Bubbly or Mist Flow Limits

Returning now to the issue of determining the boundaries of the bubbly (or mist flow) regime in pipe flows, and using the expression $R = S/\tau_w$ for the bubble size in equation (Njg4), the transition between bubbly disperse flow and separated (or partially separated flow) will be described by the relation

$$\left\{\frac{-\frac{dp}{ds}}{g\Delta\rho}\right\}^{\frac{1}{2}}\left\{\frac{S}{gd^2\Delta\rho}\right\}^{-\frac{1}{4}} = \left\{\frac{64}{3K^2C_D}\right\}^{\frac{1}{4}} = \text{constant} \tag{Njj1}$$

This is the analytical form of the flow regime boundary suggested by Taitel and Dukler (1976) for the transition from disperse bubbly flow to a more separated state. Taitel and Dukler also demonstrate that when the constant in equation (Njj1) is of order unity, the boundary agrees well with that observed experimentally by Mandhane *et al.* (1974). This agreement is shown in figures 3 and 4, section (Njb). The same figures serve to remind us that there are other transitions that Taitel and Dukler were also able to model with qualitative arguments. They also demonstrate, as mentioned earlier, that each of these transitions typically scale differently with the various non-dimensional parameters governing the characteristics of the flow and the fluids.