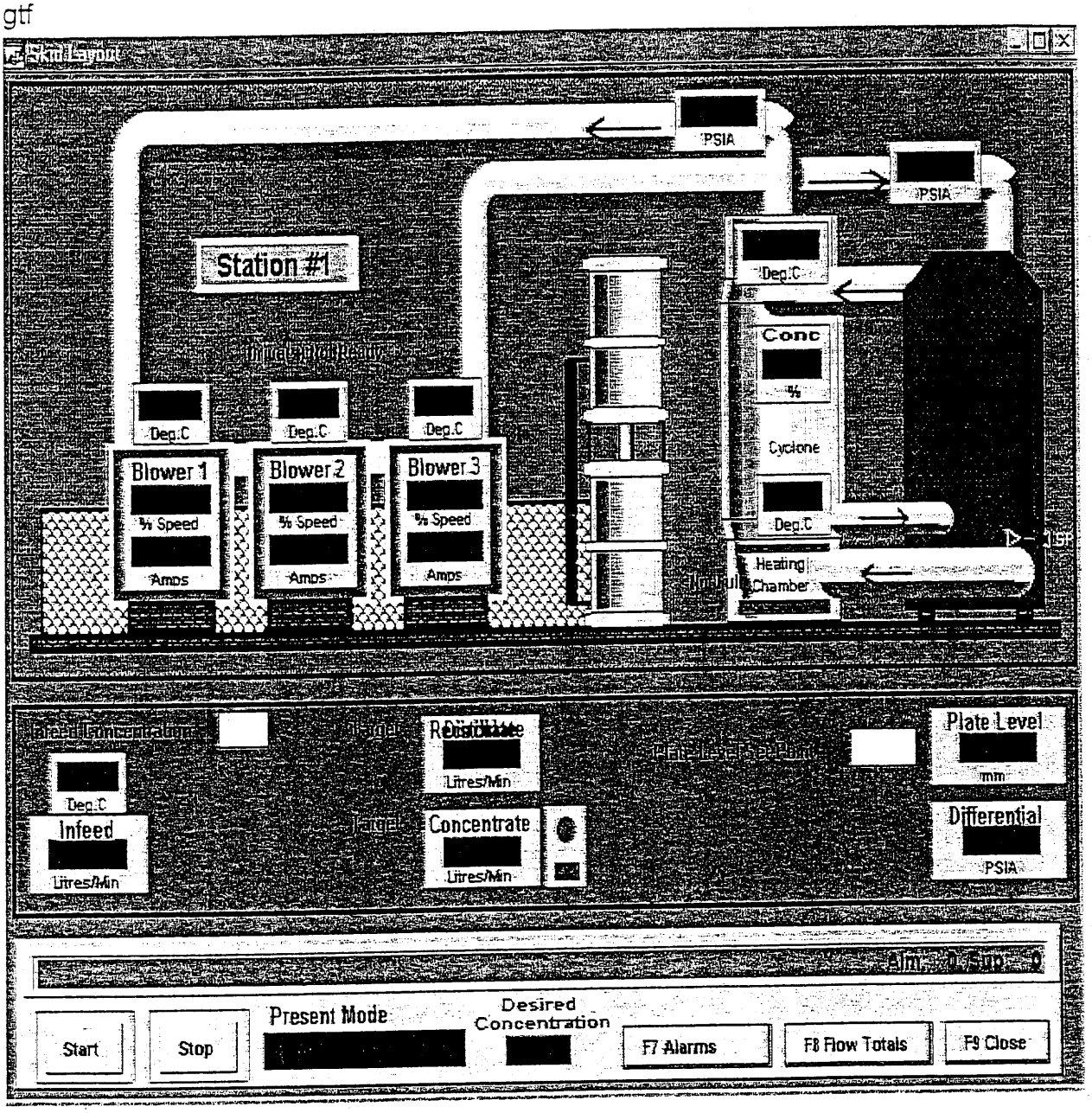
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Blower 3
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Deg.C
Infeed
Litres/Min
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Stop
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Desired
Concentration
F7 Alarms
F8 Flow Totals
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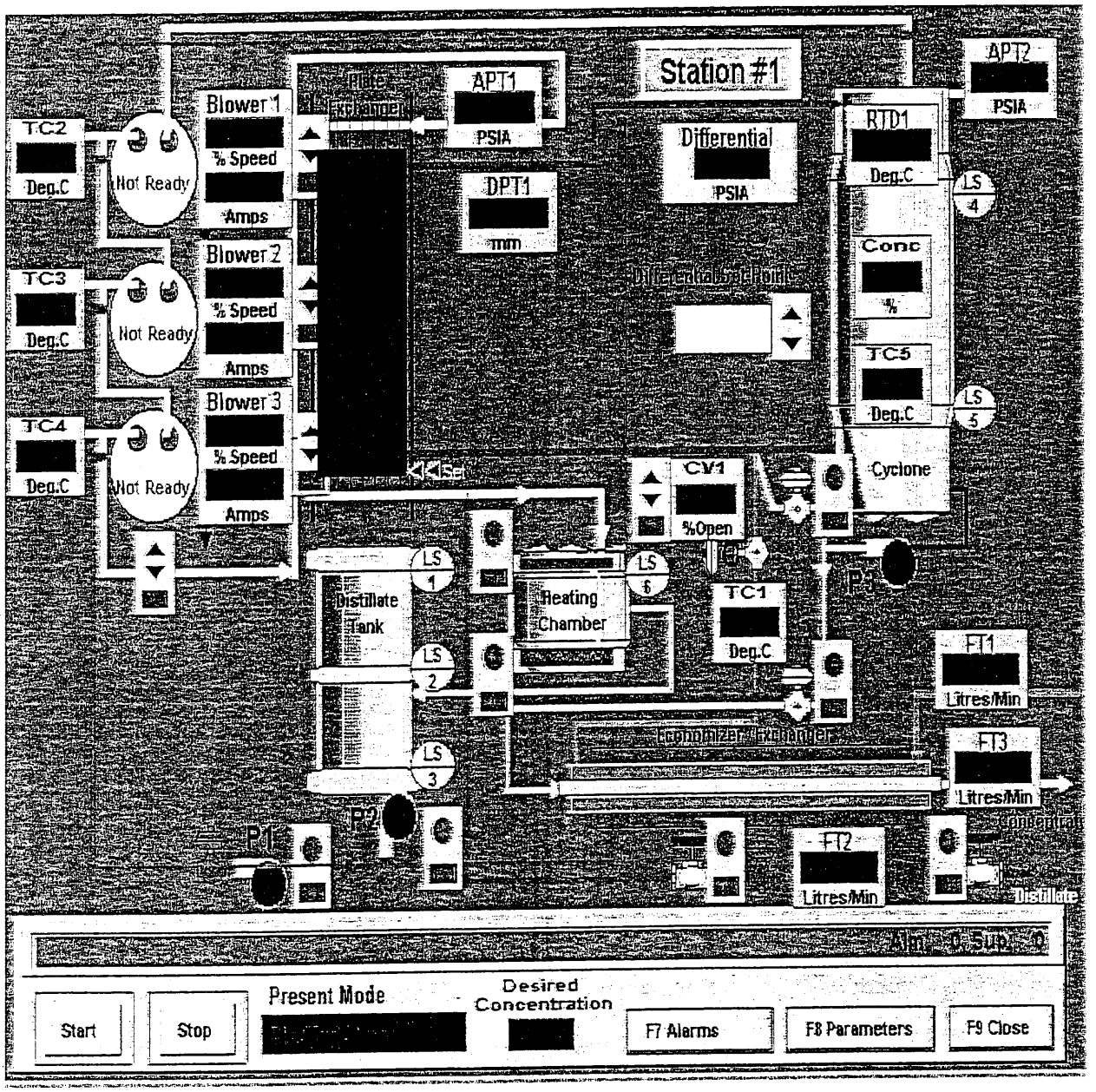
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Deg.C
Not Ready
Blower 1
% Speed
Amps
Plate Exchanger
APT1
PSIA
DPT1
mm
Differential
PSIA
RTD1
Deg.C
APT2
PSIA
LS 4
Conc
%
TC3
Deg.C
Not Ready
Blower 2
% Speed
Amps
Differential Set Point
TC5
Deg.C
LS 5
TC4
Deg.C
Not Ready
Blower 3
% Speed
Amps
Cyclone
CV1
%Open
LS 1
Distillate Tank
LS 6
Heating Chamber
TC1
Deg.C
P3
LS 2
FT1
Litres/Min
Economizer Exchanger
LS 3
FT3
Litres/Min
Concentrate
P1
P2
FT2
Litres/Min
Distillate
Alm
Sub
Start
Stop
Present Mode
Desired Concentration
F7 Alarms
F8 Parameters
F9 Close

