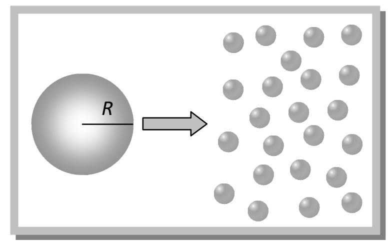
Splitting of Bigger Drop.

When a drop of radius R splits into n smaller drops, (each of radius r) then surface area of liquid increases. Hence the work is to be done against surface tension.

Since the volume of liquid remains constant therefore $\frac{4}{3}\pi R^3 = n\frac{4}{3}\pi r^3$ $\therefore R^3 = nr^3$

Work done = T ×ΔA = T [Total final surface area of n drops – surface area of big drop] = $T[n4\pi r^2 - 4\pi R^2]$



Various formulae of work done

$4\pi T[nr^2 - R^2]$	$4\pi R^2 T[n^{1/3} - 1]$	$4\pi T r^2 n^{2/3}[n^{1/3} - 1]$	$4\pi TR^3\left[\frac{1}{r} - \frac{1}{R}\right]$

If the work is not done by an external source then internal energy of liquid decreases, subsequently temperature decreases. This is the reason why spraying causes cooling.

By conservation of energy, Loss in thermal energy = work done against surface tension

JQ = W

$\Rightarrow$ $$JmS\,\Delta\theta = 4\pi TR^3\left[\frac{1}{r} - \frac{1}{R}\right]$$

$\Rightarrow$ $$J\frac{4}{3}\pi R^3 d\,S\Delta\theta = 4\pi R^3 T\left[\frac{1}{r} - \frac{1}{R}\right]$$ [As m = V × d = $\frac{4}{3}\pi R^3 \times d$]

$\therefore$ Decrease in temperature $$\Delta\theta = \frac{3T}{JSd}\left[\frac{1}{r} - \frac{1}{R}\right]$$

Where J = mechanical equivalent of heat, S = specific heat of liquid, d = density of liquid.