Development of a Biocide-Free Polyurethane-Based Coating for Effective Antifouling in Marine Vessels

Ahmed, Tahani (School: KFUPM Schools)

One of the maritime industry challenges is marine fouling, an accumulation of bioorganisms such as algae, mussels, and barnacles on marine vessels and ships. Marine fouling increases fuel consumption, reduces speed and maneuverability, increases operational costs, and may harm the environment. While traditional antifouling coatings can reduce marine fouling, most of them, such as tin-based coatings, are highly toxic. The current coatings that are less toxic are not very effective. The aim of this study is to develop an effective and novel polyurethane-based coating for marine antifouling through a more eco-friendly method while avoiding toxic biocides. First, 5 samples of waterborne polyurethane (PU) coatings were fabricated with varying concentrations (0-2 wt%) of methacrylated lignin (ML). All samples' compositions were confirmed using FTIR. The water contact angle test showed that the PU sample with 2 wt% ML had the highest hydrophobicity. The adhesion test showed that the PU sample with 2 wt% ML had the highest adhesion strength, with an average of 3.9 kgf/cm before submersion in water and 3.8 kgf/cm after 7 days of submersion. The protein adsorption test showed that the 2 wt% ML sample had the lowest protein adsorption of 5.3 µgm/cm2, proving its use in antifouling. In conclusion, the 2 wt% ML sample showed stable adhesion for 7 days of submersion and 36% better antifouling than the original PU sample. This proves the potential of this novel coating to offer a sustainable and efficient solution to combat fouling, not only in marine vessels but offshore platforms and submerged surfaces as well, all while minimizing environmental impacts.