Underground Treatment Of Airport Deicing Fluid

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Introduction

How bad was last winter? We all have different ways to answer that; but for airports, it can be measured by how much chemical was used to keep planes and pavement free of snow and ice. And, by that metric, the past two winters have been unusually severe for European airports. In the case of London Gatwick, chemical use jumped over five times compared to levels in the past decade.

While keeping air flight safe, airports and airlines are also obliged to clean up after themselves and protect nearby streams and water bodies. And due to increasing chemical usage and looming regulations, some airports will need to invest in significant infrastructure upgrades to capture and treat stormwater contaminated with deicing fluid.

In 2009, the United States Environmental Protection Agency proposed new Effluent Limitation Guidelines (ELGs) for airport deicing that would set a national standard for the capture and treatment of airport runoff. The regulations are in the process of being finalized and will be promulgated later this year. These new regulations are prompting airports to review existing and planned infrastructure to manage deicing activity. The costs can be high; the airport in Portland, Oregon recently completed a 100 million dollar project for the protection of neighboring water bodies.

Other airports have turned to a relatively new approach that provides treatment of runoff in underground basins. Referred to as “aerated gravel beds”, these biological treatment systems are specifically tailored for winter operation and are being used in the United Kingdom, Canada, and the United States. Experience with the design, construction, and operation of these systems over the past five years has demonstrated the ability of the systems to work even during the recent spate of “bad” winters.

The Cost of Compliance

The magnitude of the issue should not be dismissed. A gallon of the most commonly used deicing chemical, propylene glycol (PG) has roughly eight pounds of oxygen demand. To put that in some perspective, this is equivalent to the sewage generated by 40 people in one day. Considering that over 200 gallons of PG can be used per airplane for deicing (equivalent to 8000 people), you can imagine how the numbers and impact on the environment begin to pile up.

The problem is sizeable. No question about that. Each airport is unique in its climate, chemical usage, and stormwater storage capacity and there are different solutions depending on an airport's particular circumstances. A recent project that provides a rule of thumb for treatment costs is the treatment system at Buffalo Niagara International Airport (BNIA). The treatment system at BNIA cost 7.82 million dollars and is designed at 10,000 pounds of BOD/d treatment or $782 per pound of BOD/d. Using eight pounds of BOD per gallon of glycol that equates to roughly $6,250 per gallon of glycol captured per day. Assuming that airports can only capture about 33 percent of the chemical used, the cost of a treatment system can be estimated at $2,000 per gallon of glycol used. With larger airports using over 20,000 gallons of glycol per day, the capital cost of treatment can be staggering.

Three Treatment System Examples

Buffalo Niagara International Airport (BNIA), New York

With over eight feet of snow on average and 110 daily flights, BNIA joins the ranks of "big sprayers" when it comes to the amount of deicing fluid used each year and are required to treat stormwater prior to discharge to adjacent Cayuga Creek.

To reduce sewerage costs and meet stormwater discharge limits, BNIA selected an on-site treatment option for management of spent aircraft deicing fluid (ADF). The system had to be low profile and fit within the airside of the airport. It also needed to be capable of handling seasonal fluctuations, be designed for low operation and maintenance, and be integrated into the existing stormwater management system.

The airport constructed an aerated gravel bed treatment system in 2008-2009. A key criterion for the system was for it to be built adjacent to the edge of the object free area, 400 feet from the centerline of the runway. No easy task. The contaminated stormwater is distributed into underground beds specifically designed to operate with no exposed water or other bird attractants. The finished project is at grade with no above ground structures that could present an airside hazard. The patented Forced Bed Aeration™ system supplies air uniformly over the floor of the beds and that promotes biological degradation of glycol and other contaminants in the water. Development of the project was supported by a treatability study conducted in a walk-in refrigerator that established specific cold-weather removal rates for the airport's ADF.

"In the last year, the treatment system saved the airport $500,000 in operations cost", noted Kim Minkel, Executive Director of the Niagara Frontier Transportation Authority (NFTA) during the opening remarks of the Snow Symposium held in Buffalo on April 18, 2011. Online monitoring over the 2010-2011 deicing season indicated consistent treatment of 90 percent or more.

Mayfield Farm Refurbishment and Upgrade, Heathrow Airport, London

The British Airports Authority (BAA) commissioned a reed bed treatment facility in 2001 at Mayfield Farm to treat deicing runoff from Heathrow Airport. Due to expansion of airfield operations, the existing facility was upgraded in 2010 to provide a significant

increase in treatment capacity.

