Improved Propulsion with tuned rudder systems

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Summary

Modern ships are larger and faster than their predecessors. Larger vessels need more power – meaning more fuel. In times, where –within one year – the fuel prices are doubling, fuel efficient ships are of high interest to owners and operators.
The underwater aft body of ships contribute a lot to the overall efficiency as the propulsion unit and the manoeuvring device is located there.
In general, efficiency of ships can be equalised with the topic of fuel saving, which can be achieved by several means during design, building and operation of ships. The following table is giving some examples of fuel saving potentials in shipping:

Fuel Saving Potentials	New Buildings	Existing ships
Slow down Speed	10%	10%
Optimised Routing	10%	10%
Modern Prime Movers	5-10%	X
Efficient Ship Design	5-10%	X
Optimised Propulsion System	2-8%	2-5%
Design Tuning	2-5%	2-5%
Efficient Rudder System	2-8%	2-5%

The potential efficiency gain which can be achieved by optimising the rudder system varies from 2% up to 8%. The gain is higher, the more a propeller design is co-developed with the rudder design and vice versa.
Rudder systems for today's ships have to resist the high loads from modern propeller designs for large and high speed ship's. Thus modern rudder systems have to be different from those of former times. Becker has developed full spade rudders with their famous KSR rudder support system. KSR full spade rudders are light, slim, of special profiled design and available in unlimited rudder area dimensions. The largest KSR rudder produced has 80 m², while 85 m² rudders for 14.000 + Container ships are already on order.
KSR full spade rudders with twisted leading edge and specialised, varying profiles offer the avoidance of cavitation erosion and a propulsion efficiency gain by approx 2-4%. These rudders can be installed on nearly any large and fast ship, if the designers and shipyards integrate them early in their ship design.
More fuel can be saved, if a propeller designer and a hydrodynamic institute share the propulsion development for a new building ship with a rudder system supplier like Becker. The cooperation between Becker and Wärtsilä is aiming in the co development of a new generation of high efficiency rudder and propulsion systems. The HER is featuring a KSR twisted rudder with or without flap, combined with a torpedo shaped rudder bulb which is extended from the propeller hub into the rudder blade. Efficiency gain >5% will be achieved by that arrangement. Especially smaller ships with high thrust coefficients will gain efficiency by that new system.
Another development area of modern rudder systems is the saving of weight, joined by the added functionality of intelligent materials. Synthetic materials as fibre composites have the nice advantage that they are produced of several layers of different materials. Thus, they can be designed into many engineering directions for different tasks. Overall, these synthetic materials save a lot of weight. The "intelligence" of those materials is that a lot of different sensors can easily be integrated within them. Given that, a rudder stock or rudder bearing can log their loads and can even "cry" if a load was too high. Via remote monitoring, the bearing clearance as well as wear and tear or lubrication malfunction can be logged and transmitted from the ship to anywhere at any time. Becker will deliver the first "intelligent" rudder stock within 2008.

Conclusions

Rudder systems have great influence on the ship's efficiency and performance. They have to be robust and reliable over the ship's lifetime. If they are co designed with the propeller and the ship's hull form, they can save up to 8% of this expensive black liquid, called fuel.

The Company

becker marine systems is a German marine equipment supplier and global market leader for high performance rudder systems for seagoing ships. From small sail yachts to the largest Cruise Vessel or Containership, Becker can supply a matching rudder system, improving the ship's manoeuvrability and its propulsion efficiency.
In the last years, Becker has achieved remarkable success with the new developed twisted full spade rudder for largest container ships and other high speed vessels as ferries, cruise ships, large yachts and navy ships. Those ships suffered from propeller induced cavitation problems, causing severe rudder erosion damages, which often led to a loss of rudder blades during operation. Becker's new rudder design was developed by using latest hydrodynamic software tools (Computational Fluid Dynamics CFD) and was tested in different model test facilities. Today, nearly 70% of all large container ship on order will receive a Becker twisted full spade rudder.

Dirk Lehmann joined German Armed Forces in 1982, where he finished university as marine engineer. During service, he added studies in naval architecture. He left the forces as army captain in 1992 and joined KAEFER Isoliertechnik. There he developed the automated seaborne pallet handling system ASPH for reefer ships and initiated the European joint venture KSW Systems as general manager in 1994. In 1999 he changed as managing director to INTERING, responsible for marketing and sales of stabilising equipment for ships. In 2001 he joined becker marine systems as managing shareholder, where he was responsible for the development of large twisted full spade rudders for container ships and the related growth of the company.