50 Years of Ice Model Testing

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Manhattan project (ESSO)

- Mid 1960s large oil reservoirs were localized in the Alaskan North Slope
- It could be feasibly transported to the market through the Northwest Passage
- A decision was taken to modify an existing 106,000 DWT tanker, SS Manhattan
- Manhattan was refitted for the arctic voyage with an icebreaker bow in 1968–69
- During the retrofit process, the oil company Esso (Humble Oil) suggested to study the performance in ice of the newly designed bow in model-scale
- Esso decided to invest in construction of the first ice model testing facility in Finland
- The first ice model test basin in Finland was ready for testing at the end of 1969
## Icebreaker design in Finland 1933-1970

<table>
<thead>
<tr>
<th>Name (previous names)</th>
<th>Year</th>
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<tbody>
<tr>
<td>Louhi (ex-Sisu)</td>
<td>1939</td>
<td>Kiev</td>
<td>1965</td>
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<td>Voima</td>
<td>1954</td>
<td>Askiplios (ex-Hanse)</td>
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<td>Kapitan Belousov</td>
<td>1954</td>
<td>Murmansk</td>
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<td>Kapitan Voronin</td>
<td>1955</td>
<td>Varma</td>
<td>1968</td>
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<td>Kapitan Meheklov</td>
<td>1956</td>
<td>Vladivostok</td>
<td>1969</td>
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<td>Oden</td>
<td>1957</td>
<td>Polar Star (ex-Njord)</td>
<td>1969</td>
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<td>Karu (ex-Karhu)</td>
<td>1958</td>
<td>Dudinka (ex-Apu)</td>
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<td>Murtaja</td>
<td>1959</td>
<td>Ale</td>
<td>1973</td>
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<td>Moskva</td>
<td>1960</td>
<td>Mega (ex-Aatos, Teuvo)</td>
<td>1973</td>
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<td>Sampo</td>
<td>1961</td>
<td>Ermak</td>
<td>1974</td>
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<td>Leningrad</td>
<td>1961</td>
<td>Atle</td>
<td>1974</td>
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<tr>
<td>Tor</td>
<td>1964</td>
<td>Urho</td>
<td>1975</td>
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Time line of the ice model testing facilities
WIMB ice tank and first model tests
Test results from the first tests at Wärtsilä Ice Model Basin (WIMB)

Comparison between different testing methods

Full-scale model-scale correlation
Ice model testing was continued after the Manhattan project
- First years were time of calibration
  - Model-scale full-scale correlation
  - Model hull friction testing
Atle/Urho class icebreaker

**Fig. 5** The aft propulsion motors. Note the gearing.
WIMB testing

Fig. 1 The aft-body of Model J, i.e. the nozzles.

Fig. 18 The model in a ridge with 4000 hp bubbling. Note spray of water.
WARC presentation video
WARC – Icebreaker Bow Research
Double Acting Ship (DAS)

(Kværner) Masa-Yards Arctic Research Centre (MARC)

M-198
TARMO II
MARC
May 1991
(Kværner) Masa-Yards Arctic Research Centre (MARC)
Third Generation Facility
Fgx model ice is still in use
Testing of Offshore Structures

Floating mode structure tests

Gravity based structure tests
Arctic module carriers Audax and Pugnax were developed for the transport of massive LNG plant modules to the Yamal Peninsula. With a length of 206.3 m, a 43 m wide cargo deck, and PC3 ice classification, the heavy cargo ships are designed to navigate in exceptional ice conditions.
Icebreaker Polaris

Polaris, built in 2016, is the most powerful icebreaker ever to fly the Finnish flag and the first icebreaker in the world to feature environmentally friendly dual-fuel engines capable of using both low-sulfur marine diesel oil (LSMDO) and liquefied natural gas (LNG). It has excellent manoeuvrability due to the two Azipod units in stern and one in bow.
Aker Arctic has been leading the development of Arctic LNG carriers over the years resulting in Yamalmax icebreaking LNG carriers. The vessels are based on the DAS™ concept and capable of operating independently without icebreaker escort along the Northern Sea Route. The hull form has been extensively tested in Aker Arctic ice model test laboratory. The first Yamalmax carrier, Christophe de Margerie, was delivered in 2016.
Aalto Cooperation – Cooperation agreement with Aalto University

AALTO ICE TANK
- Large Ice Tank
  - 40 m x 40 m
- Turning Circle Tests
- Manoeuvering Tests
- Test in Compressive Ice
Today at Aker Arctic

- DP-testing
- Testing with autonomous ships
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