Marine coatings: a systematic study on structure-property relationship of potential covalently immobilized biocides

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Biofouling can be responsible for serious substrate deterioration or the loss in equipment efficiency, thus, leading to substantial economic losses with environmental issues attached. In marine transportation industry, it can lead to delivery delays, increasing fuel expenditure and augmented emissions of polluting gases such as SO_x, NOx, and CO_2, and the introduction of marine invasive species across different ocean habitats. The International Maritime Organization estimated that CO_2 emissions associated with fuel consumption from international shipping could more than double by 2030 under extreme scenarios [1]. The marine industry has been searching for solutions that could avoid such biological attack. A wide range of protection strategies have been exploited [2]. Hitherto, conventional antifouling biocide-releasing coatings seem to be the most effective method. But the active antifouling agents, named as biocides, are released into the seawater over time and not only kill the bio-organisms attached to the surface but also can be toxic to non-target organisms and/or be bioaccumulated in the food chain. As a result, ecotoxicity of some traditional biocides has increasing called for legislative control. The main aim of this work is to identify potential antifouling compounds able to be immobilized in a polymeric matrix (silicone, polyurethane and epoxy), suitable for non-releasing marine antifouling coating systems. Preliminary tests done on polyurethane based systems revealed that compounds possessing amine and/or hydroxyl groups have potential to be immobilized in such systems. A list of potential antifouling compounds was selected following criteria such as: mechanism of action, antifouling potency, feasibility to be immobilised, stability, and compliance with the EU Biocidal Products Directives (BPD).

References

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