3rd International Ship Efficiency Conference, Hamburg, 26/27th September 2011

Three Years of Experience with the Mewis Duct® – A Contribution to Ship Efficiency

by
Jan Oivind Svardal, Grieg Shipping Group, Bergen, Norway
Friedrich Mewis, Mewis Ship Hydrodynamics, Dresden, Germany

Introduction

The reduction of fuel consumption has become a major concern for ship owners. The most effective measure for reducing the fuel consumption is the installation of a so-called Energy Saving Device (ESD) near the propeller with the aim of improving the overall propulsive efficiency. There are several solutions on the market.

The Mewis Duct® has been developed in cooperation with Becker Marine Systems, Hamburg (BMS). All CFD-calculations were carried out by IBMV, Rostock. BMS is marketing and selling the Mewis Duct®. By now 30 Mewis Duct®s are installed and about 150 are on order.

The Mewis Duct® was introduced to the market in September 2008, with patent pending in March 2008. The first full scale installation was completed on the 54,000 tdw Multi-Purpose Carrier STAR ISTIND of the Grieg Shipping Group, Bergen, Norway in September 2009. The estimated power saving for that ship is about 6%.

After two years with the first Mewis Duct® in service there is a first possibility to report the experience of full scale operation and about special experience received during three years of development of Mewis Duct®s for 30 different ship types, ranging from 3,500 tdw bulk carriers to a 320,000 tdw tanker.

How it works

The design goal of the Mewis Duct® in comparison with other ESDs is to improve two fully independent loss sources, namely:

- Losses in the ship's wake, which is achieved by the duct
- Rotational losses in the slipstream, which is achieved by the fins

The key advantage of the Mewis Duct® is to improve four components of the propeller flow:

- Equalisation of the propeller inflow by positioning the duct ahead of the propeller. The duct axis is positioned vertically above the propeller shaft axis, with the duct diameter smaller than the propeller diameter. The duct is stabilising the fin effect as well as producing thrust.
- Reduction of rotational losses in the slipstream by integrating a pre-swirl fin system within the duct.
- An additional small improvement of the propulsion efficiency is obtained from higher loads generated at the inner radii of the propeller which leads to a reduction of the propeller hub vortex losses.
- A further small power reduction results from the improvement of the cavitation behaviour at the propeller blade tips.

Experience in full scale after two years in service

At the time of writing there are thirty Mewis Duct®s in service. Several measurements and observations have been made, and many crew reports from different ships are available.

By now the STAR ISTIND has been in service with a MD fitted for about two years. The most important experiences observed are:

- It is very difficult to reliably determine the power savings achieved during practical ship service
- In most cases the ship goes faster and ends up with an identical fuel consumption as before, when fitted without MD
- Crew report generally better course stability in practice.

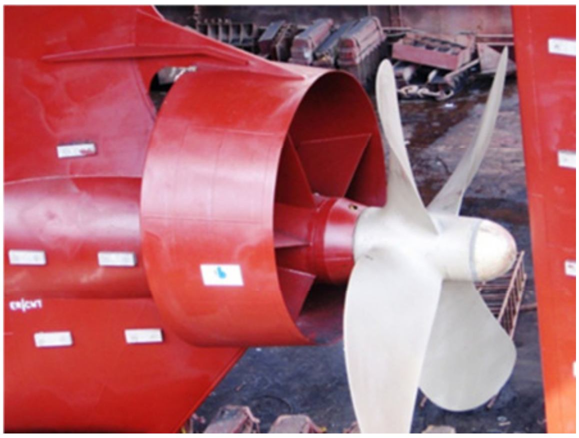

Figure 1 First installed full scale Mewis Duct®, STAR ISTIND, 45,000 tdw MPC, September 2009

The following findings from different ships to the problem proving the achieved power saving can be summarised as:

- It is very difficult to reliably determine the power savings achieved during practical ship service
- For a faultless estimation long-time measurements in conjunction with a suitable monitoring system before and after installation are required
- Currently the most reliable method for estimation of the power savings are trial trips with a newbuilding without and with MD, carried out within a short time

The following side effects are reported by crews, or measured and observed during model tests and full scale operation:

- The course stability is improved by the MD, as observed by crews and measured in model scale and full scale
- The vibration level is reduced by the MD, as observed in full scale and measured in model scale (lower pressure pulses)
- The propeller rotation in heavy seas is more stable with the MD installed

Power savings in model scale and full scale

By now self-propulsion tests to estimate the power savings by the Mewis Duct® have been carried out for 25 different projects in 6 different model tanks. The collected results are shown in Figure 2. The power savings in Ballast draught are, on average, about 2% higher than for design draught. Additionally, the model tests show that the achieved gain is virtually independent of the ship speed.