Ethylene Glycol Concentration Curve

Brix	Concentration	Brix	Concentration	Brix	Concentration
0.00	-0.05	15.00	22.97	30.00	48.24
0.50	0.69	15.50	23.77	30.50	49.12
1.00	1.42	16.00	24.58	31.00	50.01
1.50	2.15	16.50	25.39	31.50	50.89
2.00	2.89	17.00	26.21	32.00	51.78
2.50	3.63	17.50	27.02	32.50	52.68
3.00	4.38	18.00	27.84	33.00	53.57
3.50	5.12	18.50	28.66	33.50	54.47
4.00	5.87	19.00	29.49	34.00	55.36
4.50	6.62	19.50	30.31	34.50	56.27
5.00	7.37	20.00	31.14	35.00	57.17
5.50	8.13	20.50	31.97	35.50	58.08
6.00	8.89	21.00	32.81	36.00	58.99
6.50	9.65	21.50	33.64	36.50	59.90
7.00	10.41	22.00	34.48	37.00	60.81
7.50	11.18	22.50	35.32	37.50	61.73
8.00	11.95	23.00	36.17	38.00	62.65
8.50	12.72	23.50	37.01	38.50	63.57
9.00	13.49	24.00	37.86	39.00	64.49
9.50	14.27	24.50	38.71	39.50	65.42
10.00	15.05	25.00	39.57	40.00	66.35
10.50	15.83	25.50	40.42	40.50	67.28
11.00	16.61	26.00	41.28	41.00	68.21

11.50	17.40	26.50	42.14	41.50	69.15
12.00	18.18	27.00	43.01	42.00	70.09
12.50	18.98	27.50	43.87	42.50	71.03
13.00	19.77	28.00	44.74	43.00	71.98
13.50	20.57	28.50	45.61	43.50	72.92
14.00	21.36	29.00	46.49	44.00	73.87
14.50	22.17	29.50	47.36	44.50	74.82

