rate for the packed bed can be seen. The fluid velocity at the transition is taken as u_{mf}. On fluidizing the bed again, the latter type of behaviour with no peak may be observed.

If it is necessary to predict the minimum fluidization velocity the following correlation [Grace (1982)] may be used for gas–solid systems.

$$\frac{\rho u_{mf} d_p}{\mu} = (C^2 + 0.0408 Ar)^{1/2} - C \qquad (9.36)$$

where

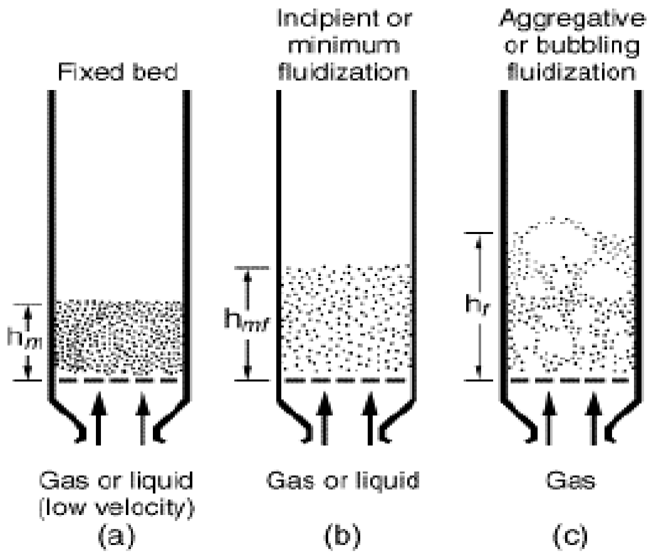
$$Ar = \rho g d_p^3 (\rho_p - \rho)/\mu^2 \qquad (9.37)$$

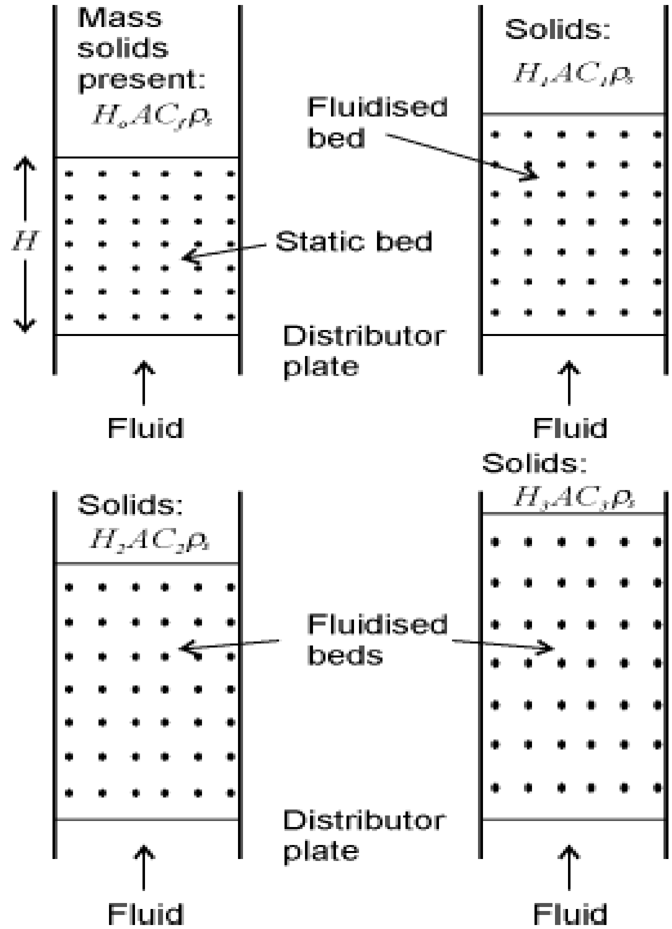
is the Archimedes (or Galileo) number. Some doubt exists regarding the value of the constant C, with some workers using the value 27.2 and others 33.4 or 33.7. It would seem reasonable to use a mean value of 30.

If it is possible to measure the height of the bed at incipient fluidization, L_{mf}, then ε_{mf} can be calculated from equation 9.34 or simply from the ratio of L_{mf} to the height of the packed bed if the void fraction in the latter is known.

In the absence of pressure drop and void fraction measurements, u_{mf} is calculated from equation 9.36 and ε_{mf} can be estimated from equation 9.35.

