NWP Transits

Although Northwest Passage transits are still somewhat exceptional, there was nonetheless an over 40 % increase in 2023, compared to previous year.

In 2023, there were 24 complete transits by 22 large commercial vessels: 17 westbound (eight cruise ships and nine cargo ships) and seven eastbound (three cruise ships and four cargo ships). Two of the transits were return voyages within the same season.

Six of the ships were first-timers on the Northwest Passage; 12 ships had completed the voyage once before and four ships more than once. PONANT's cruise ships *Le Boreal* and *L'Austral* each completed their fifth Northwest Passage transit.

While this year saw some new operators on the route, most ships belonged to companies with prior experience from sailing the Northwest Passage. One of the regulars, Royal Wagenborg, increased its total number of full transits to 31.

Unlike on the Northern Sea Route where the media has tracked a number of non-ice-strengthened oil tankers this year, all of the transits on the Northwest Passage were by ice-strengthened vessels: three ice-class 1C cruise ships, eleven ice class 1A cargo ships, six Polar Class (PC) 6 cruise ships, one PC 5 cruise ship, and one PC 2 icebreaking cruise ship.

The Northwest Passage was ice-free for much of the season and only the first few ships were escorted by Canadian Coast Guard icebreakers. Choosing an ice-strengthened ship for such Arctic voyages is still a prudent precaution.

Scott Polar Research Institute maintains an exhaustive list of Northwest Passage transits. ■

Doctoral thesis on brash ice channels approved

Riikka Matala, Aker Arctic's senior research engineer, has been investigating brash ice channels since 2018 through both full-scale and model-scale tests. She successfully defended her doctoral thesis, **Verification of vessel resistance in old brash ice channels through model scale tests**, in a public examination at Aalto University School of Engineering in December 2023.

The winter navigation system in the Baltic Sea is vital for ensuring year-round supply security. The system revolves around an icebreaker fleet escorting ice classed merchant ships, whereby the ice classification imposed on such merchant ships are intended to ensure a safe and efficient winter navigation system in the Baltic Sea. The ice class imposes requirements on, among other aspects, the ship's performance in brash ice channels that form in shipping lanes after frequent traffic. Such performance can be verified by model scale tests.

Changes in the fleet

The winter navigation system has functioned well with the current ice performance determination procedures. However, recent environmental standards have resulted in substantial changes to the merchant fleet, with new hull shapes to meet the regulations. Thus, the thesis analyses the processes and forces contributing to a ship's resistance in an old brash ice channel to assess whether current model test practices can simulate all significant factors accurately for all bow shapes.

Based on her research, Matala proposed a new approach for performing model-scale tests in an unconsolidated old brash ice channel. The new scaling approach improves the simulation of the interaction between the ice fragments to better mirror the resistance component caused by moving ice fragments sideways.

"The merchant vessels currently being replaced by new ships were constructed 30 years ago, when the fuel price was not as important as it is today," Matala explains. "In addition, new EEDI-standards limit engine power. This development will limit the ice performance of the merchant fleet, which may impact the whole system's functionality."

Reasonable transportation costs

Accurate determination and understanding of the ice performance of ships in different ice classes are vital to monitor, control, and ultimately improve the winter navigation system.

Simulation method explored for brash ice tests

The brash ice channel was filled with 4 m^3 of ice cubes.

To further secure the reliability of ice-model-test-based performance predictions in the future, Aker Arctic works continuously to add understanding to the correlation between full-scale observations and model tests in different conditions. In 2023, we evaluated how a computer-simulated, brash-ice channel test could add value to our processes.

Aker Arctic's state-of the-art ice-model testing procedures provide highly advanced and accurate methods for evaluating a vessel's ice performance prior to construction. The currently applied model ice and model scale testing methods were originally developed for predicting maximum ice conditions for a vessel in level ice.

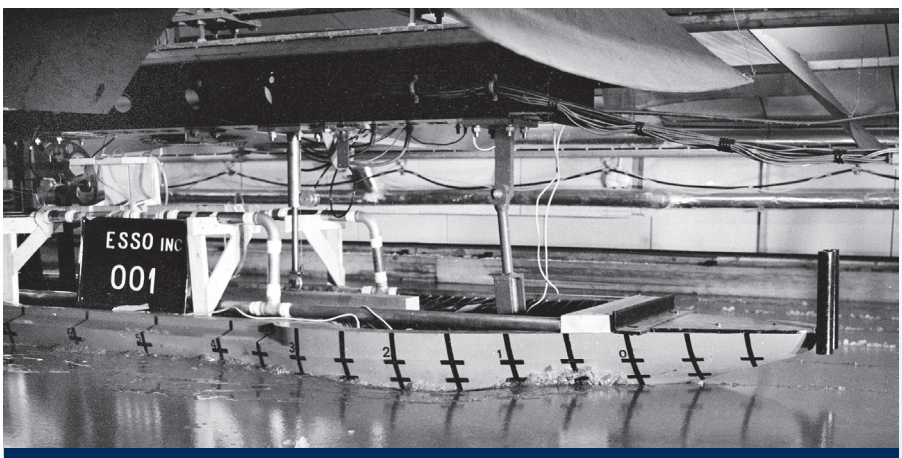
Brash ice channels differ from level ice

Brash ice increases the resistance of a ship, and thus affects the power requirement and fuel consumption of the ship on a voyage. Understanding the interaction between the ship's hull and brash ice in the channel is crucial when attempting to reduce the resistance caused by ice and managing the shipping operation.

Aker Arctic's earlier research on a ship's resistance in an old brash ice channel (Matala and Suominen, 2022) indicated that currently applied methods might be providing conservative predictions of channel resistance for certain types of modern hull shapes. This can result in unnecessary high demands on the ship's minimum engine power or in suboptimal hull shape development.

Simulation results compared to model tests

To tackle the problems of current model testing methods of predicting brash ice resistance, research trainee Juhan Voutilainen studied how a model test in a brash ice channel could be replicated using numerical simulation. As part of his master's thesis, he applied coupled computational fluid dynamics (CFD) and discrete element method



The first ice model tests were performed more than 50 years ago in Finland. Accurate performance predictions are now of the utmost importance for efficient winter navigation, both on economic and environmental grounds.

According to Matala, optimizing the whole system benefits all stakeholders. Keeping transportation costs reasonable is important both for the industry and for the citizens. Moreover, by using less fuel, both money and the environment are saved.

Reflecting on her contribution, Matala says: "I am honoured to have contributed to a solution that not only ensures the reliability of Aker Arctic's predictions in this new scenario but also serves the needs of the authorities to secure the safe and sustainable winter navigation system." ■