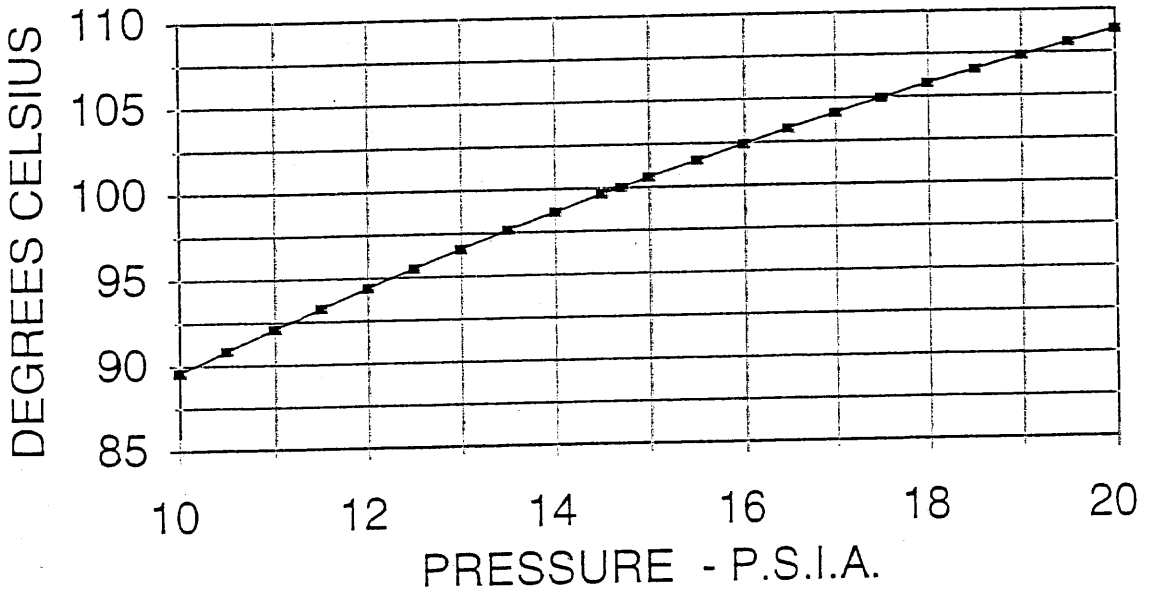
Propylene Glycol Concentration Curve

Brix	Concentration	Brix	Concentration	Brix	Concentration
0.00	0.16	15.00	18.78	30.00	41.92
0.50	0.71	15.50	19.48	30.50	42.77
1.00	1.26	16.00	20.18	31.00	43.62
1.50	1.82	16.50	20.89	31.50	44.48
2.00	2.38	17.00	21.60	32.00	45.34
2.50	2.95	17.50	22.32	32.50	46.21
3.00	3.52	18.00	23.05	33.00	47.09
3.50	4.10	18.50	23.77	33.50	47.96
4.00	4.68	19.00	24.51	34.00	48.85
4.50	5.27	19.50	25.25	34.50	49.74
5.00	5.86	20.00	25.99	35.00	50.63
5.50	6.46	20.50	26.74	35.50	51.53
6.00	7.06	21.00	27.49	36.00	52.44
6.50	7.67	21.50	28.25	36.50	53.34
7.00	8.29	22.00	29.01	37.00	54.26
7.50	8.90	22.50	29.78	37.50	55.18
8.00	9.53	23.00	30.56	38.00	56.10
8.50	10.16	23.50	31.34	38.50	57.03
9.00	10.79	24.00	32.12	39.00	57.97
9.50	11.43	24.50	32.91	39.50	58.91
10.00	12.07	25.00	33.70	40.00	59.85
10.50	12.72	25.50	34.50	40.50	60.80
11.00	13.37	26.00	35.31	41.00	61.75

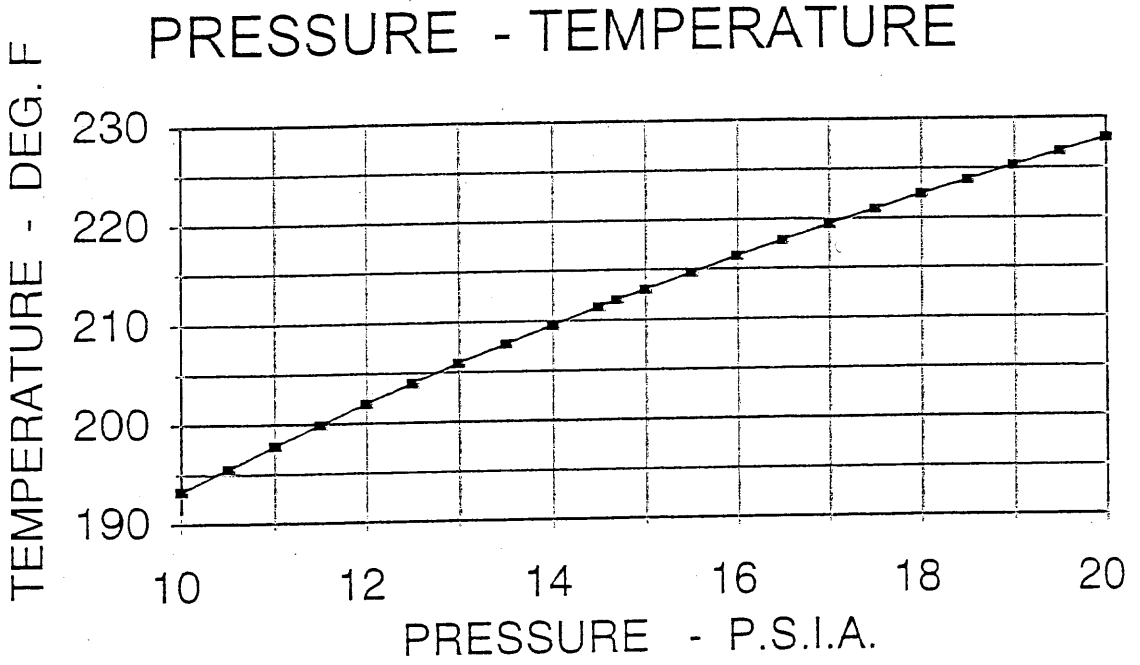
11.50	14.03	26.50	36.11	41.50	62.71
12.00	14.69	27.00	36.93	42.00	63.68
12.50	15.36	27.50	37.75	42.50	64.65
13.00	16.04	28.00	38.57	43.00	65.62
13.50	16.71	28.50	39.40	43.50	66.60
14.00	17.40	29.00	40.23	44.00	67.58
14.50	18.09	29.50	41.07	44.50	68.57

