Design of Marine Propeller for Axisymmetric Hull

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Design of propellers is crucial to the overall efficiency of ocean engineering systems. The Ocean Engineering Group has developed the numerical analysis codes to design and analyze propellers. A systematic method to design marine propellers for a given axisymmetric hull is presented to achieve the highest efficiency. Design and analysis steps are iteratively considered. The former aims to design a propeller by the numerical optimization code which models the propeller by B-spline geometry with 4 x 4 control points and aims to minimize torque for a given thrust. The latter is to predict designed propeller performance by coupling a potential flow solver with Reynolds-Averaged Navier-Stokes (RANS). The designed thrust is updated based on the updated hull resistance from the analysis step, and the procedure is completed when the thrusts of both steps converge. In this study, axisymmetric hull is considered as an image model, and right-handed propellers with 5 blades are taken into account. The final thrust, torque, and efficiency for each advance ratio are also presented.

Energy-Efficient Virus Filtration with Moringa Functionalized Natural Fiber Filters

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Fecal contamination of water and associated health burden is a global challenge. Although bacteria and protozoa cause diarrhea, human enteric viruses (EVs) are the major cause of water-related diarrhea, with just rotavirus causing 40% of the hospitalizations. Conventional filtration techniques, rapid and slow sand filtration, are not effective against viruses. Although membrane filtration techniques were shown to be effective against viruses, continuous monitoring is necessary as any defects can hinder the performance drastically. In addition, membrane filtration incurs high operational costs in terms of energy due to their small pore size, limiting their widespread use. Due to the lack of a reliable filtration technology, disinfection and boiling are the available options against viral contamination. Therefore, there is a need for cost-effective, energy-efficient, and locally accessible virus filtration technologies. We show that a simple filter made with unprocessed cotton balls functionalized with Moringa oleifera (MO) seed proteins can effectively capture viruses. Cationic proteins from MO seeds have been studied in relevance to indigenous water purification since 1979. Using MS2 bacteriophage as a surrogate virus for EVs, we showed that the proposed filters can achieve ~7 log_{10} removal of viruses, far exceeding the environmental protection agency requirements of 4 log_{10} virus removal. In addition, we compared the proposed MO-Cotton filters to commercially available membranes to show that MO-Cotton filters can achieve effective virus removal with significantly low-energy requirement. Due to the cost-effective and chemical-free design we believe that MO-Cotton filters can be a potential solution for viral contamination of water worldwide.

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