

Making and Breaking Non-Aqueous Foams

B. P. Binks¹, P. D. I. Fletcher¹, E. L. Sharp¹ and M. P. Gahagan²

(1) *Surfactant & Colloid Group, Department of Chemistry, University of Hull, Hull, HU6 7RX, UK,*

(2) *Applied Sciences, Lubrizol Limited., PO Box 88, Belper, Derby DE56 1QN, UK*

In spite of being important in many applications such as oilfield chemicals and lubricating oils, non-aqueous foams are poorly understood relative to aqueous systems. For example, it is unclear in many non-aqueous systems which species adsorb at the oil-air surface to stabilise the foam. This is because the common types of hydrocarbon surfactants do not generally adsorb at the hydrocarbon oil-air surface. In this project, we will focus on lubricating oil systems relevant to the petrochemical industry where air entrainment leading to unwanted foams occurs and must be controlled, for example, in gearboxes. This project will address some fundamental issues in non-aqueous foams.

Lubricating oils consist of a branched, saturated hydrocarbon base oil mixed with various different additives including thickeners, antiwear agents, corrosion inhibitors, antioxidants, dispersants, anti-foam agents and overbased nano-particles. These species, which include low molar mass, polymeric and particulate additives, are potentially weakly surface active and may contribute to foam formation and stability.

The foamability and foam stability has been studied for a range of single additive and combinations of additives in base oil solutions. The main findings are:

- The dominant foam stabiliser species in these complex mixtures have been identified.
- In the systems where foam was produced, the foam was wet transient foam with a foam lifetime of minutes.
- For the single additive in base oil solutions, maximum foaming occurs around the phase separation boundary. This is the point at which the solvent affinity for the solute is weak and hence the solute's tendency to adsorb at the oil – air surface is strongest.
- Consistent with the foams being wet, transient foams, it is found that the foam lifetime is determined primarily by the liquid drainage rate.