SATURATED STEAM DATA

PRESSURE - TEMPERATURE



SATURATED STEAM DATA



APPENDIX 1
ADF CONCENTRATOR
WITH SCRUBBER

1.0 DESCRIPTION OF ADF CONCENTRATOR WITH SCRUBBER

1.1 Introduction

ADF Concentrator with scrubber represents an upgraded version of the basic system. For that reason, that what is said in the Operating and Maintenance Manuel for Aircraft De-Icing Fluid Concentrator is fully applicable to the Concentrator with Scrubber. The basic and only purpose of the scrubber is to reduce glycol content in the distillate. As it is known, glycol content in the discharging distillate depend upon the concentration in the primary cyclone. So, processing a propylene type glycol by using concentrator without scrubber, distillate glycol content may amount up to 3-4% for concentration in the secondary cyclone 50-54%. For this concentration, glycol content in distillate drops to 1-1.5% if concentrator with scrubber is used. To achieve a very low glycol content in the distillate (< 0.1%), the processing is performed in two stages: one stage encompasses processing to 20 – 25% concentration in the cyclone allowing scrubber to remove glycol from the steam that is distillate below 1,000 ppm (0.1%). Second stream, 20-25% concentrate is returned to the feed tank that is usually mixed with a larger volume of low concentrated feed. In this case, second stage is just a regular processing by concentrator without scrubber. There may be more possible schemes of processing by concentrators with scrubbers depending what is the feed and what distillate quality is required.

1.2 ADF Concentrator with Scrubber – General note

Process and instrumentation diagram of the ADF Concentrator with scrubber is given in the Inland drawing No. 002_00_01, Rev. 1. The scrubber with its liquid supply pump and plumbing is only difference between this and standard version. Below is given a short overview of the scrubber system components.

1.3 Component Details

1.3.1 Scrubber-absorber assembly

Scrubber-absorber is a major component of the system. It consists of a S.S. column that is fabricated of two flanged and bolted cylinders with top and bottom cones. The scrubber is fitted into 6" S.S. piping connecting primary cyclone top and blower #1 intake port. So known structural packing is packed inside of the scrubber. There are seven layers of those modules sitting on the supporting grid and on top of each other. The structural packing is made of very thin S.S. sheet formed in such a way to use maximum possible sheet surface per unit of volume, thus, to get channel contact surface as large as possible. So, structural packing bed that is used on the scrubber has a specific contact surface of 500 sq.m/cu.m.

Hot distillate from the distillate tank is supplied to the scrubber through the ½" Yamada air-operated pump NDP-15 BAT and spray nozzle type 1/8" – GG – W – 4.3W. The spray nozzle is set in the centerline of the scrubber above the top structural packing bed. To

achieve a required flow rate through the nozzle, exact pressure on the nozzle must be obtained by the pump. For the specified nozzle, the pump pressure of 20 PSI on the nozzle may achieve flow- rate of approximately 130 LPH. A pressure of 25 PSI on the nozzle yields a flow rate of about 150 LPH. So, for flow rate 130 to 150 LPH, pressure on the nozzle must be maintained at 20 to 25 PSI. At the same time, this is the flow range that is recommended when the required glycol content in the distillate is less than 0.1% (1,000 ppm) and under the conditions that actual concentration in the cyclone never goes above 25%. It is very important that the temperature of the sprayed distillate be as higher as possible. Therefore, a special attention must be paid to heat conservation.

Spray nozzle has to be protected from clogging by a strainer of min. 20 US mesh. To achieve a uniform, circular, full jet spraying pattern over whole cross sectional area of the scrubber packing, distance between spray nozzle and surface of the top packing module must be adjusted at 5.3/4" (146 mm) for the pressure of 20 PSI and flow rate ~130 LPH, and 6" (150 mm) for the pressure of 25 PSI and flow rate ~ 150 LPH. A pressure dial gauge 0-100 PSI is installed on the supply line in the immediate vicinity of the spray nozzle outside of the scrubber.

Steam from the primary cyclone is entering the scrubber through the side 6" pipe nozzle that is furnished at the bottom cylindrical section of the scrubber. The steam flows trough the structural packing layers (beds) to the top of the scrubber. On its way from the bottom to the top, steam is encountering sprayed distillate gradually loosing its glycol content as a consequence of a continual re-establishment of the vapor-liquid equilibrium. In such a way, liquid collected at the scrubber bottom cone and drained to the heat exchanger is of the highest glycol content while the steam traveling through the packing layers is loosing most of the glycol to the sprayed liquid. Steam freed of its glycol content exiting the top of the scrubber on its way to the blower #1. Scrubber that operates inside a heated building or tent must be carefully insulated with a minimum 1" thick insulation. In cold and outdoor environment, a minimum 2" thick insulation will be provided to the scrubber and piping. In harsh climate conditions, wind shields and heating to the scrubber may be considered. For indoor scrubbers, pressure and temperature dial gauges are installed on the upper and lower section of the scrubber.

1.3.2 Pump

As mentioned above, Yamada air-operated pump Model NDP-15 BAT is used to supply hot distillate to the scrubber nozzle under the required pressure. Due to high temperature of the distillate, Teflon balls, diaphragms and O-rings are required what follows from the pump model identification. All new pumps received directly from a supplier must be upgraded by replacing aluminum valve seats with seats made out of stainless steel. This is regularly done on all pumps in the assembling shop if the pumps were supplied by Inland in Truro. Quick failure of the aluminum seats leads to quick wear of balls. For more information on Yamada pumps please refer to Operation Manual, Doc. No. NDP003U-03, and Maintenance Manual, Doc. No. NDP009M-02. Unlike the pump used for desuperheat system, this pump does not go on automatically. It is turned on/off by using a valve on the air supply line. Therefore, the pump will be turned on in the running mode and shut off in all other operating modes.

1.3.3 Steam Trap (T-4)

Steam Trap, Model Spirax Sarco FT-15, Size 1.1/4" NPT is used for quick and efficient discharge of liquid collected at the bottom of the scrubber. The liquid is drained into heat exchanger. It should be kept in mind that the drain line is under vacuum in running mode and any boiler drain opening would lead to sucking air into the system. For that reason, it is very important that steam trap operate properly.

