# Foamability of Oil Mixtures

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From an industrial point of view, understanding the foamability of oil mixtures is a major stake. For instance, in the oil industry, hydrocarbons foams made of crude oil or diesel can be found at each step of the oil extraction and recovery processes: their lifetime can sometimes reach several hours or several days. However, that subject has been poorly studied in the literature, in contrast to the foamability of aqueous foams.

Knowing that the Marangoni effect plays a major role in stabilizing foams produced without surfactant, we have developed an innovative setup in order to study quantitatively Marangoni flows induced by the condensation of a solute at the surface of a liquid. We have in particular shown that the addition of surfactants at the liquid/gas interface, even at very low concentrations, can annihilate the flows induced by the Marangoni effect. Thus, this experiment provides an experimental tool that can detect the presence of surface active agents at liquid/gas interfaces with a sensitivity that is much higher than measurements using classical tensiometry.

In parallel, we have studied the foamability of binary mixtures of alkane and toluene. Indeed, even though these oils taken separately do not foam, the binary mixture has a high foamability for given proportions. In fact, the proportion of the two species at the liquid/gas interface is not the same because the sites at the surface do not have the same energies than the sites in volume. A modification of the thickness of a liquid film composed of a binary mixture would result in a modification of the ratio of the number of sites accessible by molecules surface-to-volume. Such a thinning is thus disadvantaged: it results in a surface tension gradient that opposes the thinning and, as a result, it increases the lifetime of a bubble.

Finally, we have studied the foamability of model systems of crude oil, namely solutions composed of asphaltenes dispersed in alkane/toluene mixtures. Asphaltenes are endogenous colloidal species of crude oils with well-known interfacial properties at water/oil and solid/oil interfaces. Using the setup developed to study the Marangoni effect, we have shown that at concentrations not exceeding 5wt% of asphaltenes, the latter do not adsorb significantly at oil/gas interfaces. However, we demonstrate that the stability of the alkane/toluene foams is increased by the presence of asphaltenes: we suggest that this effect results from the osmotic pressure induced in the liquid films by the colloidal aggregates of asphaltenes.

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