

Fluid Dynamics

PENG

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1 The Physical Properties of Fluids

Definition 1.1 (material derivative [1]). *Rate of change at a point moving with the fluid locally:*

$$\frac{D}{Dt} = \frac{\partial}{\partial t} + \mathbf{u} \cdot \nabla = \frac{\partial}{\partial t} + [u_x u_y u_z] \begin{bmatrix} \frac{\partial}{\partial x} \\ \frac{\partial}{\partial y} \\ \frac{\partial}{\partial z} \end{bmatrix} = \frac{\partial}{\partial t} + u_i \frac{\partial}{\partial x_i} \quad (1.1)$$

1.1 Solids, Liquids, and Gases

Assumption 1.2 (simple fluid). *The fluid cannot withstand any tendency by applied forces to deform it with the volume $\equiv C$.*

Definition 1.3 (resistance). *The resistance cannot prevent the deformation such that resisting force vanishes with the rate of deformation.*

Definition 1.4 (compressibility). *gases $\gg$ liquids*

Definition 1.5 (pressure).

1.2 The Continuum Hypothesis

References

- [1] George Keith Batchelor. *An introduction to fluid dynamics*. Cambridge university press, 2000. ISBN: 1139643460.