GLOSSARY OF TERMS

ADF - Aircraft deicer fluid as recovered. May also be referred to as glycol or feed.

Concentrate- Glycol at 45% or greater concentration derived from the ADF.

Distillate - Condensed water vapour that has been extracted from the ADF. It may contain trace impurities of ammonia and glycol but is essentially clean water.

Desuperheating - The changing of steam from a superheated state to a saturated state by the addition of water.

Economiser - The concentric tube heat exchanger used to recover heat from the distillate and concentrate, heating the feed.

Feed - The supply of ADF to the concentrator.

Glycol - Ethylene or propylene glycol existing as recovered ADF or concentrated from ADF.

PLC - Programmable Logic Controller (Allen-Bradley)

Plate Heat Exchanger- the main heat exchanger in which the ADF is boiled using the recompressed steam. Also referred to as the "plate" or "plate exchanger".

Primary Cyclone - The cyclone in which the discharge of the plate exchanger is separated into gaseous (steam) and liquid (concentrate) fractions.

Secondary Cyclone - The smaller cyclone used to remove excess desuperheating liquid.

Solenoid Valve - A valve that is opened or closed by application or release of an electrical signal to its control coil.

Stall - A situation where the unit is running but no ADF is being processed due to thermodynamic upset.

Standpipe - A vertical pipe section with a blank end used to trap air to serve as a cushion against water hammer.

Steam Trap - A device that allows water or condensate (distillate) to pass but holds back steam.

Water Hammer - Hydraulic shock developed from a rapid reduction in flow.

APPENDIX F

HRM AND NSDEL CORRESPONDENCE
RE: WASTEWATER DISCHARGE AND BY-LAW W101

Inland

COPY

August 23, 2001

Mr. John Sibbald
Environmental & Right-a-Way Services
P.O. Box 1749
Halifax, NS
B3J 3A5

Dear Mr. Sibbald:

Further to our telephone conversation of August 21, 2001 I would like to confirm our conversation to you.

Inland Technologies will discharge fluids into the sanitary sewer system at the Halifax International Airport at a maximum rate of 14 litres per minute. An analysis of this fluid was sent to you in previous correspondence.

In order to comply with H.R.M. Bylaw W-101 we will sample, using an auto-sampler, on an ongoing 24-hour basis the fluid being discharged. For the first fourteen (14) days of operation we will have this sample analyzed for BOD_5, TSS, TOG and EG on a daily basis. After this period we will continue to analysis the fluid once a week, until you are satisfied with our results. For the first four (4) weeks, once a week we would analyze for concentration limits as per Table 1 of the by-law; again we would continue until you are satisfied with the results. Furthermore, we shall install a flow meter on the discharge line in order to supply you with accurate flow rates, total volume and to determine historical numbers.

The analysis will be supplied to you as received from the laboratory. We shall use the services of PSC in Halifax.

We would kindly request your written concurrence with the above procedure.

Thank you for your kind attention.

Yours truly,

INLAND TECHNOLOGIES CANADA INC.

William Koncsik
Operations Manager

Inland Technologies Canada Inc.
P.O. Box 253
Truro, NS
Canada B2N 5C1
Telephone: (902)895-6346
Facsimile: (902)895-6349
E-Mail: wkoncsik@inlandgroup.ca

HALIFAX
REGIONAL MUNICIPALITY

PUBLIC WORKS AND TRANSPORTATION SERVICES
ENVIRONMENTAL AND ENGINEERING APPROVALS

September 28, 2001

Inland Technologies Canada Inc.
P.O. Box 253
Truro, NS
Canada B2N 5C1

Attention: Richard Johnson

Dear Sir;

Re: Discharge of Wastewater to Sanitary Sewer

I am in receipt of your correspondence regarding the discharge of your process wastewater to the sanitary sewer system at the Halifax International Airport.

As discussed, the discharge of wastewater to municipal stormwater and wastewater sewer systems within Halifax Regional Municipality is regulated by By-Law W-101. Additionally, un metered discharge to wastewater facilities is regulated by By-Law S-100. A copy of both by-laws have been provided for your information.

Please contact Debby Leonard, Customer Service Manager, Halifax Regional Water Commission at (902) 490-4998 to discuss details of the required billing structure for the wastewater volume that your activities will generate.

A review of the analysis which you have provided from similar operations at locations in Canada indicates that BOD concentrations may exceed the allowable by-law limits from the proposed operation at the Halifax International Airport.

It is requested that results of your continuous analysis for BOD, SS, TOG and EC be forwarded to this office for review. Wastewater in which the BOD concentration exceeds the allowable limits may be permitted where no impairment to the municipal wastewater treatment process is experienced. Additionally, over strength discharges to the wastewater system may be subject to a surcharge agreement to permit the recovery of additional operating costs that this municipality may incur as a result of this over strength wastewater discharge.

I would appreciate receiving notification upon start up of your process to review current analysis of this wastewater and to discuss any concerns at that time.

I trust this information meets with your approval.

Yours truly,

John A. Sibbald
Pollution Prevention Coordinator

JAS/

Attach.

cc James Simmons, P. Eng.

2750 Oxford Village Road, P. O. Box 1749, Halifax, NS B3J 3A5 Tel: (902) 490-6050 Fax: (902) 490-4858
E-mail: sheppaj@region.halifax.ns.ca Web Site: www.region.halifax.ns.ca

HALIFAX
REGIONAL MUNICIPALITY

PUBLIC WORKS AND TRANSPORTATION SERVICES
ENVIRONMENTAL AND ENGINEERING APPROVALS

December 11, 2001

Inland Technologies Canada Inc.
P.O. Box 253
Truro, NS
Canada B2N 5C1

Attention: Richard Johnson

Dear Sir;

Re: Discharge of Wastewater to Sanitary Sewer

This letter is in response to our recent telephone conversation regarding the discharge of wastewater from your process to the sanitary sewer system.

