

Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Turbulent drag reduction by permeable coatings RICARDO GARCIA-MAYORAL, NABIL ABDERRAHAMAN-ELENA, University of Cambridge — We present an assessment of permeable coatings as a form of passive drag reduction, proposing a simplified model to quantify the effect of the coating thickness and permeability. To reduce skin friction, the porous layer must be preferentially permeable in the streamwise direction, so that a slip effect is produced. For small permeability, the controlling parameter is the difference between streamwise and spanwise permeability lengths, scaled in viscous units, $\sqrt{K_x^+} - \sqrt{K_z^+}$. In this regime, the reduction in drag is proportional to that difference. However, the proportional performance eventually breaks down for larger permeabilities. A degradation mechanism is investigated, common to other obstructed surfaces in general and permeable substrates in particular, which depends critically on the geometric mean of the streamwise and wall-normal permeabilities, $\sqrt{K_x^+ K_y^+}$. For a streamwise-to-cross-plane permeability ratio of order $K_x^+/K_y^+ = K_x^+/K_z^+ \sim 10$ -100, the model predicts a maximum drag reduction of order 15-25%.

Ricardo Garcia-Mayoral
Univ of Cambridge

Date submitted: 01 Aug 2015

Electronic form version 1.4