The V-shaped tanker

The solution to the ballast water problem

Numerous ideas on the ballast water problem have been presented over the last years, all aiming on a decreased impact on nature from ballast water transport. This article presents a solution to avoid ballast water. With a V-shaped hull, the ship sinks to ballast draft under its own lightweight, thereby rendering the ballast water unnecessary.

A VLCC concept

A Master's Thesis to study the feasibility of the V-shaped tanker was initiated by Professor Ulvarson at Chalmers University of Technology in the fall of 2003, involving tanker shipping lines Stena Rederi AB and Concordia Maritime AB. Even though the concept could be applicable to bulkers, shuttle tankers and product tankers, the study was carried out on a VLCC hull form. The fleet of VLCC:s consists of about 400 ships and is a large market. They carry vast quantities of ballast water across the globe, almost always from one otherwise isolated eco-system to another. The main criterion during the development of the V-shaped tanker was that it should be competitive regardless of the presence or absence of ballast water handling costs. To narrow the solution and minimize the iterations, the midship section shape was simplified to include only two bilge radii with a flat of bilge between them, **see fig XX**

Two concepts were developed: one with no draught restrictions, named *Optimal*, and one with a restricted draught to allow passage through the Malacca Strait, named *Malacca-max*. Both hull forms were optimised to have a deadweight of 300,000 mT and a midship section with minimal wetted surface.

Investigations including CFD testing proved the anticipated advantages to be as expected. The ballast hydrodynamic resistance for the Optimal and Malacca-max was reduced to 75% and 67% respectively compared to a conventional VLCC. The resistance in full load was equal to or slightly higher than the standard VLCC. Calculated on a half ballast/half full load voyage, the savings in total were 13% and 15%, respectively. Another option that could be utilised from the lower ballast draft resistance is to sail with a higher speed. This way one more roundtrip a year could possibly be made, increasing the ship's income considerably. The resistance calculations were carried out using SSPA stock propeller series on a twin skeg aftship for the Malacca-max and a single skeg for the Optimal hull.

A comparison between a conventional VLCC, V-MAX and V-shaped tanker

	Stena Commerce	V-MAX Stena Vision	V-shape Malacca-max	V-shape Optimal
Length o.a, metres	333	333	333	333
Length b.p, metres	320	320	322	325
Breadth, metres	60	70	79	56
Depth, moulded, metres	29.6	25.6	30	35
Draft, scantling, metres	21.1	19	21	27
Ballast water need, tonnes*	80,000	80,000	38,000	15,000
Possible, “fine weather” usage	55,000	55,000	19,000	0
Deadweight, tonnes	300,000	314,000	300,000	300,000

*Needed amount to achieve 8.4 metres mid-draught as stated by MARPOL

At a first thought, one can question the stability of such a slender and deep hull as the Optimal hull. Stability calculations have shown that stability criteria are well met and the most severe problem might be a too good stability, giving large hull accelerations in ballast condition.

Preliminary calculations revealed that the steel weight should be slightly lower for the Optimal version and slightly higher for the Malacca-max version compared to a standard VLCC. As the hull form is a of a new type, the building costs are probable to become higher than on a standard hull with the same amount of steel, but the levels of these costs have not been analyzed.

Summary

The V-shaped tanker has quite a few advantages compared to the standard VLCC of today. In good weather conditions it should be able to sail with very little or no ballast. With further investigations, including tank testing and a development of a more complex midbody section shape, it might be possible for it to discard all ballast in almost every sea-state. This leaves for the classification societies to decide.

For further information, please refer to:

Germundsson and Holmgren, *The Ballast-free Tanker* [Gothenburg 2004]