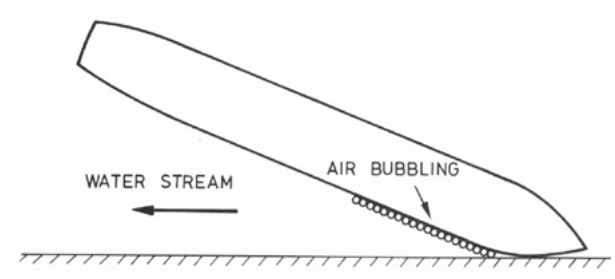
Reducing ice friction since 1969

An extensive range of both model tests and full-scale tests were made in the 1960s and 1970s to establish the optimal flow rates and dimensioning of the air bubbling system.

Air bubbling was developed by Wärtsilä Icebreaking Model Basin in the 1960s as a means of reducing friction between the hull surface and the ice, and as a result improves efficiency of operation in ice. With the growing demand for energy-efficiency in ships, similar methods have been introduced for open water ships in recent years.

The interest in using air bubbling technology as a friction reduction device both in icebreakers and open water ships has been increasing lately as shipowners and operators strive to meet the IMO's energy-efficiency design index (EEDI) in different ways.



Manoeuvring with air bubbling.
Air bubbles flush the ice away between the ship hull and the quay while mooring.

Lubricating layer

The technology is based on large volumes of low-pressure air pumped out through holes (nozzles) in the hull along the ship. As these bubbles rise along the hull towards the surface, they expand and create a strong current of water and air between the hull and the ice, reducing the friction. For open water ships, a similar method, usually at lower air volumes, creates a lubricating layer between the hull and the water surface.

"Air bubbling improves the efficiency of operation in ice, as you can either use less propulsion power for the same job, or you gain performance in ice with the same propulsion power," explains Rob Hindley, Head of Machinery and Structural Design at Aker Arctic.

Extensive testing

In the 1960s, when the air bubbling system was developed at the Wärtsilä Icebreaking Model Basin and named WABS, model tests and full-scale trials were performed to determine the correct flow rate for optimised effect. The volume of air and the size and location of the nozzles were established by repeated testing in various ice conditions.

"The system is basically very simple with a large air compressor, a series of distribution pipes and valves carrying the air to the channels feeding the submerged nozzles," Hindley says.

"However, the amount of testing we have done to achieve the right calibration cannot be under-estimated. The system has to be dimensioned correctly in order to reach the required performance."

Part of the toolbox

Air bubbling was very well received when it was first introduced and became an established part of the toolbox of auxiliary systems used to improve icebreaking. Through the 1970s and 1980s, it was installed on a number of Finnish and Soviet icebreakers built at Helsinki Shipyard, including the two nuclear-powered icebreakers Taymyr and Vaygach, as well as on a number of icebreakers built in Canada.

When the azimuthing thruster was invented, the interest in air bubbling faded away, as the same effect can be achieved from the azimuthing thruster when the ship turns stern-first using Aker Arctic's double-acting ship principle.

"The propeller wash creates a turbulent water flow between the hull and the ice resulting in the similar hull lubricating effect," Hindley adds. "This was in fact already known from the bow propellers installed on early icebreakers built in Finland."

With azimuthing propulsion, there is no real need to have an additional air bubbling system. However, if the choice is to use a conventional shaft line, auxiliary systems such as air bubbling, heeling and bow flushing are additional tools for operating in ice.

"When there is a risk of getting stuck in ice, the captain will use all the tools available to avoid that situation," Hindley underlines.

Extended equipment range

Recently, air bubbling has been included in projects where Aker Arctic has designed icebreakers with conventional propulsion, such as the Canadian Polar Icebreaker project.

Since there has been more interest in the last five years, Aker Arctic has reconnected with the main equipment suppliers, updated calculation tools in-house to be able to dimension and optimise the system correctly, and revisited old cases to transfer knowledge to a new generation of engineers.

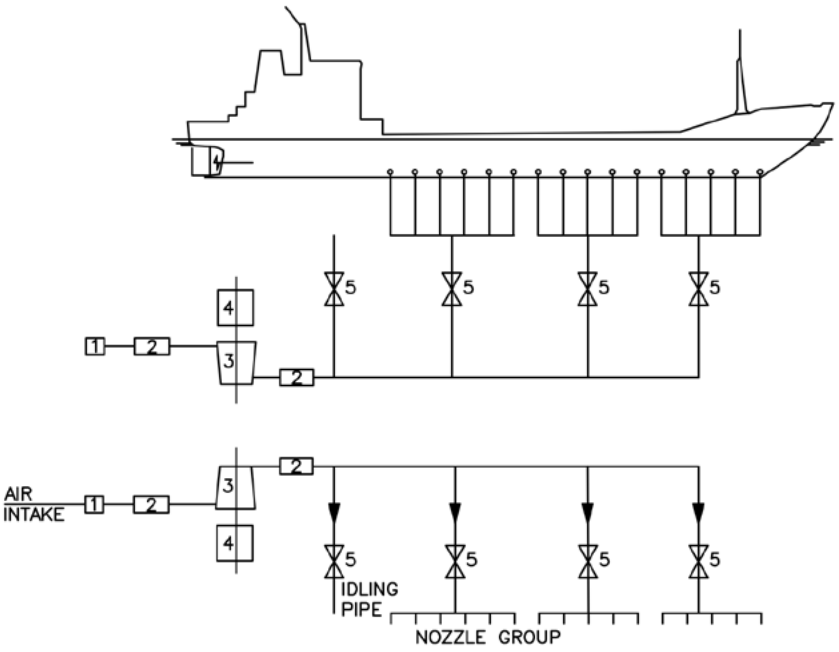
"With the experience we have in dimensioning these systems and with the refence cases we have of ships built with the system, we are in the position to offer a turn-key air bubbling system package to any interested shipyard," Hindley emphasises.

"The turn-key approach means that Aker Arctic ensure the compressor and all parts are sized correctly, the system is integrated effectively into the production design and the appropriate equipment is purchased. The equipment is delivered directly to the shipyard, but we can also be there to support the installation and commissioning."

Reduced fuel consumption

Presently air lubrication systems are installed into some open water ships in order to reduce fuel consumption. When needed, ice bubbling systems for icebreaking can also be combined into the air lubrications system, thus saving some cost in the compressors and providing a shorter return time for the additional investment. ■

You can either use less propulsion power for the same job, or gain performance in ice with the same propulsion power.



1 = AIR FILTER
2 = SILENCER
3 = COMPRESSOR
4 = DRIVE MOTOR
5 = REMOTE CONTROL VALVE

Basic components for the air bubbling system. One of the advantages with the system is its simplicity.