Finnish research improves the reliability of ice friction assessment

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Sliding speed and ice temperature affect the surface friction of ice more than had previously been thought. The thermodynamic model developed by VTT Technical Research Centre of Finland research scientists shows that under certain conditions ice warms and melts when an item of material slides across its surface. The ice then becomes more slippery. Conversely, the friction coefficient can rise a hundredfold when sliding speed reduces and the temperature drops. Among other potential uses, the model can be employed in developing road and runway maintenance, and tyres, footwear or winter sports equipment.

Ice friction was modelled by VTT's Principal Scientist Lasse Makkonen and Research Scientist Maria Tikanmäki. They have discovered that earlier theories concerning ice friction have led in part to erroneous interpretation. Makkonen says that one of the key observations in VTT's research is that of friction melting the ice when the temperature rises to form a water film between the ice and the sliding material. They discovered that the film has multiple contact points, whereas previously it was assumed to cover the surface evenly.

"Now we can make a proper calculation of the friction coefficients," says Makkonen. "We have been able to confirm the functionality of the model through measurements. At the same time our research shows that many earlier laboratory measurements are useless for theoretical interpretation and fail to represent what is happening in practice."

Ice friction has been a subject of investigation for close to 150 years.

The early explorers charting the Polar Regions were among the first to notice how extreme cold made their journey akin to dragging their sleds across sand rather than gliding over ice. Makkonen says VTT's new thermodynamic model offers a method for determining friction between ice and practically any kind of material, under any conditions. Uses for the model include applications connected with the maintenance of roads, runways and pedestrian routes, or in developing tyres, footwear and winter sports equipment.

"A novel aspect is the modelling of the reciprocal contact between blocks of ice, which promises benefits in icebreaker development, among others. We are now also able to model ice topped by melt water or rain water."

The research conducted by Lasse Makkonen and Maria Tikanmäki was recently published in the *Cold Regions Science and Technology* journal, the best-known publication in the field.

Provided by VTT Technical Research Centre of Finland