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The influence of water, snow and granular ice on ice failure processes, ice load magnitude and process pressure

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Abstract

This paper describes the outcomes of a series of laboratory ice crushing experiments that was performed (Sopper, 2016) to investigate the effects of external boundary condition and indenter contact geometry on ice load magnitude under crushing conditions. Four boundary conditions were considered: dry cases, submerged cases, and cases with the presence of snow and granular ice material on the indenter surface. Indenter geometries were a flat plate, wedge shaped indenter, (reverse) conical indenter, and a hemispherical indenter. These were impacted with artificially produced ice specimens of conical shape with 20° and 30° cone angles. All indenter – ice combinations were tested in dry and submerged environments at 1 mm/s and 100 mm/s indentation rates. Additional tests with the flat indentation plate were conducted at 10 mm/s impact velocity and a subset of scenarios with snow and granular ice material was evaluated.

The tests were performed using a material testing system (MTS) machine located inside a cold room at an ambient temperature of - 7°C. Data acquisition comprised time, vertical force, and displacement. In several tests with the flat plate and wedge shaped indenter, supplementary information on local pressure patterns and contact area were obtained using tactile pressure

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