LSSTF Forum

April 2021

Improving Ship Performance with Air Lubrication Achievements and Challenges

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NOTES AND REFERENCES

The presentation is a high-level overview of air lubrication and air cavity applications. The technology has been under study and development for some decades, while application, particularly for large commercial shipping has only gained a foothold in the last decade.

Whether for large vessels as air bubbling or air layer, or for smaller vessels as an air cavity, there is potential for significant savings in powering that can then be used together with other emissions reduction technologies.

Clearly introducing air to the boundary layer requires power at some level. The least amount of power is to introduce a flow that distributes microbubbles into the interface. To prevent the released bubbles coming together companies such as Silverstream and Foreship have found that by careful arrangement of the plenum chambers and nozzles the Kelvin-Helmholtz effect can be utilised to encourage a persistent stream diluting the lower boundary layer over much of the hull lower surface while minimising the pumping power used:

Refer to Kelvin–Helmholtz instability - Wikipedia

Their detail designs are each unique, and so protected by patents.

Other shipbuilders have developed systems operating at higher volume flowrate aimed at separating the hull surface from the water over as large an area as possible. This requires more system power but offers higher savings. Successful designs show a higher overall saving from the bubble based systems, though do involve rather more machinery and so maintenance.

As regulatory bodies become more involved in evaluation of energy saving systems standardisation of measurements and assessment becomes important. Classification bodies such as Lloyds Register, and the American Bureau of Shipping (ABS) have begun to develop guidelines.

ABS have published a general guide to air lubrication that gives a very useful summary of the technology that can be found here:
Air Lubrication Technology.pdf (eagle.org)

ABS guide to installing an ALS can also be found here:
air-lubrication-guide-oct18.pdf (eagle.org)

Meanwhile the Lloyds Register guide is here:
LR Guidance_Notes_for_Air_Lubrication_Systems__January_2020.pdf

Royal Caribbean have prepared a video explaining installation of air lubrication on their ships:
Royal Caribbean: Floating on bubbles - YouTube

Samsung have issued a short video on their Saver Air System here:
SAVER Air (Air lubrication system) - YouTube

A short piece from the BBC featuring the Silverstream system and other energy saving systems is available here:
Silverstream Technologies: Air lubrication on the BBC - YouTube

A new company also working on air lubrication based in Rotterdam has recently installed their system on an inland cargo barge, their site is here:
Marine Performance Systems | FluidicAL Product page

Turning to air cavity systems, SSPA in Goteborg have prepared a summary article on the work they have participated in here:
Hull air lubrication: future and challenges | SSPA

For those interested in a deeper dive into ALS&ACS there is my book available through Amazon or directly at Springer, where associated electronic materials can also be downloaded:

Air Lubricated and Air Cavity Ships: Development, Design, and Application: Amazon.co.uk: Pavlov: 9781071604236: Books

At Springer the book is here:

Air Lubricated and Air Cavity Ships - Development, Design, and Application | Genadiy Alexeevitch Pavlov | Springer

If you go here (read on SpringerLink)

Air Lubricated and Air Cavity Ships | SpringerLink

it is possible to download the front and back matter (including the resources section with listing of sites and gerneal references), and the software that goes with chapter 5 on planing air cavity craft – you do need the chapter to explain though!)

I hope this can give you a flavour of the technology!

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19.04.2021