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Failure pressures and drag reduction benefits of superhydrophobic wire screens

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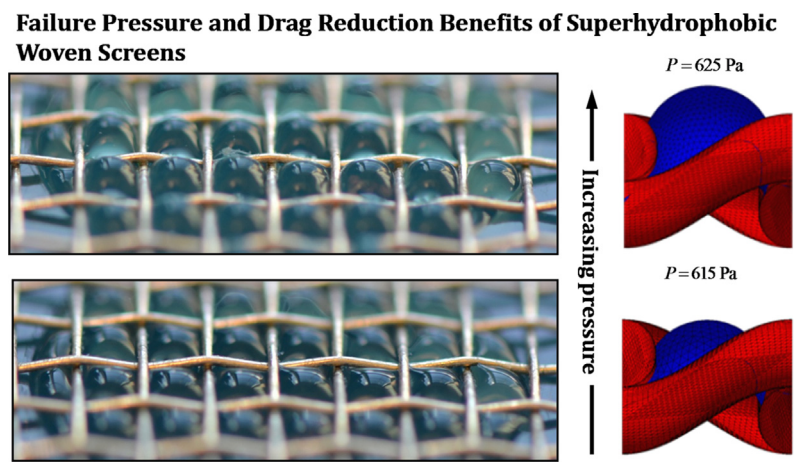
HIGHLIGHTS

- Failure pressures for different superhydrophobic wire screen are obtained.
- Numerical and experimental results are in relatively good agreement.
- Screens' wetted area are obtained as a function of hydrostatic pressure.
- Drag reduction benefits of SHP wire screens are predicted.
- Drag reduction benefits are not affected by hydrostatic pressure.

GRAPHICAL ABSTRACT



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ABSTRACT

This work presents a detailed study on the failure pressure of spray-coated superhydrophobic wire screens in terms of their geometric and wetting properties. Such information is needed in designing fluid–fluid or fluid–air separation/barrier media as well as drag reducing and self-cleaning surfaces, amongst many others. Good agreement has been observed between the results of our numerical simulations and the experimental data for failure pressure. In addition, the wetted area of the screens was calculated and used to predict their drag reduction benefits when used in a Couette flow configuration under different operating pressures. Interestingly, it was found that operating pressure in the Couette configuration does not significantly affect the drag reducing effects of the screens.

Abbreviations: AWI, air-water interface; CHP, critical hydrostatic pressure; PBC, periodic boundary conditions; SE, surface evolver; YLCA, Young–Laplace contact angle.

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