Revolutionizing Maritime Dynamics
Hull Air Lubrication Systems as a EET Solution

Alex Routledge, CEO Armada Technologies

Shipping decarbonization will require a broad and resolute commitment to alternative fuels, operational best practises, and energy efficiency enhancements. With zero carbon fuels further out on the horizon, the pursuit and deployment of Energy Efficiency Technologies (EETs) is under the spotlight for the near-term reduction in emissions they deliver. EET's allow owners to wring every last calorie from the fuels we currently burn, simultaneously creating environmental benefits and commercial savings. Steven Jones, CEO of the Sustainable Shipping Initiative, emphasizes this, stating: "*As the maritime industry works to meet ambitious emissions reduction targets, prioritising energy efficiency is a strategic imperative that pays dividends both financially and environmentally. The return on investment for ship owners is clear - lower operating costs, compliance with regulations, and a smaller carbon footprint that appeals to charterers and cargo owners seeking greener supply chain options. Energy efficiency is a rare opportunity where economic and environmental interests are perfectly aligned for the benefit of the entire shipping value chain.*"

To realize these opportunities, its vital to consider what is the supply landscape and market dynamics of EET both now and in the coming years. Over the past decade we have witnessed extensive fleet deployment of lower cost, and well proven, flow modifying devices such as propeller boss cap fins and Mewis Ducts. By accepting their technological maturity, it's safe to say that the industry has embraced the 'novel' and it has become 'normal'. Similarly, advances and onboard demonstration of wind propulsion technologies have enabled steady uptake. We continue to see substantial time, effort and resource applied to the deployment of wind technology, whether that be at the IMO MEPC, advocacy groups (e.g. IWSA) and direct marketing through the many technology providers. Air Lubrication systems have seen rapid uptake based on strong pay back periods without the need for quite such vocal independent industry advocacy and are now widely deployed across different ship categories and operating profiles. Richard Tyrrell, CEO of CoolCo, comments: "*The need to improve the environmental performance of shipping is clear and we have embarked on this journey with a $75 million investment program that is focused on the retrofit of EETs to our LNG fleet. Next generation Air Lubrication systems are an important part of this program with positive results expected from an installation later this year.*"

This then begs the question as to why the ratio of sales of wind propulsion technologies to Air Lubrication is 1:4 in favour of Air Lubrication and why the number of flow modifying device orders continue to dwarf that of ALS and wind propulsion technologies orders combined.

The claimed performance of wind propulsion technologies is extremely encouraging and that, as a technology category, wind assisted propulsion must play its part in the makeup of a decarbonized shipping future. That said, the sales figures appear somewhat paradoxical. The underlying drivers for this are nuanced and not simply a result of claimed performance, total cost of ownership and/or relative ease of operability between the two technology categories. Instead, more subtle drivers predominate, or at least heavily influence decision making.

What is certain is the question should not be whether to install energy efficiency technology or not, but rather a question as to how to fit ALS, flow modifiers and wind assisted technologies in a commercially attractive manner. To set a new course towards clean maritime operations the industry must think bigger and more aggressively, set aside decision making based rigidly on archaic go- or no-go payback period durations and be willing to make environmental decisions built on commercially solid foundations. This isn't purely the responsibility of the owner, or the technology provider, but instead requires a concerted effort of a much boarder spectrum of stakeholders.

Whilst this may sound a bit "I have a dream", it is certainly possible. Sustainability issues are interconnected and to drive meaningful change, the industry must take a collaborative systems approach. It is my belief that the missing piece of the puzzle could be as targeted as EET technological performance certainty.

With technological certainty, we develop a self-supporting positive feedback loop that drives EET investment, delivers higher margins and creates step change environmental improvements. Without it we create a considerable set of obstacles, any one of which could derail an investment decision. For instance, if the Maker has high

performance certainty, they can offer reliable and tight tolerance performance guarantees. If the owner has tight tolerance performance guarantees, they can reliably accept more commercially onerous terms in charter party agreements and in doing so offer more competitive vessels to the market. If the charterer has more competitive options, they can safely assign value and share in the benefits of the technology with the owner in the form of higher day rates and/ or extend charter lengths. As a result, the owner can invest in more specialized, higher CAPEX new build projects, safe in the knowledge they will realize a solid return on their investment whilst simultaneously enhancing resale values.

Bolstering this further, if the financier has performance certainty, they can reduce the cost of capital available to owners to fund (potentially multiple) energy efficiency technology installations. As a direct result the EET business case becomes more compelling and, in many cases, a 'no brainer'. This opens the door to multiple EET installations that together produce savings far greater than the sum of their constituent parts. With zero carbon fuel alternatives so far on the horizon, performance certainty may well be the much needed tool to meaningfully decarbonize shipping in the short term, whilst providing an enabler for the zero carbon fuels of the future.

The question then becomes, how can we deliver performance certainty in our energy efficiency offerings when a lot of the factors influencing performance are external, environmental, and completely out of operational control; to the example of wind propulsion technologies, this would constitute geographically variable wind speed and direction. A nice resolve for this predicament is to 'accept that which cannot be changed, to change what can be changed and gain the wisdom to know the difference'.

Air lubrication providers in particular could have the most to gain from a relentless focus on what can be controlled. For instance, the boundary layer of an air lubricated vessel is, in essence, a black box. We can 'enter inputs' in pursuit of higher performance, but realistically the behaviour of a bubble in the extremely dynamic boundary layer is, in absolute terms, unpredictable. Even the creation and injection of the bubbles is fraught with uncertainty. Too big and the bubbles break apart, coalesce or are sucked out of the boundary layer, too small and it does not deliver sufficient air to displace sea water and create meaningful frictional resistance reduction. The method of injection is also critical. Supply at too higher pressure and the majority of air is pushed through the boundary layer and wasted to ocean, supply at insufficient pressure and air is trapped within the system, unable to overcome the hydrostatic pressure needed for boundary layer aeration. Low control ALS is fraught with factors that are not within the commercial discretion of the Maker or even owner in certain instances. For instance, vessel speed, vessel utilization, hydrostatics or sea state are all either orders placed on the vessel or are external environmental states. However, what can be adapted are the number, type and set points of the ALS control mechanisms. With the proper management and interpretation of raw performance data we can begin to identify patterns of performance and ultimately optimize the output across speed, draft and environmental operating states. Over time and applied consistently, we can begin to develop technological certainty.

This is the approach Armada Technologies have prioritized and heavily invested in. With discreet control of bubble size, air:water ratios and the momentum balance at point of injection, Armada's Passive Air Lubrication System (PALS™) is well placed to deliver verifiable patterns of performance and deliver it on an ongoing basis. Taking a first principals design approach, questioning unsupported yet accepted truths and relentlessly experimenting in the world's preeminent test facilities, we have applied fresh knowledge that has supported the design and engineering of the ground breaking PALS system.■