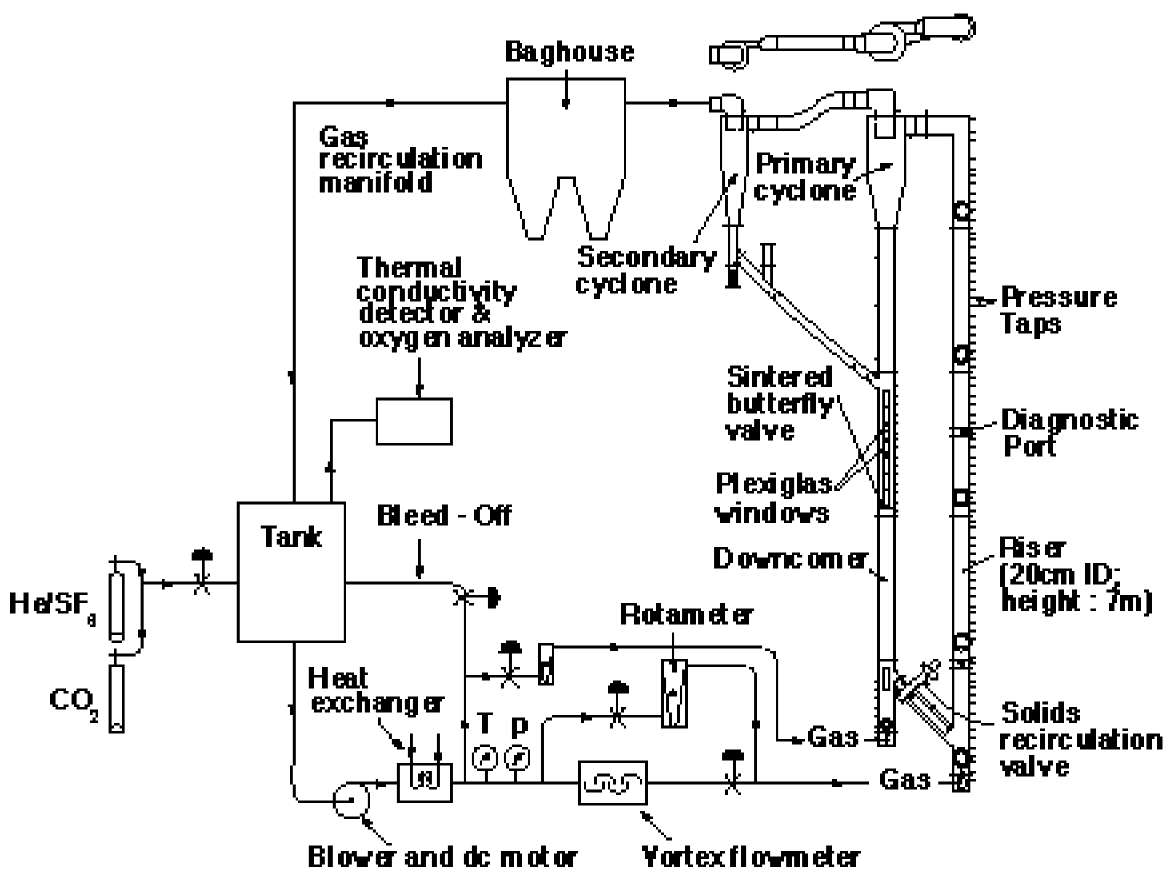
Louge M.Y., Bricout V. and Martin-Letellier S.: "On the dynamics of pressurized and atmospheric circulating fluidized bed risers," *Chem. Eng. Sci.* **54**, 1811-1824 (1999).

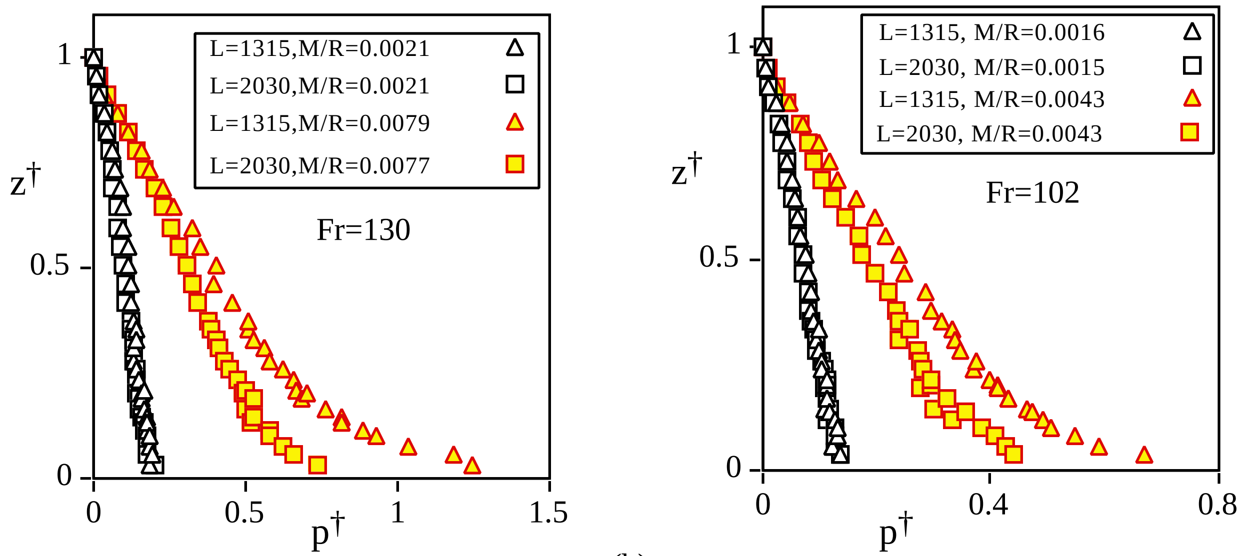
We employ a facility that recycles fluidization gases to investigate the effects of gas density, scale and operating conditions on circulating fluidized bed risers. By matching five dimensionless parameters, experiments employing plastic and glass powders fluidized with mixtures of sulfur hexafluoride, carbon dioxide, helium and air near ambient temperature and pressure achieve hydrodynamic similarity with generic high-temperature risers of variable scale operating at pressures of 1 and 8 atm.

