Science, Technology, Research and Innovation for Development (STRIDE)

Synthesis and Characterization of Polymer-Based Graphene Nanomaterials with Anticorrosion and Anti-barnacle Properties for Sea Vessel Hull Applications

GRANTEE: De La Salle University (DLSU)

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INDUSTRY PARTNER: Blue Sea Energy Technology Corporation

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Nanomaterial coating for anti-corrosion in ships

Shipbuilding and ship repair is a fast-growing industry in the Philippines. In ship repair, most of the activities revolve around removing barnacles and rust that contribute to metal degradation. Heavy rusting entails added cost and affects safety. Barnacles on ship hulls drag the vessels, resulting in higher energy and fuel consumption.

During the early days of seafaring, lime, arsenic, mercury compounds, and pesticides were utilized as anti-barnacle protection. Chemical industries likewise developed the Organotin compound *Tributylin* (TBT). However, use of TBT was found to have adverse environmental consequences, demonstrated by shell deformation in oysters, sex changes in whelks, weakening immune response among sea creatures, and other undesirable genetic effects in many marine species. Application of TBT was stopped to avoid these effects and, most importantly, because TBT apparently enters the food chain.

Field inspection of ship servicing at SAS Shipyard Inc.

In response to this concern, DLSU, with support from USAID STRIDE, developed a polymer-based nanomaterial coating called graphene to prevent the formation of corrosion and the attachment of barnacles to the hulls of the ships. Graphene is low cost but has excellent chemical resistance properties. It is impermeable to gases, has high adsorption capacity with

antibacterial properties, and is mechanically strong and thermally stable. Graphene is recognized for its anti-corrosion, flame retardant, wear and scratch resistant, antifouling, pollutant adsorption, and antiseptic properties.

The research team during an inspection

The research team is currently working closely with local shipping industries, particularly the SAS Shipyard, Inc., and Blue Sea Technology Corporation Field visits and studies have been conducted to gather information and gain a better understanding of servicing approaches to the development of a nanotechnology that would increase the life and durability of coatings applied to hulls by two times what is achieved by the current benchmark technology. The research team is intent on developing a technology that reduces the number of hull coatings that is equally or even more effective in preventing corrosion and barnacle growth or attachment. Different formulations have already been produced with varying percentages of graphene and differing compositions of binder.

To test these formulations, metal samples coated with both the commercial and the experimental coatings were submerged in sea water and observed for 10 days. Results of the experiments will serve as determinants in the formulation of the technology that will be developed.