

Iceberg Towing in Newly Formed Ice

Yaroslav O. Efimov
Department of Marine Operations, Arctic Research Centre
Moscow, Russia

Konstantin A. Kornishin and Oleg Y. Sochnev
R&D and Technical Regulations Department, Rosneft Oil Company
Moscow, Russia

Yury P. Gudoshnikov and Alexander V. Nesterov
Arctic-Shelf Laboratory, Arctic and Antarctic Research Institute (AARI)
St. Petersburg, Russia

Ivan A. Svistunov and Polina V. Maksimova
Department of Ship Performance in Ice, Arctic and Antarctic Research Institute (AARI)
St. Petersburg, Russia

Igor V. Buzin
Arctic-Shelf Laboratory, Arctic and Antarctic Research Institute (AARI)
St. Petersburg, Russia

The paper presents the results of experimental iceberg towing operations performed in ice fields during the early stages of ice formation. Experiments were conducted in October 2017 in the Kara sea. Towing techniques and scope of works are described. Limitations of iceberg towing under different ice conditions are determined and discussed. Technological features of towing operations within negative air temperatures and the presence of sea ice are also highlighted. Optimal tactics for towing icebergs of different sizes under conditions of early ice formation are proposed. A one-day non-stop experiment towing an extra-long iceberg for 50 miles in ice conditions is described.

INTRODUCTION

Iceberg towing experiments in ice conditions performed during the “Kara-Summer-2017” expedition, as far as the authors know, are unique and first in the world in their real-scale tests with monitoring of all parameters.

Numerical simulations and ice basin modeling (Eik and Marchenko, 2010; Yulmetov and Loset, 2017) show a fundamental possibility of iceberg towing in ice conditions, as well as its significant difficulties. It is noted that a lack of information about the actual behavior of the iceberg and towing system under the influence of ice cover seriously complicates interpretations of the obtained results (McClintock et al., 2002; Randell et al., 2009; PAL, 2010). This work describes experiments of iceberg towing under conditions of newly formed ice as well as ice effects and thus gives unique data for further research.

The Rosneft Oil Company, in cooperation with the Russian Arctic and Antarctic Research Institute and the Arctic Research Centre, tested iceberg towing technology in the autumn periods of 2016–2017 (Pavlov et al., 2018). Real-scale field experiments on icebergs were performed with various technical means. A description of the conducted studies and discussion of the results of iceberg towing in ice-free waters is given in Stepanov, Gudoshnikov,

and Buzin (2005), Stepanov, Gudoshnikov, and Iltchuk (2005), and Kornishin et al. (2019); this paper covers iceberg towing experiments in sea conditions of early ice formation.

This scientific expedition was carried out in 2017, onboard the diesel icebreaker “Novorossiysk” (Russian Federation) (Fig. 1).

The choice of a maneuverable and powerful diesel icebreaker made it possible to tow icebergs in a wide range of ice conditions, including breaking out icebergs frozen in ice fields. The vessel was equipped with the necessary deck equipment: towing and mooring winches, and hydraulic cranes of various capacities located in the fore and aft parts of the vessel. The main technical characteristics of the vessel are presented in Table 1.



Fig. 1 “Novorossiysk” icebreaker

Received April 29, 2019; updated and further revised manuscript received by the editors August 30, 2019. The original version (prior to the final updated and revised manuscript) was presented at the Twenty-ninth International Ocean and Polar Engineering Conference (ISOPE-2019), Honolulu, Hawaii, June 16–21, 2019.

KEY WORDS: Iceberg, towing, defense, water, Artic, Kara, Barents, ice.