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Project Summary

Technology Transfer Outreach Publication

Identifying the Fundamental Mechanisms of Potassium Acetate Deicer on Runways

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Project Title
Identifying the Fundamental Mechanisms of Potassium Acetate Deicer on Runways

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Potassium acetate (KAc) is a chemical applied to the surface of airport runways to inhibit the formation of ice (anti-icing agent) or melt ice already formed (deicing agent). It became widely used in the early 1990's after discovering the high environmental cost of glycol-based deicers. It has since become the predominant anti/deicing agent in use on runways in the USA, but has been associated with premature distress and failure of portland cement concrete at a few airports across the country.

The observed distress appears to be alkali-silica reactivity (ASR) of aggregates, with map cracking visible on the pavement surface and a loss of physical integrity throughout the structure. ASR only occurs if there is "reactive" silica aggregate in the concrete, a source of hydroxyl (OH^-) anions, and water present in the concrete. Reactive aggregates are amorphous, cryptocrystalline or poorly crystalline silica species such as opal or chert. Hydroxyl ions are supplied by portlandite ($Ca(OH)_2$), a mineral compound that forms as portland cement hydrates and is therefore included in the hardened cement paste matrix. Water is supplied by the environment in which the pavement is placed.

The basic chemistry of the ASR distress process is relatively well understood whereas the mechanism leading to cracking is less well understood. The first step in the chemistry of the process – the dissolution of silica – is the focus of this research. The acetate anion is a carboxylate and is known to enhance the dissolution of minerals, silica included. In fact, carboxylates are widely used in water treatment regimes to control silica deposition in process water circuits. In particular, acetate solutions are used to dissolve colloidal silica that has precipitated on the surface of process water systems.

Michigan Technological University

MiSTI
U.S. DOT University Transportation Center for Materials in Sustainable Transportation Infrastructure
Michigan Technological University

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University Facts (2008-2009)

Total Enrollment	7018
Graduate Enrollment	984
Number of Faculty	445
Placement Rate	96%

Michigan Technological University is located in Houghton, Michigan on the south shore of Lake Superior. This rural area is known for natural beauty, pleasant summers, abundant snowfall, and numerous all-season outdoor activities. In addition, the University maintains its own downhill and cross-country ski facilities and golf course. There are numerous cultural activities and opportunities on campus and in the community. Michigan Tech has also been rated as one of the safest college campuses in the United States, and the local community provides excellent resources conducive to an outstanding quality of life.

For more information, visit the University's website.

www.mtu.edu

Research Objective

- Determine the effect KAc has on the solubility of reactive silica aggregates.
- Determine the potential for paste alteration from KAc exposure.

Methodology

A series of experiments will be conducted in which neat cement paste will be exposed to potassium acetate solutions and compared to pastes exposed to sodium hydroxide and plain water. A parallel series of experiments will investigate the relative solubility of silica in potassium acetate and sodium hydroxide. Both the solution and solids will be characterized upon completion of each experiment to determine the relative effect of potassium acetate on the aggregates and cement pastes.

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