As discussed, the discharge of wastewater to municipal stormwater and wastewater sewer systems within Halifax Regional Municipality is regulated by By-Law W-101.

As indicated during our conversation, it is your intention to provide pretreatment to your proposed wastewater effluent to reduce the BOD concentration to a level which meet the requirements of By-Law W-101. Our previous concerns regarding loadings at the Aerotech WPCP will be alleviated by the reduction of BOD concentrations prior to discharge to the municipal sewer system.

We currently have no other concerns regarding your proposed discharge.

I would appreciate receiving notification upon start up of your process to review current analysis of this wastewater and to discuss any concerns at that time.

I trust this information meets with your approval.

Yours truly,

John A. Sibbald
Pollution Prevention Coordinator

JAS/

2750 Dutch Village Road, P. O. Box 1749, Halifax, NS B3J 3A5, Tel: (902)-490-6950, Fax: (902)-490-4858
E-mail: sheppaj@region.halifax.ns.ca Web Site: www.region.halifax.ns.ca

HALIFAX
REGIONAL MUNICIPALITY

PUBLIC WORKS AND TRANSPORTATION SERVICES
ENVIRONMENTAL AND ENGINEERING APPROVALS

December 13, 2001

Inland Technologies Canada Inc.
P.O. Box 253
Truro, NS
Canada B2N 5C1

Attention: **Richard Johnson**

Dear Sir;

Re: Discharge of Wastewater to Sanitary Sewer

Further to our telephone conversation of today, December 13, 2001, I am writing to confirm that the required BOD concentration of wastewater which will be permitted to be discharged to the municipal wastewater system is 300 ppm.

This concentration is specified in the Halifax Regional Municipality By-Law W-101 which regulates the discharge of wastewater to municipal storm and sanitary sewer systems.

I trust this information meets with your approval.

Yours truly,

John A. Sibbald
Pollution Prevention Coordinator

JAS/

2750 Dutch Village Road, P. O. Box 1749, Halifax, NS B3J 3A5, Tel: (902)-490-6950, Fax: (902)-490-4858
E-mail: sheppaj@region.halifax.ns.ca Web Site: www.region.halifax.ns.ca

NOVA SCOTIA

Department of the Environment & Labour
Central Regional Office

Suite 224, Sunnyside Mall
1595 Bedford Highway
Bedford NS B4A 3Y4

Tel: (902) 424-2560
Fax: (902) 424-0597
File:30100-31-/
BED-023609

Bernard J. Matlock, P. Eng.
Environmental Engineer

January 24, 2002

RECEIVED
JAN 2 8 2002

H. James Simmons, P. Eng.
Senior Project Engineer
Jacques Whitford Environment Ltd.
3 Spectacle Lake Drive, Dartmouth
B3B 1W8

Dear Mr. Simmons:

Re: Inland Technologies (ProposedAircraft De-icing Fluid Recycling Facility)
BOD_5 Discharge Criteria

Further to your fax request dated January 10, 2002 the maximum concentration of BOD_5 in liquid effluent discharging to the municipal sanitary sewer from the proposed aircraft de-icing fluid recycling plant should not exceed 300 mg/l.

It is strongly advised that the proponent consult with the Halifax Regional Municipality to determine discharge requirements which will not further compromise the performance of the Aerotech sewage treatment facility and subsequent impact to the receiving streams. In this regard I would also advise that the design be conservative to achieve well within the 300 mg/l sewer discharge by-law limit.

The proposed activity will require environmental assessment registration and approval prior to being granted an approval in accordance with the *Activities Designation Regulations*. The outcome of the environmental assessment process may dictate more stringent effluent discharge criteria be applied to mitigate potential environmental impacts.

Should you have any questions I can be contacted at 424-2560.

Yours truly,

B. Matlock

Bernard Matlock, P. Eng.
Regional Engineer

cc. S. Cameron
S. Morash
A. Brady (HRM)

APPENDIX G

SPILL RESPONSE CONTINGENCY PLAN

Inland

SPILL CONTINGENCY RESPONSE PLAN

Table of Contents

1.0 SCOPE 1

2.0 NOTIFICATION PROCEDURES 1

3.0 ROLE OF THE RESPONSE TEAM LEADER 2

4.0 CONTAINMENT AND CLEAN-UP PROCEDURES 3

4.1 On-Site Spills/Leaks within Contained Areas 4
Minor Spill/Leak 4
Serious Spill/Leak 4
4.2 On Site Spills/Leaks Outside of Containment Areas 4
Minor Spill/Leak 4
Serious Spill/Leak 5
4.3 Major Spills 5
4.4 Transport Releases 6

5.0 RESTORATION OF THE SPILL SITE 6

6.0 DISPOSAL 6

7.0 RESOURCES 7

8.0 PUBLIC RELATIONS 7

9.0 REPORTING 7

10.0 SPILL RESPONSE CHECKLIST 10

Inland

1.0 SCOPE

Risk to the environment during the operation of the glycol concentration facility may result from an unauthorized release of glycol materials from containment or piping. An unauthorized release is defined as the release of a substance into the environment, as regulated under the Nova Scotia Environment Act and Regulations, that has caused, is causing or may cause an adverse effect. The purpose of this contingency plan is to provide a predetermined sequence of actions that can be immediately initiated to manage an unauthorized release in the course of the operation of the glycol concentration facility.

This contingency plan is developed for the operation of a glycol concentration facility located at the Halifax International Airport (HIA) and is to be followed in the case of unauthorized release of de-icing fluids and/or operational glycol products to the environment.

The following parties have specific responsibilities under the contingency plan.

- Inland on-site representatives including operators and/or staff personnel
- Delivery and removal transportation drivers
- Inland management
- Additional contractors or personnel on-site at the time of an event and employed by Inland Technologies Canada Inc.

2.0 NOTIFICATION PROCEDURES

The following notification procedures are to be undertaken on a 24 hour/day basis for the operation of the facility.

