Interest warms up in heated runway systems

The FAA’s funding of two heated runway concept trials has reawakened interest in this de-icing technology

The University of Arkansas plans to test an anti-ice runway slab, which uses solar power to implement a photovoltaic energy system with conductive concrete, in the 2011-12 winter season.

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Airport operations managers have traditionally relied on chemicals and snowploughs to clear snow and ice from runways and taxiways. However, some believe that new methods, such as passing electric current under the runway or circulating warm liquids through pipes in the pavement, could do a better job.

The US Federal Aviation Administration (FAA) is funding two small-scale, proof-of-concept demonstrations of new runway de-icing methods. It issued an Advisory Circular (AC) on 31 March 2011 that established minimum performance requirements for the design, construction and maintenance of heated pavement systems.

The AC states that: “A heated pavement strategy offers an alternative method to mitigating the effects of winter by melting snow and preventing bonding to the pavement surface”. Application of AC 150/5370-17 is mandatory for all projects funded with federal grant monies through the Airport Improvement Program (AIP) and with revenue from the Passenger Facility Charge (PFC).

The FAA says heating systems could enhance safety, minimise disruptions caused by heavy snow, provide a ‘greener’ option and reduce snow removal time. However, disadvantages include high operating costs and complex installation.

Interest in heated runways dates to at least the mid-1970s. Maryland-based Dynatherm investigated the application of electricity, oil-fired steam and solar power to heat pavement systems on airport runways, taxiways and ramps.

The resulting FAA technical report issued in 1975 said that “of the three systems investigated, the capital, total annual costs and annual operating costs for an electrically heated runway are the highest”.

It added: “The annual operating cost of the solar system is the lowest for the range of pavement areas represented by runways and ramps. The electrical system is the least efficient and steam is the most efficient.”

Nineteen years passed before the next demonstration of heated runway technology, which involved a 7,000 ft² (2.1 km²) section of taxiway at Chicago’s O’Hare International. The test involved a patented, electrically conductive asphalt pavement system called Snowfree developed by Superior Graphite. The conductive pavement layer of the heated pavement system utilised an asphalt/pavement mix containing approximately 25 per cent synthetic graphite. The conductive pavement layer was laid between the aggregate base course and the regular asphalt surface course and was electrically charged by copper cables laid on top of the base course. The amount of electrical current was regulated automatically by a group of sensors that monitored pavement and weather conditions.

Superior Graphite said the demonstration was a resounding success, but an FAA official said at the time: “If you use enough electricity you will melt the snow, but who pays the electric bill?”

History would seem to agree as no airport stepped forward to acquire the Snowfree technology. However, the FAA AC of March 2011 could change the game, according to Gerry Hand, Superior Graphite’s vice-president of industrial product sales. “Airports now see the availability of federal funding. It is a shot in the arm for Snowfree. We’re now seeing some progress in selling Snowfree to airports [and are] discussing [low or intermediate] airport installations,” he said.

Alternative concepts

Airports may have other technology to consider in the future as the FAA recently awarded two grants to university researchers for investigation of alternative heated runway concepts.

One of these uses solar energy and battery banks to heat a small section of concrete runway. Dr Ernie Heymsfield, associate professor at the University of Arkansas, received a grant in July 2010 to build and test a 20 x 14 ft anti-ice runway slab on university property that implements a photovoltaic energy system with conductive concrete and utilises renewable solar power.

Conductive concrete is concrete rir containing steel fibres and carbon graphite particles. Solar panels produce electrical energy that is stored in batteries connected to the runway slab. Heymsfield said that concrete stores heat well and the idea is to keep the temperature of the runway slab above freezing at all times – as solar energy cannot be surged to melt ice and snow.

Heymsfield expected to have the energy...
system in place to test the concept during the 2011-12 winter season. He believes the concept has great potential. “At this stage we’re just trying to prove this is something that could be applicable in the future,” he told IHS Jane’s.

The other FAA-funded demonstration considers a geothermally heated airport apron. Radiant geothermal heating systems harness thermal energy below the earth’s surface using heat pumps. Such systems are currently used on a small scale to heat pavements, roadways and bridges.

Pumps collect renewable geothermal energy through a series of looped pipes installed underground. The systems circulate heated fluid (such as anti-freeze) or steam through plastic tubing installed within or below the pavement, thereby heating it and melting snow and ice.

This type of system works better with concrete than asphalt as the latter must be laid at very high temperatures and compacted, which may damage the tubing.

The project team includes Binghamton University and Greater Binghamton Airport in New York State, as well as local engineering firm McFarland-Johnson. A USD 374,000 grant from the FAA funded Phase I of the USD 1.4 million project at the airport.

The main ramp pavement in front of the terminal had already been scheduled for rehabilitation and as the project requires the removal of pavement, the timing was perfect to install the heating prototype.

Binghamton University Associate Professor William Ziegler told IHS Jane’s that Phase II will not begin until the rest of the FAA grant is received in the first half of 2012, meaning the demonstration won’t take place before the 2012-13 winter season. Phase II will provide geothermal wells, heat pumps and monitoring and control systems that will heat the 200 ft² apron. The heating system will not run all the time and it will take several hours for the temperature of the test apron to rise above freezing. Snowploughs and shovels will remain on standby in case the system malfunctions.

Ziegler is confident the geothermal heating system will work. At issue is the cost of operations at Greater Binghamton, which encountered 150 inches (381 cm) of snowfall in the 2010-11 winter season.

The fiasco at London Heathrow in December 2010 did not escape the attention of UK-based ICAX, which believes that the disruption could have been mitigated or prevented entirely if up to GBP5 million (USD7.9 million) had been spent installing runway and taxiway heating.

According to ICAX, water-filled pipes could be installed just beneath the runway and taxiway surfaces that would absorb the heat of summer sun hitting the pavement. This heat could be stored in thermal banks, to be returned through the pipes when temperatures fall below 3°C.

ICAX touts the ‘green’ benefits of this approach, arguing that it releases no CO₂ and de-icing chemicals into the atmosphere or the water table. The system, known as Interseasonal Heat Transfer (IHT), is an automatic computer-monitored process that only releases warmth when conditions require.

Company officials estimate the cost of installing the system on Heathrow’s two runways and around 200 parking bays at GBP3 million to GBP5 million. It would be difficult to deploy IHT at an airport without causing disruption – but ICAX suggests installing IHT on groups of parking stands in batches, limiting interference with normal operations.

Airport officials remain generally opposed to the concept of heated runways because of the high energy costs. “There isn’t a compelling need for these systems in the industry,” said Chris Oswald of ACI North America. “We don’t believe a case has been demonstrated for the need, and that’s what we want to see.”

He added: “We feel that in order for an airport to make a qualified decision for or against proceeding with a heated pavement system they must understand the life-cycle costs associated with operating and maintaining the system.

“We would encourage the FAA to provide a better understanding of what these costs will be. In particular, we urge FAA to clearly identify that the operating and capital costs to de-ice an entire runway will be substantial and that the system might be better suited to treat localized areas that present serious operational or safety problems in efforts to control winter contaminants, such as high-speed turnoffs or sections of pavement at the ends of landing runways,” said Oswald.

FAA officials were equally sceptical: “We can say there is technology available that works. The problem is whether it is cost effective when you’re talking about clearing a 10,000 ft runway.”

The researchers said that the technology may be best applied selectively, with Heymsfield adding: “What may not be applicable for an entire runway may be applicable for runway sections, taxiways or intersections that are difficult to plough.”