2.2: Adiabatic and Isothermal Processes

Among the various types of thermodynamic processes possible, there are two very important ones. These are the **adiabatic** and **isothermal** processes. An adiabatic process is one in which there is no supply of heat to the body undergoing change of thermodynamic state. In other words, the body is in adiabatic isolation. An isothermal process is a thermodynamic change where the temperature of the body does not change.

The thermodynamic variables involved in the change can be quite general; for example, we could consider magnetization and the magnetic field, surface tension and area, or pressure and volume. For a gas undergoing thermodynamic change, the relevant variables are pressure and volume. In this case, for an adiabatic process, since $dQ = 0$,

$$\begin{aligned} dU &\equiv C_v dT = -pdV \\ d(U+pV) &\equiv C_p dT = V dp \end{aligned}$$

From these, we find

$$\gamma \frac{dV}{V} + \frac{dp}{p} = 0 \tag{2.2.1}$$

Generally γ can depend on temperature (and hence on pressure), but if we consider a material (such as the ideal gas) for which γ is a constant, the above equation gives

$$pV^{\gamma} = \text{constant} \tag{2.2.2}$$

This is the equation for an adiabatic process for an ideal gas.

If we consider an isothermal process for an ideal gas, the equation of state gives

$$pV = nRT = \text{constant} \tag{2.2.3}$$