St. Lawrence TECHNOLOGIES

ABSTRACT

A glycol concentrator was commissioned at a facility adjacent to Dorval Airport during the 1996-97 de-icing season. The glycol concentrator processed approximately 200 000 L of spent de-icing fluid in about 300 hours of operation time. The output concentration of the recycled glycol averaged 48-51%. The batch of recycled glycol met the performance based requirements as a Type I de-icing and anti-icing aircraft fluid, in accordance with AMS Standard 1424A. These results support the ultimate objective: reuse of the recycled glycol as aircraft de-icing fluid.

INDUSTRIAL WASTEWATER

ON-SITE RECYCLING AND POTENTIAL REUSE OF AIRCRAFT DE-ICING FLUIDS

MAIN FEATURES

- **Technology**
  - Glycol concentration attained from evaporation followed by mechanical vapour recompression of water
  - Processing capacity of over 1000 L/hour of spent de-icing fluid
  - Fits into a trailer for transport to airport sites
  - Adapted to actual airport installations
- **Environment**
  - Efficient recycling of the ethylene glycol (EG) derived from spent de-icing fluid
  - Significant reduction in biological oxygen demand (BOD_5) entering the sewer system
  - No gaseous emissions
- **Cost**
  - Reusable glycol feedstock for a variety of product formulations
  - Recycled glycol at approximately half the price of new ethylene glycol based de-icing fluid
  - Reduce sewer and operating costs to airports and airlines

Saint-Laurent Vision 2000

Environment Canada Protection Québec Region

Environnement Canada Protection Région du Québec

Inland Technologies Inc.

Federal Office of Regional Development (Québec)

Bureau fédéral de Développement régional (Québec)

PROJECT OBJECTIVES

More specifically, the objectives of the project were as follows:

1. To determine optimum absorption material.

2. To increase the unit throughput from 800 to 1000 L/hr.

3. To increase recycled glycol concentration from 40 to 50%.

4. To reduce distillate concentration of 10 000 mg/L.

5. To evaluate the recycled fluid with respect to the Society of Automotive Engineers - Aerospace Material Specification (SAE-AMS) for De-icing/Anti-icing Fluid Aircraft SAE Type I.

6. Increase range of spent aircraft de-icing fluids input concentration.

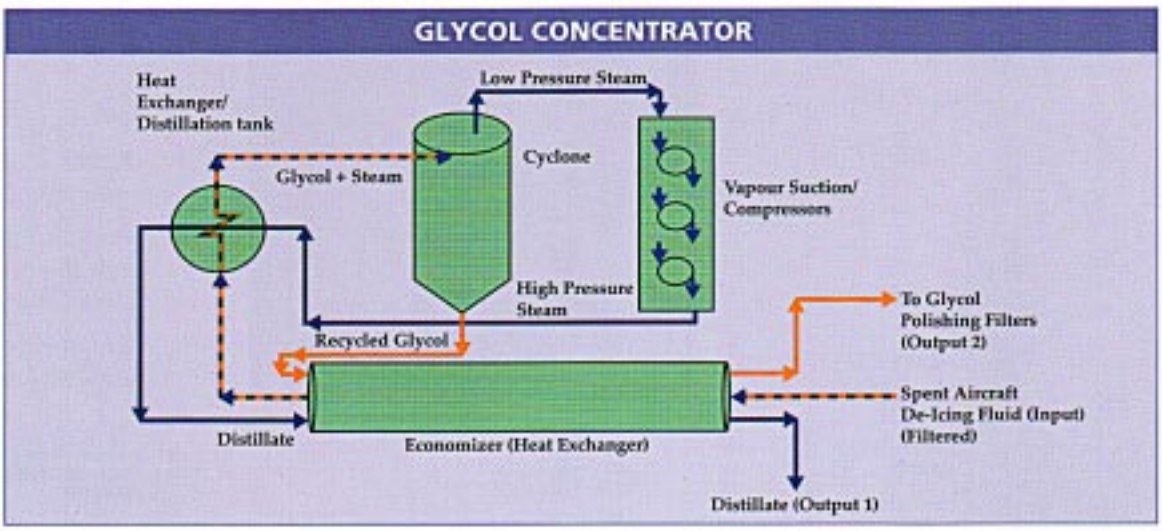
BACKGROUND

Ethylene glycol or propylene glycol ("glycol") is used as the main ingredient for aircraft de-icing/ anti-icing fluids. These products exhibit a high biological oxygen demand (BOD_5) that may be harmful to the environment. To prevent glycol from entering surface waters, most Canadian airports collect the glycol after de-icing operations. The spent aircraft de-icing fluid is then discharged into sewer systems, where it must comply with the Canadian Environmental Protection Act guideline for discharges of glycol into surface water (100 mg/L). In the case of the Dorval Airport, the Montreal Urban Community allows as much as 20 tonnes per day and up to 30% of glycol into the sewer system. The Montreal sewage treatment plant only performs a physical-chemical treatment, and no biological treatment. The resulting effluent is then discharged to the St. Lawrence River.