Results in the upper riser are interpreted using steady, fully-developed momentum balances for the gas and solid phases. The analysis shows that, for a wide range of experiments, two parameters capture the dependence of the pressure gradients upon the ratio of the mean gas and solid mass flow rates. The first is the ratio of the mean particle slip and superficial gas velocities. The second represents the spatial correlation between the radial profiles of interstitial gas velocity and voidage. Variations of the first with dimensionless parameters indicate that the "atmospheric" and "pressurized" experiments conform to distinct viscous and inertial regimes.

Figure excerpts

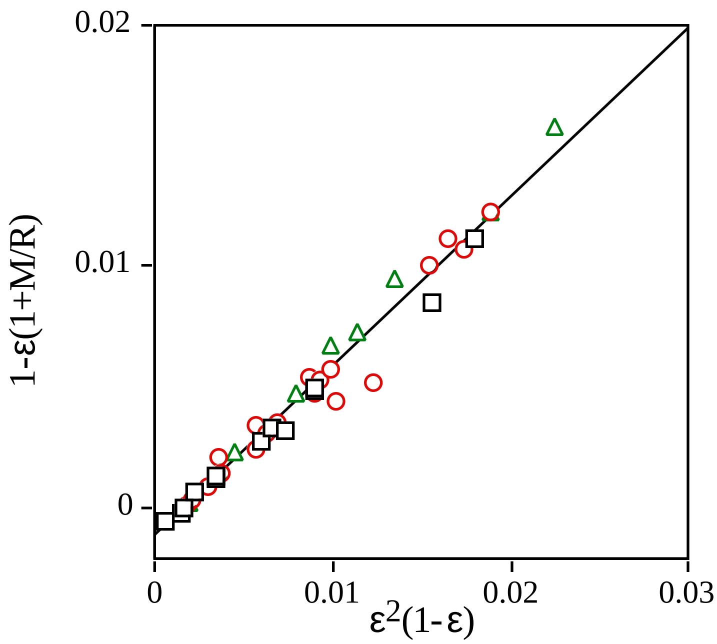


The Cornell circulating fluidized bed facility.

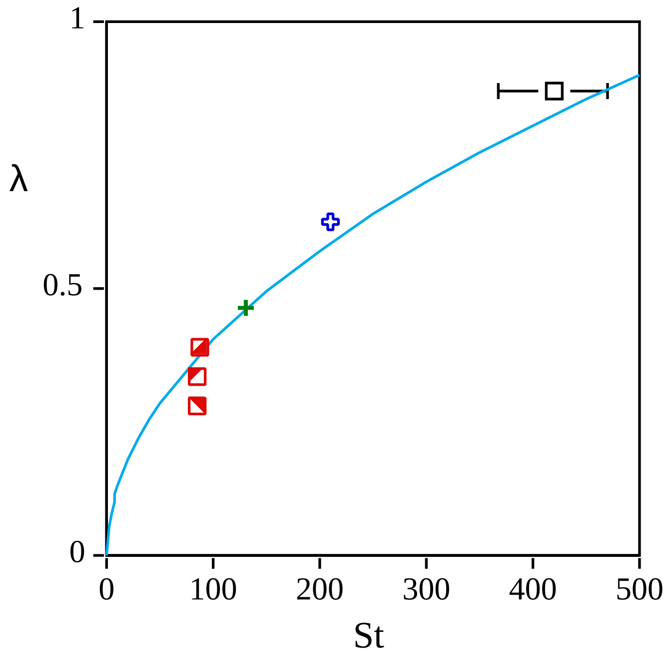


(a) (b)

Effects of scale in "pressurized" simulations with R = 600 and Ar ≈ 360. The triangles and squares represent experiments with plastic and glass powders at L = 1315 ("small PCFB") and 2030 ("large PCFB"), respectively. Conditions are (a) Fr ≈ 130, M/R = 0.0021 (open symbols), M/R ≈ 0.0078 (solid symbols) and (b) Fr ≈ 102, M/R ≈ 0.0016 (open symbols), M/R = 0.0043 (solid symbols).



Plot of $1-\bar{\varepsilon}(1+M/R)$ versus $\bar{\varepsilon}^2(1-\bar{\varepsilon})$ for the "pressurized" simulations with R = 600. The squares represent L = 2029 and Ar = 356 ("large PCFB"); the triangles are L = 1315 and Ar = 370 ("small PCFB"); the circles are L = 2092 and Ar = 95 ("Archimedes tests"). The best least-squares fit is λ = 0.700±0.018 and (α-1) = 0.00111±0.00018.



Variations of of the slip coefficient in the viscous limit.The horizontal bar represents the range of superficial velocities in the “atmospheric” simulations. The line is a best fit proportional to the square root of the Stokes number.