NoICE
Nordic Icing Center of Expertise

NoICE Highlights No. 5 – NOVEMBER 2021

COLD WEATHER PROBLEMS IN RAILWAY TRAFFIC

Cold weather causes many problems for railway traffic. Low temperature itself can cause problems, but a more significant problem is the ice that cold weather causes. Ice build-up hinders the operating of a train, and it affects both the railway infrastructure and the rolling stock. Ice covers railway tracks and stops railway switches from working and can break power lines. Ice build-up increases the weight of a train increasing the strain on the machine, and it can jam brakes and lower visibility for the operator, or even derail the train.

Railway industry uses a lot of resources to combat cold weather and icing. The challenges caused by icing are multifaceted, so a variety of different ice prevention methods is used in tandem to keep the trains running through winter.

ICING TESTS FOR TRAIN PROFILE SAMPLES

Icing tests at Tampere University Icing Research Group were conducted to determine how different train cart properties and different ice types affect the icing and de-icing of railway traffic. Testing was done using the Icing Wind Tunnel to accrete ice on train profile shaped samples. Four samples were made for testing, with two different shapes, and two different surfaces. Each of these were covered with three different ice types.

The train profile samples used in testing were designed using train blueprints from Valtion Rautatiet. The samples are shown in Figure 1. The material was 6082-aluminum, which is commonly used in trains. Two differently shaped sample profiles were used, an evenly rounded shape for the "roof" and partially flattened "roof." One of each shape was left bare, and one of each shape was coated. Coating was done by flame spraying of low-density polyethylene.

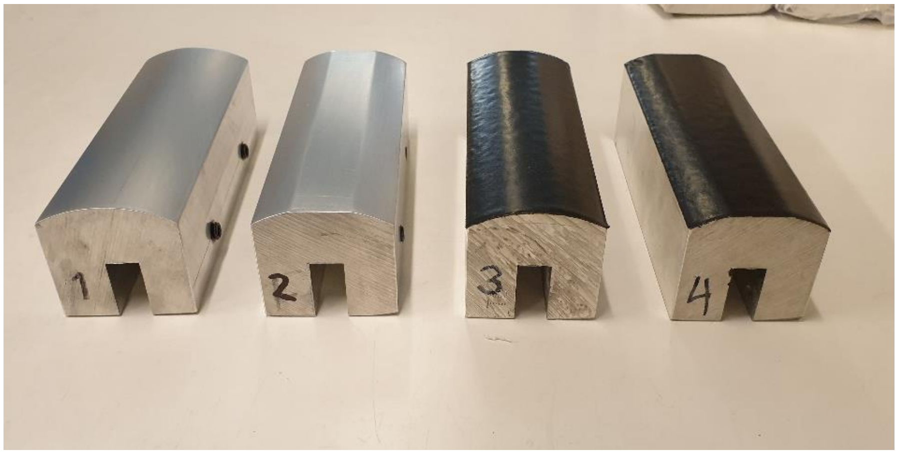

Figure 1. Train profile samples for the icing tests.

ICE ACCRETION

In order to study the effect of different icing conditions, three different ice types were accreted on each sample. These ice types are rime ice, glaze ice, and mixed glaze ice. Rime ice is oblique because of its porosity and looks almost like snow. Glaze ice is clearer and denser than rime ice. Features of mixed glaze ice, which is the most used in ice adhesion tests, are a mix of the two. It is clear but has no run back ice like glaze ice. These ice types also appear in natural icing, depending on e.g., the temperature, wind speed and humidity.

Ice types have clear differences in their appearance and properties. In this study, the effect of different ice types for ice accretion and de-icing was studied. Fig. 2 shows example of train profile sample under the icing wind tunnel at Tampere University.

Figure 2. Train profile sample under the icing wind tunnel.

DE-ICING TEST

To test de-icing of the samples, the ice-covered samples were placed in room temperature. They were tilted 45 degrees, so when the ice melted, it would fall of the sample. The detachment time was measured for comparison between different affecting factors. The de-icing test is presented in Fig. 3.

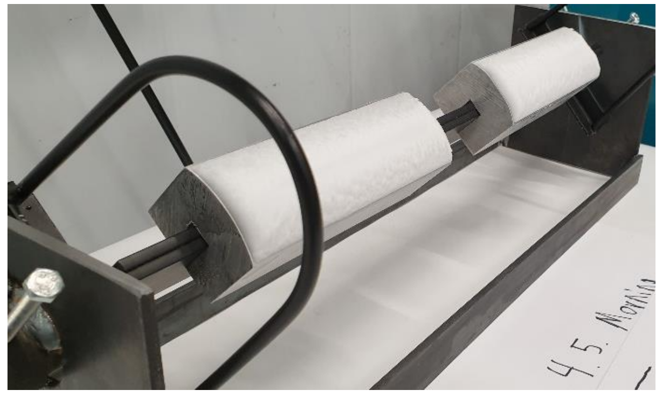

Figure 3. Train profile samples covered with rime ice during de-icing test.

THE RESULTS OF THE DE-ICING TESTS

The de-icing test results showed clearly that the ice type had the effect on de-icing. Rime ice was slowest, mixed glaze ice was second slowest, and glaze ice the fastest.

Sample properties that clearly affected the de-icing were the roof shape and the surface material. Aluminum de-iced faster, because of its higher heat conduction. Flat roof de-iced clearly slower than the completely round roofed samples. This shows how even a small detail can change the ice removal.

AUTHORS:

Tampere University, Icing Research Group

Niklas Kandelin, Researcher
niklas.kandelin@tuni.fi

Heli Koivuluoto, Senior Research Fellow
heli.koivuluoto@tuni.fi

EUROPEAN UNION
Interreg Botnia-Atlantica
European Regional Development Fund
region västerbotten
Regional Council of Ostrobothnia
Luleå University of Technology
NOVIA University of Applied Sciences
Tampere University
Umeå University
Vaasan yliopisto University of Vaasa