Proceedings of the Eighth (1998) International Offshore and Polar Engineering Conference
Montréal, Canada, May 24-29, 1998

ISBN 1-880653-34-6 (Set); ISBN 1-880653-36-2 (Vol. II)

Operational Experience and Expertise of Hulls Reliability of "Samotlor" Type Polar Tankers

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Abstract

Polar tankers of "Samotlor" type are constructed by Finnish firm "Rauma Repola" and are the largest ships in conditions of Russian Arctic. Their experience of 20-years operation is of prime importance for development of the theory and practice of designing of ship hulls' ice strengthenings.

Mistakes and demerits, found in the ships of this series, are mainly kept in the modern normative documentation for ice strengthenings designing. Methodology of analysis, carried out in this work, has allowed to describe precisely a real picture of damage and can be used for qualified expertise of ice strengthenings reliability.

Key words: Arctic, Tankers, Hulls, Ice, Damages, Reliability.

1. Introduction

From the first years of operation "Samotlor" type tankers received very large damages while working in ice. Register Rules did not give the answer concerning the cause of these damages. Drawing up of the "ice passports" of these vessels has not solved the problem.

In 4 years after commissioning a head vessel the shipowner has addressed for the help and the scientists of the Far-Eastern State Technical University in short time have developed the design of additional ice strengthenings. In 1981 the design was carried out at once for 3 (from 12) vessels. A basis of the design was the only one possible way - to bring reliability of the hull up to a level, appropriate to actual load intensity. This load intensity can be estimated according to the characteristics of damages.

The design was often realized partially - in damaged regions, planned to replacement. It did not solve a problem and the failures continued. Besides that to correct all mistakes of designing, as a rule, is impossible (because it is too expensively).

2. Hull damages

Damaging distribution of years (fig. 1, a) rather precisely reveals 3-year periodicity, connected with the conditions of navigation in the appropriate years. The analysis of failure distribution depending on age has revealed 2-year periodicity, connected with dock repairs. The increasing of failures quantity is observed up to 10-year age, then there is the fast fall because of additional strengthenings. There were 569 failures for the period of 1984-1987 (at this time usual repairs were alternated with strengthening of 9 vessels), for the period of 1988-1991 years - there were only 170 failures. Thus, additional strengthenings have lowered damaging of vessel hulls more than in 3 times. Damaging decreasing directly in additionally strengthened regions is much higher.

Failure frequency is very high. For example, the failure quantity for all vessels has exceeded 200 cases during navigation of 1983 year. For some plates there were up to 50 failures during 20 years of operation. There were most failure quantity for bow ice strengthening region and upper part of forepeak. Leaning on an icebreaker stern during close towing causes the latter. Damaging frequency of an ice zone in region of transition of a cylindrical insert in a stern because of maneuvers in the ice channel and moor in ice is rather high.

3. Vessel operational modes

Up to 50 % of damages apply to close towing by icebreaker operational mode. There were up to 20 % of damages for a mode of working in channel for an ice breaker and as much at mooring in ice. Self-dependent navigation (6 %) and forced drift in ice (4 %) are the least dangerous modes. This information is shown on fig. 1, b.

The practice of ice strengthenings designing is predominantly oriented to a vessel in full condition and presents operational modes, which 30 % of damages are cause of only. In the "ice passports" the most dangerous operational modes are not presented. In them close towing by icebreaker mode is faulty considered to be absolutely safe and not requiring any restrictions /5/. Movement speeds at the moment of damage (more than halves of cases) apply to a range of 6-10 knots. The load condition at the moment of damage has distribution: in a load -50 %, in a ballast - 50 %.