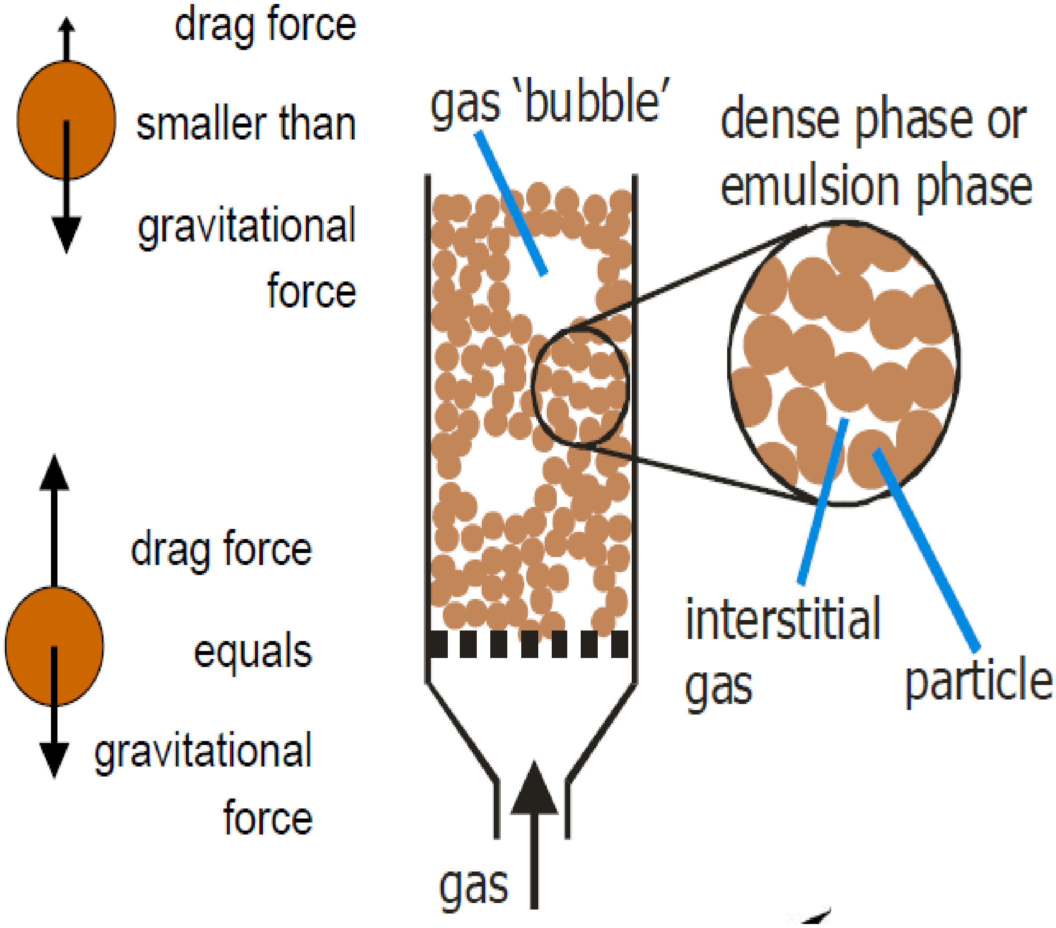
Single particles will tend to be carried out of the bed if the fluid velocity exceeds the terminal falling speed u_t of the particles given by equation 9.5. Thus the normal range of fluidization velocity is from u_{mf} to u_t. However, it may be found that the fluid velocity required to bring about fast fluidization is significantly higher than u_t because particles tend to form clusters.


Fixed bed
Incipient or minimum fluidization
Aggregative or bubbling fluidization
h_m
h_{mf}
h_f
Gas or liquid (low velocity)
Gas or liquid
Gas
(a)
(b)
(c)

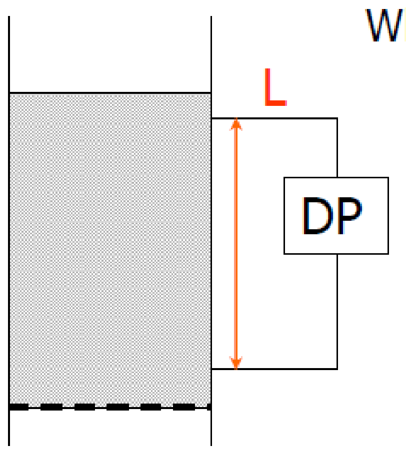

Mass solids present: $H_0AC_f\rho_s$
H
Static bed
Distributor plate
Fluid
Solids: $H_1AC_1\rho_s$
Fluidised bed
Fluid
Solids: $H_2AC_2\rho_s$
Fluidised beds
Distributor plate
Fluid
Solids: $H_3AC_3\rho_s$
Fluid

Packed bed: particles are stagnant

Fluidized bed: particles suspended in an upward gas stream; they move



Static Head of Solids



When acceleration, friction and gas head are negligible

$$\Delta P = \frac{\text{weight of particles} - \text{upthrust on particles}}{\text{bed cross} - \text{sectional area}}$$

$$\frac{\Delta P}{L} = (1-\varepsilon)(\rho_p - \rho)g$$