The first person to observe an unauthorized release of any size is expected to immediately take all responsible measures required and assume that responsibility. A release exceeding a volume of 50 litres will be reported to the Supervisor.

Should the situation warrant additional help, the Supervisor or designate will assume responsibility for implementation of the response plan, and will coordinate the activities of all other employees and, when relevant, contractors providing assistance.

The Inland representative will continue to coordinate response and notify necessary parties until the event is completely dealt with as per the guidelines of this manual.

In situations requiring external notification the Inland representative will contact the provincial Environmental Emergencies Report System as well as coordinate response until the arrival of Inland management, and/or authorities.

Notification List

Environmental Emergencies Report System	1-800-565-1633
Fire	911
Police	911
Corporate (24 Hour) Response Emergency Plan Activation pending (Richard Johnson)	(902) 899-8015
Local Response Team Leader– pending (Richard Johnson)	(902) 899-8015
Local Management – Roger Langille/Richard Johnson	(902) 895-6346
Regional/National Management –	
Inland Technologies (Truro) Richard Johnson	(902) 895-6346
Inland Technologies (Dorval, Quebec) William Koncsik	(514) 426-0042
Industry Assistance – HIAA Duty Manager	(902) 873-1234
Government Assistance - Canadian Transport Emergency Centre of the Department of Transport (CANUTEC) (collect call - 24 Hours/Day)	(613) 996-6666
Clean-up Contractors - Atlantic Industrial Cleaners	(902) 481-9011
Supplies - Atlantic Industrial Cleaners	(902) 481-9011

3.0 ROLE OF THE RESPONSE TEAM LEADER

The response team leader is designated as the person in charge of the countermeasures phase of a spill response. The response team leader will be trained in emergency response, be responsible for implementing the Spill Contingency Response Plan and will coordinate the activities following the spill. The team leader will delegate tasks and instruct personnel in accordance with the Spill Contingency Response Plan.

The team leader will determine the degree of emergency of the event. Under discretion to the degree of emergency, the leader may direct resources and communicate with government agencies to accomplish resolution of the situation. The leader will also act as the focal point for information exchange between management and government agencies and may follow additional response instruction from Inland management outside the scope of the Spill Contingency Response Plan.

Following a release, the response team leader will undertake the immediate steps for environmental clean-up. If applicable, Inland management will be contacted and will instruct on-site sampling to determine the acceptable remediation levels in accordance with applicable guidelines.

The response team leader will submit a report including the Spill Response Checklist (Section 10.0) detailing response measures to Inland management.

4.0 CONTAINMENT AND CLEAN-UP PROCEDURES

It is the responsibility of all glycol recovery and recycling staff to ensure the storage areas are clear, safe, neat and clean at all times. Not only will this equate to a safe working environment, but will also demonstrate a "green" sensitivity to visitors and airport staff.

However, in the event of a spill the following containment and clean-up procedures are to be used in the case of glycol de-icing fluids and/or derivative products released from the operation of the glycol concentrator facility and/or during the transport of fluids for the purpose of the operations.

The quantities of fluids used during the operation of the glycol concentrator facility and/or during transport are as follows:

2,000,000 litre aboveground feed tank (approximately 1-20% glycol)
46,000 litre aboveground concentrate tank (approximately 18% glycol)
46,000 litre aboveground concentrate tank (approximately 50% glycol)
6000 litre glycol recovery vehicle (approximately 1-20% glycol)

Exposure to released materials may be irritant to the eyes, skin and respiratory tract. Personnel involved in the clean-up of a spill should wear skin and eye protection. Respiratory protection is not required under normal conditions. The fluids do NOT contain ingredients designated by IARC, NTP, ACGIH or OSHA as causing chronic effects or as carcinogenic.

The fluids contain surfactants that may cause it to disperse in water. In high, localized concentrations, this product may be harmful to aquatic life, however there are no surface water courses near the facility.

The site is located at the Halifax International Airport on Goudey Drive. There is an elevated embankment between the operation and the roadway ditch located approximately 30 meters southeast from the

operation location. Addition site features were in the development phase at the time of writing.

4.1 On-Site Spills/Leaks within Contained Areas

Minor Spill/Leak

i. Interrupt source and contain spill
ii. Prevent fluids from entering any storm drains
iii. Clean up with mops/rags immediately
iv. Store rags in drums labeled as such in shop area for eventual cleaning/disposal
v. If caused by faulty equipment, notify Supervisor immediately for inspection/repair of equipment.

Serious Spill/Leak

i. Interrupt source and contain spill
ii. Prevent fluids from entering any storm drains
iii. Contain spill within as small an area as possible. Clean up with mops/rags immediately
iv. At this point, the management must be notified. If additional manpower or equipment is necessary these, arrangements should be made.
v. Pump spilled product to storage by truck or portable pump. Push product toward low spot with squeegees for maximum product removal
vi. Clean up remaining Glycol completely with rags and/or absorbent
vii. Place rags and absorbents used in response in containers marked for that purpose, and store for eventual disposal
viii. The Supervisor must ensure full completion of a Response Checklist as soon as possible
ix. Notification/Record Keeping by Management:
- Ensure completion of checklist,
- Notification of Environmental Concerns Committee chairman or alternate member, within 24 hours of occurrence,
- If spill exceeds containment, immediate notification of the Airport Department of the Environment, or equivalent.

4.2 On Site Spills/Leaks Outside of Containment Areas

Minor Spill/Leak

i. Interrupt source
ii. Remove soil until no odor can be detected in the soil

iii. Soil is to be stored in a pail in the facility building for disposal
iv. Spill is to be logged on site plan by the Compliance Officer (or his/her alternate) within 48 hours of occurrence.

