Droplet Stability and Coalescence

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Coalescers are filters made from fibrous materials that collect fine dispersed droplets from a continuous phase (liquid or gas) and cause them to coalesce into larger drops that are easily separated by gravity. There are many problems associated with these devices but the stability and breakup in air of a large inviscid drop held together by interfacial tension is fundamental. A second important problem involves the interaction of droplets with fibers as they travel through the filter media. Droplets will collect on high surface energy fibers by wetting them but will be repelled from low surface energy fibers making it more likely the droplets collide with each other. The problem is to understand how these competing phenomena affect coalescence.

Lamb, in his "Hydrodynamics" addressed the problem of a liquid sphere held together by gravity to study tides and ocean waves. George Taylor studied mixing processes and the energy required to break droplets into very small sizes in the 1930s. An extensive literature on deformation of viscous drops in shear and biaxial extension flows has evolved from this work in which surface energy balances viscous stress. The main question in mixing is how much energy is needed to reduce droplets a given small size. The main question in coalescence is how large a drop can be maintained intact long enough to collect it. A coalescer can create a large droplet but keeping it from disintegrating in transit to a liquid collection point is a challenge.

Any advance to our understanding of either the stability of a large drop or the competing effects of wetting and non wetting fibers on coalescence will be a useful outcome of the workshop.