# Sound airport deicing fluid management

*New regulatory rules proposed by the United States Environmental Protection Agency (EPA) in December 2007 will likely require airports to limit the discharge of deicing and anti-icing fluids to nearby surface water bodies.* ***Mark O. Liner****, P.E., a senior engineer for the consultancy Jacques Whitford NAWE, Inc., reports on current regulatory developments and explains the technical challenges in managing airport deicing fluids and treating stormwater.*

Airplane deicing requirements have made air travel in winter months safer, but airport managers worldwide will soon have to cope with new regulations as the environmental impacts of the practice are now coming under regulatory scrutiny.

Many major international hubs including London's Heathrow International have incorporated management systems to handle these fluids. By the end of 2007, the United States Environmental Protection Agency (EPA) plans to propose guidelines for airport deicing to limit the discharge of pollutants to streams and other surface water bodies. The necessary actions at airports will differ and depend on the scope of the new EPA Effluent Guideline. For some U.S. airports, such as Buffalo Niagara International Airport in New York, changes are already underway. One thing is certain – each airport that conducts deicing activity will require a solution.

The new deicing fluid guidelines will establish a baseline with which all U.S. airports must comply. Currently the EPA is working with airports to collect survey data and conduct detailed sampling programs. This work will be used to identify the best available technology that is economically achievable for treatment of deicing and anti-icing fluids. Typically, the best available technology is the basis on which numerical discharge limitations are developed. The EPA plans to publish the proposed rule in December 2007 and take final action by September 2009.

The environmental effects of deicing fluids are most notably related to the high oxygen demand they exert when released to rivers and streams. A large slug of glycol can quickly deplete the dissolved oxygen in receiving waters, which can kill fish and other organisms that need aerobic environments. Removal of these "loads" prior to discharge is the primary basis for the use of sewage plants throughout the world. As a reference, typical household wastewater has a Biological Oxygen Demand (BOD) of around 200 mg/l, while some discharges from airports have measured more than 100 times stronger than that at 22,000 mg/l (from EPA's *2000 Preliminary Data Summary on Airport Deicing Operations*). In most cases, surface water permits limit discharge of BOD to below 30 mg/l.

The depletion of oxygen in water bodies is only part of the story; recent work by the United States Geological Survey (USGS) has examined the toxicity of airport deicing fluids. The research, presented by Steve Corsi of the USGS at the American Association of Airport Executives' 15th Annual Deicing and Stormwater Management Conference (2006), examined the toxic effects associated with the melt of glycol-laden snow banks. Further, the presentation probed the toxicity associated with the additives used in deicing liquids. It concluded that toxicity could be related to the additives used in deicing and anti-icing formulations. Although treatment for glycol may eliminate oxygen depletion in streams, it is the glycol additives that may be of more concern in terms of toxicity to the environment.

## Strategies for managing wastewater

Four areas to be considered in developing a strategy for managing the wastewater from deicing are: source reduction, containment, stormwater treatment, and disposal. The importance of each area differs in various airports. In some cases, an airport may choose to completely do away with glycol-based deicing activities in favor of non-chemical means such as infrared heating. In some other cases, an airport may have the luxury to dispose of all wastewater to a sewage plant. For the rest, some form of treatment is necessary.

Source reduction is probably the most sensible course. This umbrella term covers the use of methods taken to reduce the quantity of glycol being flushed downstream. It is sensible because for every gallon of glycol that is vacuumed, one less gallon of glycol requires treatment. This approach gathers importance when one considers that once glycol becomes diluted, the volume of water requiring treatment increases proportionately. For airports, source reduction is most commonly associated with the use of vacuum "sweeper" trucks that circulate during deicing to suck up spent deicing liquids. The reclaimed glycol is purified and sold. Not only does source reduction limit the wastewater requiring treatment, it also provides income. The downside with the use of vacuum trucks is in managing traffic in and around the airfield.

Most airports practice some form of containment for collecting the most contaminated deicing fluid. This highly concentrated wastewater can be collected in a sump and trucked directly to sewage plants for treatment in anaerobic digesters, however this strong waste stream often requires some treatment to reduce its organic load prior to discharge. The Albany airport in the state of New York has had noted success in using an onsite anaerobic treatment process to greatly lower BOD loadings. Treatment of high strength wastewater typically favors anaerobic processes that convert glycol and other hydrocarbons to methane gas, though these processes have a reputation for being sensitive and potentially malodorous. Conventional aerobic treatment is also an option, but the high strength of the wastewater typically results in high operational costs associated with running blowers and managing bacterial sludge.

**Many major international airports safely manage deicing and anti-icing fluids.** ***Photo by Rick Reeter, Dallas Ft. Worth Airport***

Up to 40 percent of glycol can be recovered and recycled or treated. A significant percentage of the remaining portion does end up in stormwater and can have concentrations as high as raw sewage. Subsurface-engineered wetlands are proving to be effective in treating this contaminated stormwater. Three wetlands are now operating to treat glycol-contaminated stormwater in Edmonton International Airport in Edmonton, Alberta, Canada; Heathrow International Airport, London, United Kingdom; and at Air Express Airport, Wilmington, Ohio, USA.

