

Dimensional Analysis of Drop Problem ①

$$H = f^n(a, g, \rho_d, \rho_f, \mu_d, \mu_f)$$

M	0	0	0	1	1	1	1
L	1	1	1	-3	-3	-1	-1
T	0	0	-2	0	0	-1	-1

full rank, so $7 - 3 = 4$ groups

$$\frac{H}{a}, \frac{\rho_d}{\rho_f}, \frac{\mu_d}{\mu_f}, Re$$

$$Re = \frac{(\rho_d - \rho_f) g a^2}{\mu} \frac{a \rho_f}{\mu} = \frac{\Delta \rho g a^3 \rho_f}{\mu^2}$$

Strengthen:

Now we suppose that $\rho_d - \rho_f \ll \rho_f$

so $\Delta \rho$ only comes into gravitational term!

$$\therefore H = f^n(a, \Delta \rho g, \rho_f, \mu_d, \mu_f)$$

M	0	0	1	1	1	1
L	1	1	-2	-3	-1	-1
T	0	0	-2	0	-1	-1

still of full rank, $\therefore 6 - 3 = 3$

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$$\therefore \frac{H}{a} = f^n \left(\frac{\mu_d}{\mu_f}, Re \right)$$

$$Re = \frac{4 \rho g a^3 f_f}{\mu^2}$$

So if we fix $\frac{\mu_d}{\mu_f}$ (choose same materials) we can determine how $\frac{H}{a}$ varies from a few experiments.

Empirically, we can determine the distance to breakup, normalized by a , for different drop sizes.

We can also look at different composition drop fluids, varying μ_d/μ_f , to see how that affects process.