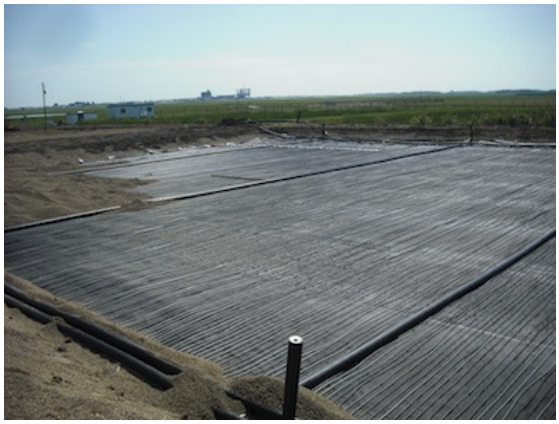
The upgrade of the treatment system included the addition of aeration equipment, a nutrient feed system, a reconfiguration of the existing reed beds, and related electrical and instrumentation work. The upgrade is divided amongst three major “unit processes” downstream of the main reservoir: a complete mix lagoon, partial mix lagoon, and the aerated gravel beds. During normal operations, flow is pumped from the main reservoir so as to flow in series through each unit process until discharge.

The system upgrade allowed BAA to re-use its existing infrastructure therefore reducing the impacts of new build facilities. The re-engineering, including Forced Bed Aeration™, allowed Mayfield Farm to increase its treatment capacity from 770 pounds of BOD to a minimum of 7,700 pounds of BOD per day.

Edmonton International Airport (EIA), Alberta

Glycol contaminated stormwater at Edmonton International Airport stays frozen every winter until the spring thaw. At this point, glycol and other plane and pavement deicing compounds are washed away to a large collection pond. Water from the pond requires treatment prior to discharge to a nearby creek. The existing wetland system has been treating the flow for almost a decade, but with expansion of the airport, a major increase in overall treatment capacity was required.

The system expansion is designed to provide over 1,500 pounds of BOD/d treatment capacity and is engineered to allow increased flow rates as the concentration of the BOD drops during spring melt. The upgrade includes reconfiguration of up to three of the existing treatment trains. The first cell of each train has been modified to a vertical flow configuration and incorporates Forced Bed Aeration™. The second cell in the train has been reconfigured as a surface flow wetland for polishing of the effluent. A nutrient feed system will also be included to allow addition of nutrient solution to match the level of organics in the influent.



With addition of aeration and nutrients, the upgraded system can provide up to 10x more treatment in half the footprint of the old wetland system. The aeration and nutrient systems are designed so that levels can be adjusted based on influent concentrations. Converting to vertical flow removes the hydraulic constraints previously experienced with the old horizontal flow wetlands. A new lift station also provides substantially more flexibility with meeting the aberrant flows of spring melt. Finally, incorporation of a recycle system permits expedited start-up in the spring.

In Closing

Under coming regulations, some cold climate airports will have to consider onsite treatment for ADF contaminated stormwater. The environmental impacts of not treating are significant and engineers will be challenged to develop systems that are cost effective. The evolution and use of aerated gravel beds for treatment of runoff is proving to be an effective solution for this unique problem. They offer the benefit of excellent treatment, low safety risk, and significant savings in operations costs.

About the Authors

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Scott Wallace is a globally recognized leader in the design of ecological systems including constructed wetlands, decentralized wastewater systems, stream bank stabilization and control of nonpoint source pollution. The author of papers in numerous technical and environmental publications, Mr. Wallace is the co-author of *Treatment Wetlands Second Edition*, the definitive textbook on wetland treatment systems. Wallace and his team were awarded the *2009 Diamond Award for Engineering Excellence in Water Resources* from the American Council of Engineering Companies (ACEC) for his design of a natural treatment system to treat spent deicing fluid at Buffalo International Airport in Buffalo, New York. They also received the *2005 Grand Award for Engineering Excellence* from (ACEC) for his design of a hydrocarbon remediation wetland for British Petroleum in Casper, Wyoming.

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Mr. Liner is a senior engineer with Naturally Wallace Consulting. Over his 20-year career, he has worked as a regulator at EPA headquarters, as a process and equipment supplier, as a design-build project manager, and as a consultant engineer for industrial clients. He has designed over 500 new and retrofit treatment systems across the world. He specializes in the design of onsite treatment systems for industrial facilities with an emphasis on airport deicing, mines, landfill leachate, and remediation. Mark as the Senior Design Engineer on the Buffalo Airport project.

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