

A Comparison of the Ice Test Results for Korean Icebreaking Research Vessel

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ABSTRACT

In the near future, the number of ice-going and icebreaking vessels is expected to increase. This is linked to expected utilization of the northern sea route as an international trade route between the North Atlantic and the North Pacific region. Since many ice-going vessels are expected to be developed, increased demand for physical model testing in ice to assist vessel designers is anticipated. Various types of ice model tests will be required in order to improve the ice-going performance of these new vessels. Estimation of ship resistance in ice-covered waters has been an interesting and challenging topic for ship designers. Ice resistance is dependent primarily on ice thickness and flexural strength, and the ship's operating speed. Ice resistance determines the engine power and drives the propulsion system design. This is a crucial and expensive component of an icebreaking vessel. With the support of the Korean Government, the research community and the ship building industries, MOERI decided some years ago to build the next generation ice model basin at Daejeon. The MOERI ice model basin was completed in September 2009. Since then, MOERI's ice tank has produced more than 23 ice sheets and a series of ice model test for a Korean icebreaking research vessel was conducted. In order to check the reliability and accuracy of the ice test as a whole, some comparative studies were made. The test results are compared with those conducted in Helsinki university ice model basin in 2004-2005.

KEY WORDS: Ice resistance; Model testing; Icebreaking vessels

INTRODUCTION

MOERI's ice model basin are equipped with square type basin, trimming tank, ice melting tank, thermal barrier, X-Y main carriage, service carriage and refrigeration system etc. The size of main basin is 42m long, 32m wide, 2.5m deep and various kinds of ice performance tests and full turning circle tests can be conducted. For the economic purpose, linear tests such as resistance and towed propulsion tests can be tested using multiple tracks with supported boundaries; for example, one ice sheet can be divided by 5~7 narrow tracks(see Figure 11). The trimming tank is installed in the front side and ice melting tank in the back side.

Some fundamental investigations showed that the facility fulfills the basic requirements for a modern ice model basin such as uniformity and repeatability of model ice thickness and mechanical properties and reliability of the test results.

The EG/AD (Ethylene Glycol/Aliphatic Detergent)-CD solution is

being used similar to that in the Institute for Ocean Technology of the National Research Council Canada. This model ice has been proven to provide more accurate scaling of full-scale ice properties (Timco, 1986). The growth rate during freezing is approximately 2.5 mm/hour at 20°C.

The following tests may be performed in various ice conditions, including level ice, pressure ridges, pack ice and rubble ice fields. The results will be correlated with results obtained from other modeling facilities as part of the facility calibration effort:

*Study of mechanical properties of model ice
Resistance, propulsion and maneuvering tests of ships
Measurements of Ice load on fixed and floating structures*

A series of model test for Korean icebreaking research vessel was conducted in MOERI ice model basin. The icebreaker was built in 2009 and will be operated in the Antarctic and Arctic water for research purpose. The ice resistance tests in level ice and pre-sawn ice were performed with the 0.24, 0.36 and 0.48 m/s (2, 3 and 4 knots in full scale). From the resistance test, towing force was assumed to represent the resistance in ice. Pre-sawn ice test was performed in order to calculate each resistance component in level ice.



Figure 1 MOERI's Ice Model Basin

MOERI's ICE MODEL BASIN

Ice Model Basin

With a dimension of 42m long by 32m wide by 2.5m deep, the