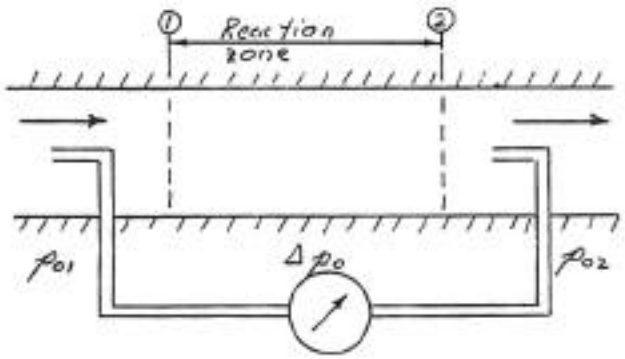
Problem 5.7

Pressure drop in a reaction zone



The sketch shows a liquid emulsion—a finely-divided mixture of two immiscible, incompressible liquids—with mean density ρ_1 entering a reaction zone of a constant-area reactor with speed V_1. The components of the emulsion react chemically in the reaction zone and leave at station 2 as one homogeneous phase with density ρ_2. Pitot tubes are installed upstream and downstream of the reaction zone. These measure the total (or stagnation) pressure

$$p_o = p + \frac{1}{2}\rho V^2.$$

Assuming that the flow is inviscid, steady, and one-dimensional, obtain an expression for the change in total pressure from 1 to 2, expressed in the dimensionless form

$$\frac{p_{01} - p_{02}}{\frac{1}{2}\rho_1 V_1^2},$$

as a function of the density ratio ρ_2/ρ_1.

HINT ANSWER