Air entrainment in Dip Coating under Vacuum

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Abstract

Air entrainment studies in dip coating have formed over many years the essential experimental tool to understand[1-5] dynamic wetting in coating flows. Although limited (no hydrodynamic assistance) in its representation of all coating flows, dip coating captures the essential feature of dynamic wetting and air entrainment. It is also a convenient simple basis for formulating theories on dynamic wetting and its failure. In this study, dynamic wetting failures have been observed and corresponding air entrainment velocities measured in dip coating at atmospheric conditions as well as under vacuum with a series of substrates and silicone oil of various viscosities to see the effect of air viscosity on air entrainment velocity. A vacuum chamber was designed and built for the purpose of these experiments and will be described in this paper. Silicone oils were used due to their low vapour pressure to prevent boiling under vacuum. Throughout the experiments, temperature changes in the vacuum chamber were closely monitored and we observed that the temperature remained constant with all test liquids. When we compared the air entrainment speeds at atmospheric conditions and also at low pressure, we found that air entrainment speed is delayed significantly as the pressure in the vacuum chamber is increased. When the results were plotted as air entrainment velocity against pressure, an exponential relation was observed. The data from this study have significant implication to the fundamental understanding of dynamic wetting. Indeed they form the *missing data link* to fully understand this phenomenon.

References

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