

MarineFuture 2025: Aquaculture and Marine Ecosystem Sustainability

Conference Proceedings

September 22, 2025 - Singapore

Eco-Friendly Hull Cleaning and Biofouling Management: Engineering Solutions for a Sustainable Blue Economy

Azizur Rahman

Trainee Engine Cadet, AMET University, Chennai, India

Abstract

In a world racing toward decarbonisation and sustainable ocean industries, eco-friendly hull cleaning and biofouling management have emerged as pivotal themes for blue economy advancement. Marine biofouling—the relentless buildup of algae, barnacles, and microorganisms on ship hulls—creates far-reaching challenges for maritime transport, from increased fuel consumption to greenhouse gas emissions and the global dispersal of invasive species. Recognizing these threats, marine engineering is pivoting from chemical-intensive antifouling solutions to holistic maintenance strategies that blend innovative materials, automation, and ecological responsibility. This presentation explores the transformative impact of sustainable hull cleaning—a practice at the crossroads of operational efficiency and marine conservation. Fuel efficiency in shipping can be boosted by up to 35% simply through regular, effective hull maintenance, cutting both costs and emissions in line with global sustainability targets such as the International Maritime Organization’s GHG strategy. Moreover, new antifouling coatings formulated without biocides and toxins, along with robotic hull cleaning systems, prevent harmful runoff and shield delicate marine ecosystems from the long-term impact of chemical pollution. A central concern is the role of hull cleaning in controlling marine biosecurity. Ship hulls serve as vectors for invasive species, with far-reaching ecosystem consequences in port cities and protected waters. By combining real-time sensor networks and digital monitoring tools, marine engineers are revolutionizing maintenance timing, minimizing invasive spread, and ensuring compliance with increasingly rigorous regulatory frameworks. These innovations also enable ports and shipowners to automate hull inspections, verify cleaning outcomes, and maintain industry-wide excellence in eco-friendly practices. From a marine engineering cadet’s viewpoint, eco-friendly hull cleaning is more than a technical challenge—it embodies the spirit of stewardship and innovation that defines the future of ocean enterprise. Collaboration among engineers, regulators, and scientists is driving a shift towards green hull maintenance as the new norm, positioning the maritime industry as a leader in sustainable transport. Eco-friendly hull cleaning stands as a practical, high-impact solution for the blue economy, blending technology and conservation to make ocean transport cleaner, safer, and smarter for the decades ahead.

Keywords: Sustainable Hull Cleaning, Biofouling Management, Marine Environmental Protection, Energy Efficiency in Shipping, Eco-Friendly Antifouling Technology