

Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Coating flow in the presence of an irrotational airflow with circulation ANDREW MITCHELL, BRIAN DUFFY, STEPHEN WILSON, University of Strathclyde — An analysis of steady coating flow of a thin film of a viscous fluid on the outside of a uniformly rotating horizontal circular cylinder in the presence of an irrotational airflow with circulation shows that the presence of the airflow can result in qualitatively different behaviour of the fluid film from that in classical coating flow. Full-film solutions corresponding to a continuous film of fluid covering the entire cylinder are possible only when the flux and mass of fluid do not exceed critical values, which are determined in terms of the parameters F and K representing the speed of the far-field airflow and the circulation of the airflow, respectively. The qualitative changes in the behaviour of the film thickness as F and K are varied are described. In particular, the film thickness can have as many as four stationary points and, in general, has neither top-to-bottom nor right-to-left symmetry. In addition, when the circulation of the airflow is in the same direction as the rotation of the cylinder the maximum mass of fluid that can be supported on the cylinder is always less than that in classical coating flow, whereas when the circulation is in the opposite direction the mass of fluid can be arbitrarily greater than that in classical coating flow.

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Date submitted: 30 Jul 2020

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