Propeller Fouling

Polishing propellers annually is routine, noting that during a year a fouled propeller can add up to 4% on fuel consumption. There has always been nervousness about following the merchant marine with anti-fouling propellers and the impact it may have on naval capabilities. To assess the issues of adherence, performance and signature HMS Chatham had one of her propellers coated with foul release as part of a minor trial. Unfortunately the ship was decommissioned whilst only 18 months into the trial. Another trial on a T23 is nearly a year old and had the first diver survey, in general the adherence is good, as expected there has been some loss of coating at the propeller tips but not enough to cause concern and no significant growth was seen in the exposed areas, most probably as it will have been washed off by the same mechanism that removed the coating. The divers video showed the build-up of slime from recent inactivity was washed off easily by the diver's hand. The ship has been noise ranged and the results show no differences to before.

Transom Flaps

Transom flaps create a vertical lift force at the transom, and modify the pressure distribution on the after portion of the hull. These flow field changes cause a reduction in drag on the ship's afterbody, and modify the wave resistance of the ship. This relatively inexpensive change to the ship can significantly reduce fuel consumption. The transom flap fitted to the T23 has shown, on average, provides a 6% reduction in resistance in the speed range of 7-13 knots and 13% at speeds above 13 knots. On the basis of the success of the Type 23 trial, transom flaps were also fitted on T42 & CVS

The reductions in resistance are worth in the order of £60m over 10 years for the fleet at £500/m3 fuel costs, this represents a good return for £100k fitting costs per ship.

Displacement and Trim

The payload in proportion to the Basic Ship is small in warships as most operate at relatively constant displacement, however carrying unnecessary payload will deliver savings in a similar manner to a car. The ability to capitalise on these savings is more limited for the Royal Navy as they carry fuel and munitions necessary to expedite immediate tasking. The percentage reductions can be scaled linearly up to a 10% reduction in displacement (e.g. if a 1% reduction in displacement reduces shaft power by 1% then a 10% reduction in displacement reduces shaft power by 10%)

Most of the Fleet are considerably heavier than designed due to capability insertion through life as was the case for the T22's. This meant they sat deeper in the water with transom stern immersions much greater than desired. At speeds below approximately 20 knots the flow of water off the bottom edge of the transom does not break away cleanly to leave a "dry" transom, but becomes entrained and is dragged along by the ship. This results in significant parasitic drag. Conversely, at speeds above 20 knots the flow breaks away cleanly, leaving a void behind the ship. This gives the ship a virtual increase in effective length which reduces resistance.

Optimising trim has a relatively small effect, a level to slight stern trim is best but managing trim is difficult for a warship as they are not designed with extensive ballasting capacity.

The Future

The majority of solutions offering major hydrodynamic savings have been explored and implemented and it is likely that future developments in this area will be limited only to small percentages. These will be worth pursuing where through life cost/benefit demands, potential examples being new propulsion devices and onboard condition monitoring of fouling. The RN will continue to follow, and most likely adopt, new mercantile anti-foul coatings as they arise, with developments driven by profitability due to the rising cost of fuel. Future sustainability targets are pending with a government wide operational fossil fuel consumption reduction of 18% by 2020 and 20% by 2030. Unfortunately the baseline date for these targets already includes the implemented savings outlined in this article and with bigger ships replacing the existing RN fleet, fuel consumption savings on current allocations will be a real challenge.

Summary

When the Hull Fouling Management Programme was instigated in 2007 four heavily fouled ships were immediately identified. Over the following two years cleaning hulls became routine but since 2009 cleans have reduced dramatically as awareness about managing the issue grew and furthermore as a result of the implementation of new anti-foul technology. Now with the majority of hulls having the silicone based foul release (where the fouling has difficulty attaching and washes off at cruising speeds) no demands for hull cleans have been received in the past two years. The programme commenced following demands for increasing activity by 20% with no uplift in fuel allowance. When combining the hydrodynamic initiatives of hull fouling monitoring, new anti-foul coating, transom flaps, reducing displacement, optimising trim and ensuring propellers are polished, this target has been met.

Further Information

The Hull Fouling Management Programme is run by Steve Marshall, Ship Hydrodynamics, Naval Authority Group. For further information regarding the programme please contact desnag-shipstab@mod.uk