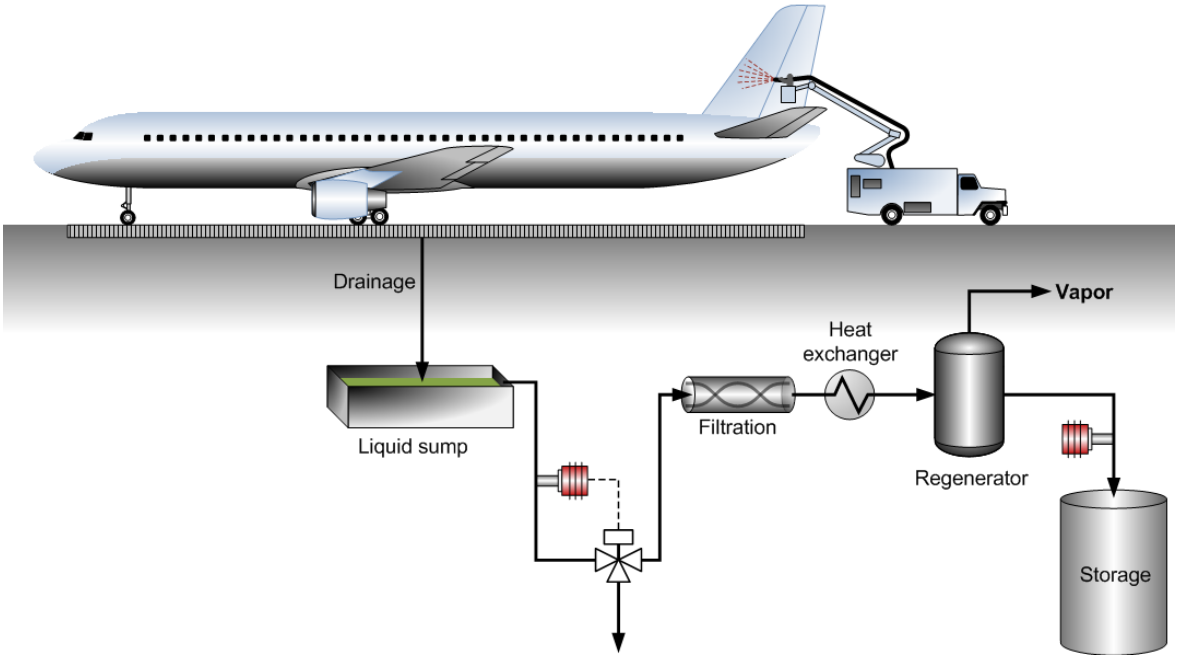
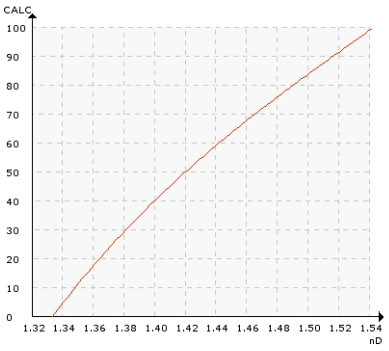


ETHYLENE GLYCOL CH_2OH_2, PROPYLENE GLYCOL $C_3H_8O_2$

Typical end products

Airplane de-icing

Chemical curve: R.I. per BRIX at Ref. Temp. of 20˚C



Introduction

Aviation de-icing and anti-icing fluids, such as ethylene glycol (EG) or propylene glycol (PG), keep atmospheric ice from accumulating on aircraft's flying and control surfaces while in flight. The effects of ice accretion on an aircraft can cause loss of control, resulting in catastrophic flight events.

De-icing on the ground is usually done by spraying the aircraft with a de-icing fluid. The operational procedures are continually checked and updated by an international group of experts under the auspices of the Society of Automobile Engineers (SAE) G-12 Committee on Aircraft Ground De-icing/Anti-icing.

The de-icing fluids must be used with a containment system to capture the used liquid, preventing ground and streams contamination. Airport storm water discharges containing de-icing fluids are the focus of numerous regulatory actions.

Application

1. Spraying

De-icing is typically accomplished with the application of a glycol and water mixture via spray nozzles to the aircraft's fuselage and flying surfaces. The de-icing fluids are applied through spray nozzles in the apron area either from fixed application platforms or from mobile tanker trucks. To ensure that the fluid performs effectively, operators must perform quality control checks with regard to the fluid's viscosity and Refractive Index.

The fluid's freezing point e.g. -36ºC (-32.8ºF) rises with the addition of water (e.g. through contamination or precipitation), reducing its effectiveness. Therefore, regular checking of the fluids' freezing point is necessary to ensure safe operations. The freezing point can be measured directly using the ASTM D1177 -method. However, this method is cumbersome for field application.

The Refractive Index is related to the concentration of ethylene glycol, the freezing point depressant contained in the de-icing fluid. Therefore, the R.I. is also related to its freezing point. In the field, glycol's freezing point can effectively and easily be monitored by measuring the fluid's Refractive Index with a K-Patents Compact Process Refractometer PR-23-AC. The acceptable range for the Refractive Index is at 20°C (68°F) and 30.5–33.5ºBRIX. The K-Patents refractometer is automatically temperature compensated and covers the Refractive Index range, which is measured in BRIX.

Hydrometers are unsuitable for calculating the freezing point for the aircraft de-icing formulations because they are not sufficiently accurate. Air bubbles are often present in the de-icing/anti-icing fluid. The K-Patents refractometer is uninfluenced by the presence of bubbles.

2. Recovery

After application, the de-icing fluid and water mixture is either disposed of through natural rainwater drainage channels, or recycled via centralized de-icing fluid recovery and recycling facility. A drainage system, which is incorporated into the concrete or asphalt apron, collects the de-icing fluid along with melted ice and snow and directs the liquid into a sump.

Upon accumulating a sufficient quantity of the used and diluted de-icing fluid, it is pumped to a sludge tank. Solids and free water are separated by settling and filtration processes in the sludge tank. The filtered de-icing fluid mixture is heated through sequential heat exchangers and directed into a regenerator. The de-icing fluid mixture is leaned with a dehydration process in the regenerator, involving water and water condensate evaporation in a reflux stripping column. Then, it is passed on to an accumulator.

The heated, lean de-icing fluid is pumped from the accumulator back through the sequential heat exchangers and then returned to the storage tank for subsequent reuse.

Installation

The K-Patents refractometer can be used to measure the concentration of glycol from spraying platforms and mobile units, as a quality and safety check. Another process control area is in the recovery system. It monitors the concentration of collected fluids in order to direct pure water to drainage and diluted glycol to the sludge tank. The K-Patents refractometer measures the final concentration after the dehydration process before the glycol is returned to storage.

Instrumentation	Description
	K-Patents Sanitary Compact Refractometer PR-23-AC for small pipe line sizes of 2.5 inch and smaller. The PR-23-AC sensor is installed in the pipe bend. It is angle mounted on the outer corner of the pipe bend directly, or by a flow cell using a 3A Sanitary clamp or Varivent® connection.
Measurement range:	Refractive Index (nD) 1.3200 – 1.5300, corresponding to 0-100 % by weight.