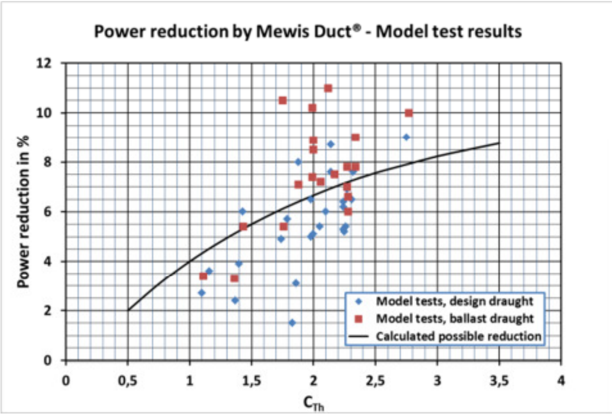

Figure 2 Power reduction by Mewis Duct®, model test results, average measured power reduction: 6.4 %

At full scale are only two sets of clean measurements currently available, both of which give identical results to model scale within an accuracy of about +/- 1%.

Usability of CFD-methods for design and optimisation of the Mewis Duct®

For every new ship project to which the Mewis Duct is applied, an individually designed and optimised Mewis Duct® has to be developed. This process is largely based on CFD-calculations in combination with model tests.

After three years of development and improvement, the collected experience shows that

- CFD-calculations are very well suited for design and optimisation of passive Energy Saving Devices like Mewis Duct®
- The goal in power saving through the use of CFD-optimisation is on average about 2% additional to that achieved through model tests alone
- The global optimisation of the MD design parameters is possible with a high accuracy by using CFD-methods only
- The accuracy in estimating power savings of MDs by CFD is about +/- 2,5%
- The accuracy in estimating power savings by model tests is about +/- 0.5%

The difference in achievable accuracy for estimating the power savings between CFD-results and model-test results has led to the necessity of extensive model tests for nearly each project as an accepted certification for the power savings achieved by the Mewis Duct®.

Special experience achieved during the development process

During the last three years, intensive development has taken place; the design- and optimisation-methods for the Mewis Duct® have resulted in a lot of scientific findings by the team involved. Below is a selected short summary:

- The wake field as a result of the ship lines has a crucial influence on the possibility of improvement by the pre-duct. In other words, a beautiful wake field is a result of excellent ship lines with few losses in the propeller inflow. But in general full blocked ships show more-or-less strongly pronounced bilge vortices, which give room for improvements. The wake field has less influence to the improvement by the pre fin-system.
- The duct is producing thrust by itself, but the pressure field of the duct is causing an additional resistance on the ship aft-body. By using CFD-methods it is possible to find

duct-geometries which deliver a positive net-thrust to the whole system (ship, rudder, propeller, MD).

- The pressure pulses of the propeller can be reduced by the MD. This results in a reduction of cavitation severity at the blade tips of the propeller. It also leads to lower vibrations on the ship, especially at lower draughts.
- The hub vortex of the propeller is reduced by the MD.
- The course stability of ships can be improved by the Mewis Duct®.

Summary

After three years of development time, 30 full scale installations, the first full-scale duct in service for two years of successful operation, and more than 25 sets of model tests, it can be summarised that the Mewis Duct® is a very promisingly product. In conclusion the Mewis Duct® has been found to offer:

- Power reductions of up to 8%, on average after 45 model tests for 25 projects the observed power saving is 6.4%
- A reduction of propeller induced pressure pulse and tip cavitation, which leads to less vibration in the aft ship
- Small improvement in course stability

Our thanks go to all persons involved in the development process.