Proceedings of the Canadian Society for Mechanical Engineering International Congress
32nd Annual Conference of the Computational Fluid Dynamics Society of Canada
Canadian Society of Rheology Symposium
CSME-CFDSC-CSR 2025
May 25–28, 2025, Montréal, Québec, Canada

Simulation-Based Evaluation of Runway Deicing Products

Aida Maroufkhani[1*], François Morency[1]
[1]Département de génie mécanique, École de technologie supérieure, Montréal, Canada
* aida.maroufkhani.1@ens.etsmtl.ca

Abstract

Effective deicing is essential for maintaining safe airport operations during winter conditions, where ice and snow accumulation on runways pose significant safety risks. The application of Runway Deicing Products (RDPs) plays a crucial role in removing ice, ensuring runway safety, and minimizing operational disruptions. While most existing studies focus on experimental assessments of RDP effectiveness, numerical models could offer a promising alternative for systematic, repeatable evaluations under controlled conditions. This study aims to evaluate the performance of five widely used RDPs—sodium acetate, ethylene glycol, sodium formate, potassium formate, and potassium acetate—by comparing their effectiveness in melting ice under identical conditions. The primary objective is to investigate the mass of ice melted and the time each RDP remains active in ice melting. The active time refers to the duration during which the RDP remains effective after application, before it becomes diluted and the deicing solution temperature reaches the freezing point. This comparative study is performed using a previously developed Runway Deicing Model (RDM), which simulates the interaction between thermal dynamics and RDP application on a frozen runway surface. The RDM integrates variations in temperature and diffusive flux in the normal direction to predict ice melting rates over time. The model accounts for mass and heat transfer in the liquid, mushy, and solid phases, employing the enthalpy method to handle phase transitions. Fick's law governs the spatial and temporal evolution of RDP concentration, while the effect of solution dilution on the melting point temperature is also incorporated. Simulations are conducted for each RDP under identical conditions, ensuring consistency in the initial ice thickness and RDP quantities. In this paper, we compare the mass of ice melted and the duration for which five deicing products remain effective under identical conditions. This comparison provides a quantitative assessment of their effectiveness. Additionally, this study investigates how the chemical properties of each RDP, such as freezing point and thermal conductivity, affect their melting efficiency. By analyzing the relationship between these properties and the mass of ice melted, we aim to determine whether RDPs with lower freezing points or higher thermal conductivities are more effective in melting ice. The results of this study will contribute to the identification of the most efficient runway deicing products, enabling airports to make informed decisions regarding chemical usage during winter maintenance.