# Spray Formation by Bubbling

When gas bubbles rise through a pool of liquid and approach the free surface, the various violent motions associated with the break through to the cover gas generate droplets that may persist in the cover gas to constitute a spray. Even in an otherwise quiescent liquid, the details of the bubble breakthrough are surprisingly complicated as illustrated by the photographs in figure 2. Two of the several important processes are sketched in figure 1. Just prior to breakthrough a film of liquid is formed on the top of the bubble and the disintegration of this film creates one set of droplets. After breakthrough, as surface waves propagate inward (as well as outward) an upward jet is formed in the center of the disruption and the disintegration of this jet also creates droplets. Generally, the largest *jet droplets* are substantially larger than the largest *film droplets*, the latter being about a tenth the diameter of the original bubble.

In both the industrial and oceanic processes, a key question is the range of droplet sizes that will almost immediately fall back into the liquid pool and, on the other hand, the range of droplet sizes that will be carried high into the atmosphere or cover gas. In the ocean this significant transport above the water surface occurs as a result of turbulent mixing. In the industrial context of a liquid-fluidized bed, the upward transport is often the result of a sufficiently large upward gas flux whose velocity in the cover space exceeds the settling velocity of the droplet (Azbel and Liapis, 1983).

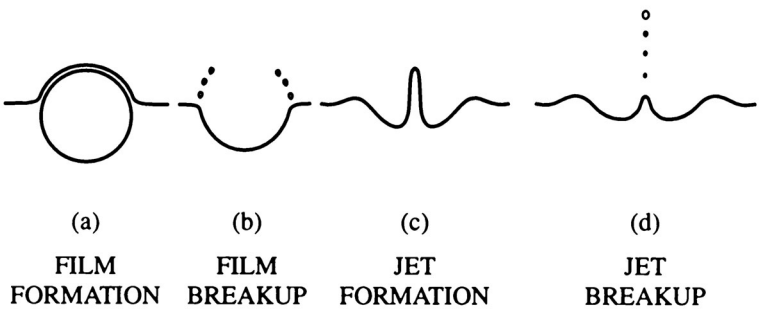


Figure 1: Stages of a bubble breaking through a free surface.

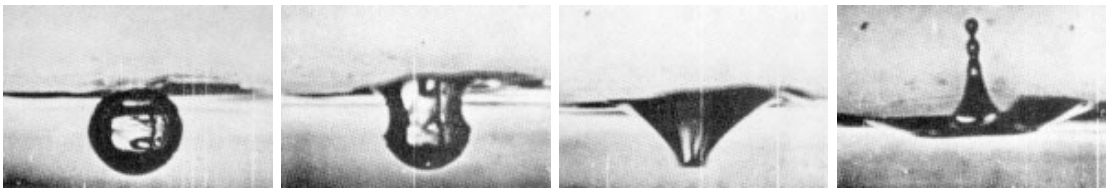

Figure 2: Photographs by Blanchard (1963) of a bubble breaking through a free surface. Reproduced with permission of the author.