The ultimate disposal of glycol-contaminated water significantly affects the final system design.

Discharge to a sewage plant is often the easiest solution. The challenge is that many sewage plants have reached their design capacity and operators are frequently less inclined to receive large, cold, high strength flows from airports. In most cases, the level of treatment required will dictate the options chosen and is directly related to the environmental health of the receiving water body. As the EPA continues to develop and revise effluent guidelines and stormwater permitting criteria, the level of treatment necessary may be a moving target. This may mean that environmental managers should expect stringent limits.

**Airplane deicing practices have made air travel safer during cold, winter months.** ***Photo by Rick Reeter, Dallas Ft. Worth Airport***

### Stormwater regulations

Currently, most airports have a National Pollutant Discharge Elimination System (NPDES) permit that regulates the discharge of stormwater collected in and around the airfield. Complicating matters is a separate wing of the EPA charged with regulating stormwater under the NPDES. The NPDES program has a well-established permitting system for end-of-pipe discharges, typically associated with sewage plants and other pipe outfalls. This area of stormwater permitting is still evolving and undergoing implementation of a second phase. For these discharges, permit writers have little uniform guidance on how to establish limits for pollution from deicing. Effluent guidelines should fill the gap, however, such guidelines are rarely used to support stormwater permits. Permit writers will need to balance local stormwater conventions with national guidance.

Along with current stormwater permitting and the new Airport Deicing Effluent Guidelines, airports will also be subject to constraints related to water quality-based discharge limits and total maximum daily loads (TMDLs). These constraints vary from state to state and place to place and will add complexity to the permitting process.

### Technical challenge

Most deicing areas are constructed to provide quick drainage as reflected by the pipes and drains around an airport. Though useful for keeping gates and pads free of ponding water, this flush-and-forget approach results in the potential for downstream flooding. To combat this, airports have incorporated stormwater storage tanks, vaults, and ponds to shave peak flows. With large airfields producing significant runoff, stormwater storage volumes can be massive and are typically sized in the millions of gallons.

Though effective at buffering peak flows, these large storage volumes are not usually piped to capture the initial first flush of a storm. This is the period of time that generally contains the largest concentrations of pollutants. Civil engineers are increasingly aware of this and are incorporating front-end quality control volumes into stormwater management systems. The dirty, first flush that is captured is pulled aside during a storm event and treated. A common challenge in this is that most airports do not have quality control volumes integrated into the airfield storm piping, which would require significant engineering effort to implement.

The nature of the deicing wastewater must also be considered. Wastewater engineers need three pieces of data to design a treatment system: the strength of wastewater, the required quality for discharge, and the volume. In most cases, these pieces are easy to define resulting in the stepwise development of a treatment system. The greatly fluctuating nature of deicing activity, however, can make the development of a good design just as erratic.

In summary, a design must address the following criteria to be an effective solution:

- Provide treatment of cold and variable strength wastewater;
- Integrate into the existing storm water management system;
- Handle large seasonal variations;
- Be on or close to the airport property;
- Not present a bird strike or airside hazard;
- Have negligible odor production;
- Demonstrate cost effectiveness.

From a technical standpoint, the most important aspect is coupling wastewater treatment with stormwater management. These two disciplines have competing interests: a wastewater engineer is interested in first flush, high concentration treatment and the stormwater engineer is interested in storing the peak, diluted flows. The competition leaves each fighting for storage volume that is hard to accommodate on site.

An innovative method for stormwater treatment is the use of subsurface, aerated gravel beds. These engineered wetlands were used at Heathrow and are currently under construction at Buffalo Niagara International Airport. The below-grade beds are designed to sustain a resident, attached community of bacteria acclimated for the specific task of glycol removal. The stormwater is distributed uniformly over the beds and flows vertically through the gravel to a system of underdrains. Air is pumped to the beds through a network of aerating tubing. The bed is insulated on top with a layer of peat mulch, which has been proven to be an important means to conserve heat.

The wetland will consist of eight wetland cells excavated from an existing open area near the airport's main runway and will encompass roughly 10 acres. At ground level, only a field of wetland grasses will be observable, growing from a "dry" mulch surface. The size of the gravel used and the porosity of the bed are important design factors. Detailed analysis of biomass growth, storage, and decay was undertaken to ensure that the bed could seasonally accommodate the transient nature of the bacterial community.

### Conclusion

And for now, as airport managers wait for the proposed rule, time is best spent planning on what to do once clearance for take off approaches. How each airport takes on glycol management will vary from site to site; the peculiarities of each airport will drive the process for treatment and the solution. How much deicing activity is there? What are the options for disposal? What is the existing infrastructure at the airport? Each facility will need to answer these questions, which will then channel the solution in a different direction. Many possible solutions for airports can be considered, so it is imperative that airport managers and their engineers look at all the factors affecting their deicing operation and the available options before starting down a treatment path.

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