

27.1: Introduction to Static Fluids

Water is everywhere around us, covering 71% of the Earth's surface. The water content of a human being can vary between 45% and 70 % of body weight. Water can exist in three states of matter: solid (ice), liquid, or gas. Water flows through many objects: through rivers, streams, aquifers, irrigation channels, and pipes to mention a few. Humans have tried to control and harness this flow through many different technologies such as aqueducts, Archimedes' screw, pumps, and water turbines. Water in the gaseous state also flows. Water vapor, lighter than air, can cause convection currents that form clouds. In the liquid state, the density of water molecules is greater than the gaseous state but in both states water can flow. Liquid water forms a surface while water vapor does not. Water in both the liquid and gaseous state is classified as a fluid to distinguish it from the solid state.

At the macroscopic scale, matter can be roughly grouped into two classes, solids and fluids. There is some ambiguity in the use of the term fluid. In ordinary language, the term fluid is used to describe the liquid state of matter. More technically, a fluid is a state of matter that, when at rest, cannot sustain a shear stress and hence will flow. A solid, when at rest, can sustain a shear stress and although it may deform it will remain at rest. However there is some ambiguity in this description. Glacier ice will flow but very slowly. So for a time interval that is small compared to the time interval involved in the flow, glacial ice can be thought of as a solid. This description of a fluid applies to both liquids and gases. A gas will expand to fill whatever volume it is confined in, while a liquid placed in a container will have a well-defined volume with a surface layer separated the liquid and vapor phases of the substance. We shall The viscosity of a fluid is a measure of its resistance to gradual deformation by shear stress or tensile stress.

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