Different Technologies for Making a Wider Channel in Ice for Large-Size Ships

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ABSTRACT

New icebreaker concept has developed at The Krylov State Research Centre. This novel icebreaker would be capable to make a 50 m or wider channel in ice. A remarkable feature of this advanced design is that the icebreaker will have a 30 – 40% lower icebreaking resistance as compared with a conventional icebreaker in making a channel of the same width.

The paper suggests a different tactical method when the icebreaker leading a large-size vessel is following a curvilinear path with a certain turning radius. This method makes it possible to reduce ice loads on the large-size vessel.

KEY WORDS: Icebreaker; wide channel in ice; large-size carriers; ice resistance; ice model tests; ice-breaking capability; ice loads.

INTRODUCTION

Traditionally, the icebreaker made a channel through which commercial vessels are sailing in ice. This tactics can use for ships with hulls of lesser beam than that of the icebreaker, which they follow. Now we see increasing demand for large-size carriers much wider than icebreakers. So, more efficient tactics to assist these vessels through ice have to be researched.

New icebreaker concept has developed at The Krylov State Research Centre. This novel icebreaker would be capable to make a 50 m or wider channel in ice. A remarkable feature of this advanced design is that the icebreaker will have a 30 – 40% lower icebreaking resistance as compared with a conventional icebreaker in making a channel of the same width. Therefore, the advanced icebreaker will have a relatively low power requirement. The propulsion & steering system is designed to combine the traditional propellers with propulsion pods.

The paper contains estimations of the icebreaker path, analysis and estimations of the vessel’s ice resistance and speed in all phases of sailing through the water infested with small floes. The ice conditions suitable for this tactics are determined; the maximum safe speeds of the icebreaker and vessel are estimated to ensure fail-free operation.

The paper also reviews other existing icebreaker-assisted operation tactics for the cases when one ice-breaker leads a large-size vessel in continuous level ice fields. These tactics are analyzed to compare and appreciate the advantages of the curvilinear-path tactics.

TECHNOLOGIES TO MAKE A WIDE CHANNEL IN ICE

One of the important tasks for the shipbuilding community today is the development of efficient transportation systems for sustained and safe shipments of hydrocarbons from the remote oil and gas fields of the North. Numerous studies on this subject indicate that the transportation system efficiency largely depends on the deadweight of ships and highlight the need for large-size vessels capable to navigate in ice-infested waters.

Nowadays the vessels designed for transportation purposes in freezing seas are much longer and wider than ever before. The hull breadth of modern large-size vessels is 1.5 to 2 times the breadth of existing icebreakers. In this context the traditional ice navigation tactics when ships are channelled through ice led by an icebreaker is no longer a practical scenario. Given the traditional tactics a large-size ship has to break off the ice channel edges left over by the icebreaker with a requirement to significantly increase the ship’s horsepower and structural strength.

In the last decade the attempts to find solution to this problem have been made all around the world. Various approaches have been proposed to ensure safe and efficient navigation of large-size tankers in ice. Double-acting ships able to break ice astern have aroused a lot of expectations. The inventors of this concept intended to use the well-known effect of ice resistance reduction by propeller slipstreams used to wash the hull. However, the research studies have revealed that for the large-size vessels this effect is less as compared, say, to icebreakers. The point is that the propeller slipstreams fail to clean ice throughout the length of long ship hulls. Therefore the double-acting ships like any other large-size ice-class vessels need more horsepower and special measures to ensure the adequate structural strength and performance of