Disposal of Zurich airport's de-icing effluents by irrigation

A new method of disposing of aiport de-icing effluents has been evaluated over the last five years at Zurich aiport, report **E JUNGO** and **P SCHÖB**.

Zurich airport is Switzerland's main airport, with around 270,000 aircraft movements each year and a total area of 800 ha, of which 450 ha are green and 350 ha are impermeable areas. The rainwater runoff from the impermeable areas is 2.2M m³ per year (Unique 8/2002).

In winter, alcohols and small amounts of urea are used for de-icing. As a consequence the rainwater runoff is polluted with de-icers. When the airport expansion took place between 2000 and 2004, the authorities arranged a competition to find an efficient way of treating the de-icing effluents. Until then, the wastewater had been discharged untreated into the nearby river Glatt where it created, amongst other problems, a considerable oxygen consumption.

Aircraft de-icers consist mainly of propylene glycol, water and some additives: triazoles (corrosion inhibitors), tensides, food colourings and polyacrylates, which account for less than 1% of the total. Propylene glycol, tensides and the food colourings are easily biodegradable. The polyacrylates are barely degradable but are not environmentally hazardous, but the triazoles may be potentially toxic.

Surface anti-icers consist of ethylene glycol (41%) and isopropanol (59%), with urea used in small quantities. These do not contain additives and are easily biodegradable. De-icer wastewater may contain tarmac residues such as copper (from abrasion of break coverings), cadmium and zinc (from tyre abrasion) and PAH (polycyclic aromatic hydrocarbons).

The discharge parameters regulated by law are BOD5 (10 mgO_2/l); dissolved organic carbon (DOC) (20 mgC/l), NH_3/NH_4^+-N (2mgN/l), NO_2^--N (0.3 mgN/l), total phosphorus (0.8 mgP/l). Four out of five samples have to fulfil these conditions in a simplified report.

Disposal of de-icing effluents

Three levels of DOC concentrations are defined for disposal of de-icing effluents. Effluents with less than 20 mgC/l are discharged directly into a water course. Very concentrated effluents are used as part of the denitrification process in a wastewater treatment plant. To dispose of the main element of de-icer wastewater between those limits a new, groundbreaking and cost-effective method was developed, which has been successfully applied since winter 2000/2001. The de-icing effluents are used to irrigate the surrounding green areas and decompose naturally thanks to microorganisms in the soil.

The effluents are collected by the sewer system in storage reservoirs, from where pumps feed them into the irrigation system. A total of 20 ha (50 acres) of land are equipped with heated pop-up sprinklers. The irrigation method is effective even on snow and at low temperatures (to -15°C air temperature). The largely automated procedure is computer-controlled and supplies data for optimum operation.

The procedure, developed by Jungo Engineering, is based on field studies and theory. The plant must be capable of coping with enormous fluctuations in concentration of de-icing effluents (ranging from 0 to 150,000 mg DOC/l) and load (up to 200 tC/winter), rainfall runoff (short, medium and long term) and temperature variations.

The main advantages of this technique are: cost-efficiency (investment and maintenance); only small storage basins are required; it is proven on snow and at low temperatures; it is environmentally friendly and innovative, thus enhancing the airport's public image. A further advantage is that the groundwater is augmented by rainwater from the impermeable tarmac areas. Since this is the first treatment plant of its kind, a group of scientists and representatives from the authorities have been surveying the operation and its results over the first five years.

In all, 25% of the irrigated area is divided into four intensively monitored zones. Automatic samplers are sited in the drainage systems of these areas and in the storage reservoirs. In these, DOC is also analysed online, using infrared absorption. At two soil water measuring points, the soil water is monitored at different depths.

Results and discussion

During the winter of 2004/05, carbon degradation of 99.8% was obtained. The average DOC concentration in the drainage system has been between 4.4 and 8.3 mgC/l, depending on the monitoring area. This is 1 to 3 mgC/l above the natural DOC level. The carbon degradation performance for the last five years is between 98.3 and 99.8%, even at very low temperatures. Degradation has never been lower than 97.8% (Unique 9/2002).

Most of the de-icer alcohols degrade within the first 200mm of the soil. By a depth of 800mm degradation is nearly complete. In just five out of 60 samples some very low concentrations of de-icer alcohols were detected (1 to 7 mg/l). The BOD5 limit was exceeded in four out of 122 samples.

The discharge limits for the N-species (ammonium, nitrite) and total phosphorus were all met. Triazoles are occasionally found in the storage reservoirs, but the concentrations are lower than expected. It is obvious that most of these are being adsorbed onto the metallic surface of the airplanes and removed from the tarmac. No triazoles were detected in the drainage systems for the monitoring areas (detection limit: 0.01 mg/l). Efforts are being made to use triazole-free de-icers.

PAHs were never detected in the storage reservoirs (detection limit: 0.01µg/l). Lead, cadmium and copper were occasionaly found in concentrations around the detection limit (0.01 mg/l). Zinc was more or less regularly measured in all storage reservoirs at a concentration of 0.1 mg/l.

Conclusions

The past five years of experience at Zurich airport have shown that disposal of de-icing effluents by irrigation is a cost-effective, sustainable and natural way of solving a wastewater problem that airports will face more and more in the future. The intensive monitoring proves that a near-total DOC degradation (98.3 – 99.8%) is obtained. ●

References:

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