Serious Spill/Leak

i. Interrupt source and contain spill.
ii. If possible, scoop any free liquids into a five (5) gallon pail. Soak up any remaining free fluids with rags.
iii. Remove soil until no odor can be detected in the soil. Store in pail(s) in the facility building for disposal
iv. Ensure checklist is fully completed and returned to the Operations Manager immediately
v. Airport Environmental Management must notify the Environmental Concerns Committee Chairman or an alternate member within 24 hours of occurrence

4.3 Major Spills

i. Interrupt source
ii. Use any and all methods available to contain the spill to the smallest area possible and especially to prevent contamination of any watercourse or ditch. Options are:
    - Absorbent booms
    - Dyking to contain/trenching to divert; using hand tools or contractor equipment - backhoe, dozer, etc.
iii. As soon as practical the Operations Manager and Environmental Support Manager must be notified of spill
iv. Pooled product is to be removed immediately to storage drums, tanks, or truck by portable pump and/or truck pump. Soil removal is to begin as soon as possible after spill is contained. Remove until no odor is detectable in the soil. Soil is to be stored in drums on the paved area of the truck yard for eventual disposal. Note that drums with tops cut out should only be filled 2/3 full to facilitate their eventual transportation
iii. Complete response checklist and return to Management
iv. Airport Environmental Management must ensure that:
    - Environmental Concerns Committee Chairman or alternate is notified within 24 hours of occurrence,
    - Site plan logging and occurrence report are both completed within 48 hours of occurrence,
    - If spill exceeds 70 litres the Airport Department of the Environment, or equivalent, must be notified immediately,

- Samples are taken of remaining soil from each 16 square feet of affected area after soil removal. Samples to be labeled with occurrence report number and retained indefinitely

The above does not preclude local airport emergency call-out procedures.

4.4 Transport Releases

The driver transporting de-icing fluids containing glycol to the facility assumes responsibility to respond immediately to an occurrence, and to follow the guidelines of this manual. The driver is also required to activate the response plan by notifying an Inland representative of the event.

If the situation has warranted the inclusion of local authorities in a response, then upon their arrival the driver will render full assistance and cooperation until the arrival of Inland's Supervisor.

The Inland response team leader will work in conjunction with local authorities to coordinate all Inland personnel responding to an in-transit occurrence, including the driver originally involved.

The driver will follow the above noted Containment and Clean-Up Procedures (Section 2.0), as well as follow any further instruction given by the Response Team Leader.

5.0 Restoration of the Spill Site

The site will be restored in accordance with the lease agreement and also is to be within applicable regulatory guidelines. During restoration environmental considerations will include sediment erosion control, terrestrial habitat and nonpoint source pollution. The magnitude of restoration will be in accordance to the extent of release.

Directly following a release, efforts will be made to contain the spill area to control further impacts to the environment (details can be found in the Containment and Clean-Up Procedures (Section 4.0)). If necessary, Inland will contact environmental professionals for consultation on site clean-up options and restoration techniques.

6.0 Disposal

Industrial Environmental Services (IES) located in Debert, Nova Scotia has been approved as a facility for the disposal of material released from the facility. Disposal material will be transported by truck to IES. The

material may be stored in the on-site containment tanks until transport is feasible.

7.0 RESOURCES

An operator will be on-site at all times during the period of the 24 hour operation. In the case of a spill, additional manpower may include Inland management, clean-up contractors, HIAA duty manager, government agency representatives and/or environmental professionals. Contact numbers can be found in the **Notification List** on page 2 of this document.

On-site spill kits will be kept properly stocked and be located in close proximity to the storage tanks. All communication equipment (telephone/cell phone) will be kept in proper working order.

Information and expertise in an emergency may be obtained from the Local Response Team Leader (Richard Johnson)(902) 899-8015, Inland management or government agencies.

8.0 PUBLIC RELATIONS

In the event of a spill it is the responsibility of the Response Team Leader and all glycol recovery and recycling staff to ensure that all measures are taken to limit environmental impacts and to immediately commence the clean-up plan. In the case of a major event, all public relations must be carried-out by the following personnel or as appointed by the following:

- Operations Supervisor Eastern Region - Richard Johnson
- Operations Manager - William Koncsik

It is the responsibility of the Response Team Leader to contact the above in regards to public relations in the case of a major event, as well as notify all team members of the public relations plan.

9.0 REPORTING

The Supervisor must ensure full completion of a Response Checklist as soon as possible following a spill or release. Management is required to notify and ensure recording of the event including:

- Ensuring completion of checklist,
- Notification of Environmental Concerns

Committee chairman or alternate member, within 24 hours of occurrence,
- If spill exceeds containment, immediate notification of the Airport Environment Department, government organizations or equivalent.

If required, a report detailing response measures will be compiled by the response team leader and Inland management for submission of the request.

The report may include but is not limited to the following:

- Date and time of release;
- Time spill or leak was interrupted and contained;
- Weather conditions at the time of release and during the response phase;
- Cause of the release;
- Product or products involved;
- Quantities involved;
- Areas or properties involved;
- Time Operations Manager contacted,
- Identification of all parties and individuals involved in the response or exposed to the release;
- If applicable: time outside contractors/agencies contacted,
- Any health treatments or tests conducted on individuals;
- Containment and Clean-Up Techniques;
- Disposal methods including quantities and location;
- Site remediation completed and planned;
- Short and long term impacts;
- Status of the Response;
- A log of Actions taken to including associated times; and
- Measures to be implemented to prevent re-occurrence.

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10.0 SPILL RESPONSE CHECKLIST

SPILL RESPONSE CHECKLIST

	Time
Spill Detected	_____
Spill Interrupted	_____
Spill Contained	_____
Storm Drains Blocked	_____
Management Contacted	_____
Outside Contractors / Agencies Contacted	_____
Clean-up Materials Disposed of	_____
Clean-up Completed	_____

Note: If an action above is relevant to the response, indicate approximately time action was taken, otherwise mark "N/A". e.g. 10 Litre spills in containment would not require contacting outside agencies - This would be marked N/A.

Type and amount of material used in clean up.

_____
_____
_____
_____
_____

Comments (Cause of spill, repairs made, etc)

_____
_____
_____
_____
_____

Signed: _____ Date: _____