TECHNOLOGY

The concentrator, in conjunction with filtration operations, removes water from glycol solutions using evaporation with mechanical vapour recompression. The concentrator consists of a skid-mounted apparatus which includes four principal components: a heat exchange/distillation tank, vapour suction units (steam compressor), a cyclone (steam-glycol separator), and an economizer for heat recovery from the output streams. The unit can function over a wide range of feedstock concentrations of either ethylene or propylene glycol, and is designed to produce an output of up to 55% glycol concentration. The distillation overhead stream, comprising approximately 99.5% water and 0.5% glycol, is discharged to the sewer system, in accordance with applicable permits.

An important feature of the glycol concentrator is that it is relatively compact and requires no special services other than electricity and water connections. This allows the concentrator to be easily integrated into any airport environment. Furthermore, a concentrator can be added or removed according to the recycling requirements of each airport.



RESULTS

Glycol Concentrator Performance

The pre-production unit was commissioned on November 15, 1996. The concentrator was used for 24-hour periods to process spent de-icing fluids from the Dorval Airport. It was operated virtually maintenance free for over 300 hours in the period from November 15, 1996 to February 7, 1997. The concentrator has operated an additional 10 months since the end of the demonstration project and will be in full utilization for the 1997-98 de-icing season.

GLYCOL CONCENTRATOR PERFORMANCE

Parameter	Units	Demonstration Project: Start	Demonstration Project: End
Processing capacity	L/hour	600-800	950-1150
Glycol concentration (Input)	% EG	5-20%	8.5-30%
Glycol concentration (Output 2)	% EG	40-50%	48-51%
Distillate (Output 1)	mg/L (EG)	10 000-12 000	5800
Power Costs	$/Litre	0.0045	0.0040

Performance of Recycled Glycol Fluids

The evaluations followed the Aerospace Material Specification (AMS) of the Society of Automotive Engineers (SAE) standards for de-icing fluids 1424A "De-icing/Anti-icing Fluid Aircraft SAE Type I" (revised October 1996) and were performed by the Anti-Icing Materials Laboratory (AMIL) of the Université du Québec à Chicoutimi. The results are applicable for the 1996-97 batch of recycled glycol and are valid for a two-year period. The recycled de-icing fluid was also tested for physical properties, storage stability and effects on aircraft materials in accordance with SAE-AMS specification 1424A. The recycled de-icing fluid was in conformity with virtually all of the 1424A specifications. Additional work is needed to address a slight variation in the pH stability of the recycled fluid (due to the presence of urea from runway de-icing).

PERFORMANCE OF RECYCLED AIRCRAFT DE-ICING FLUID

1424A test (AMS) Type I	Minimum time		Conforms
	Required	Measured (1,2)	
Anti-Icing (Water Spray)	3 minutes	5.5 minutes	Yes
Anti-Icing (High Humidity)	20 minutes	42 minutes	Yes

[1] Recycled aircraft de-icing fluid conforms above -31.5 °C.

[2] Applicable for 1996-1997 batch of recycled de-icing fluid and valid for a two-year period.

POTENTIAL AND LIMITATIONS

Potential

The glycol concentrator resolves many of the problems associated with the management of spent de-icing fluid by providing a cost-efficient and flexible solution. Airport authorities and airlines are now aware of the importance of controlling releases of glycol into the environment and they require that environmental control systems be in place. Most municipalities have BOD_5 sewer discharge surcharges. These factors make the glycol concentrator economical for use at most major airports with extensive de-icing operations. The glycol concentrator works equally well with either ethylene or propylene glycol based de-icing fluids.

Limitations

The economic viability of the glycol concentrator may be hindered where there are no regulations or sewer surcharges governing the discharge of spent de-icing fluids into the environment.

INFORMATION

This data sheet is based on the results of a technology development and demonstration project carried out by Les Services Environnementaux INL Inc., a wholly owned subsidiary of Inland Technologies Inc., with the technical and financial assistance of Environment Canada and the Federal Office of Regional Development (Quebec).

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St. Lawrence TECHNOLOGIES

St. Lawrence Technologies data sheets are intended for all companies, industries, organizations and individuals interested in new environmental technologies. They are produced by the Eco-Technology Innovation Section, Environment Canada, as part of the St.Lawrence Vision 2000. They serve to disseminate the results of technology development and demonstration projects conducted in the following five sectors: industrial wastewater; contaminated soil; hazardous wastes; contaminated sediment and innovative tool.

Data sheets may be obtained from:
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http://www.qc.doe.ca

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Printer:
J. B. Deschamps inc.

Published by authority of the Minister of the Environment

Cat. No.: En 1-17 / 28-1997E
ISSN: 1188-8903
ISBN: 0-662-26161-5

November 1997

Cette fiche est également disponible en français sous le titre:
Recyclage sur place et réutilisation potentielle des liquides de dégivrage des avions

Canada