Types of Work

Work, like heat, is an energy interaction between a system and its surroundings. Energy can cross the boundry of a closed system in the form of the heat or work. Therefore, if the energy crossing the boundary of a closed system is not heat form, it must be work form.

Work is the energy transfer associated with a force acting through a distance. Work denoted with "W" and it is a form of energy so the units of work is kJ.

Types of Work

Electrical Work

If the work depends on electron transfer and electrons crfossing the system boundry do electrical work on the system.

$$We = V*N \quad (1)$$

Here, V and N are potential difference and Coulombs of electrons move through a potential difference respectively.

If we Express equation (1) in the mole form;

$$W_e = V * I \quad (2)$$

I is the number of electrons flowing per unit time.

V and I vary with time so;

$$W_e = \quad ; W_e = \quad (3)$$

$$W_e = V* I * \Delta t \quad (4)$$

Gravitational Work

As the work done b yor against a gravitational force field is called gravitational work.

$$F = m * g \quad (5)$$

We assume g is constant, so;

$$W_g = \quad = \quad (6)$$

$$W_g = m * g * \Delta z \quad (7)$$

Here, Δz represent vertical distance (like potential energy).

Gravitational work depend on the states (start and end) only and is independent of the path followed.

Accelerational Work

The work associated with a change in velocity of a system is called accelerational work. This type of work require to accelerate mass from initial velocity V_1 to final velocity V_2

$$F = m * a \quad (8)$$

$$a = — \quad (9)$$

Eq. 9 is called a velocity gradient.

If we assume displacement depend on time, so;

$$V = — \quad (10)$$

$$ds = V\,dt \quad (11)$$

$$W_a = \quad (12)$$

$$W_a = \quad — \quad (13)$$

$$W_a = \quad = m \quad (14)$$

$$W_a = -(V_2^2 - V_1^2) * m \quad (15)$$

Shaft Work

In shaft work energy transferred energy transferred with the rotating shaft. Force applied on this shaft by torque,, so applied force on this shaft is constant work depends on the revolutions “n”. F acting through a moment arm “r” generates a torque.

$$\tau = F * r \quad (16)$$

Distance related by radius of rod and revolutions, so;

$$S = (2\,\pi\,r)\,n \quad (17)$$

$$W_{sh} = F * s = -(2 \pi r) n = 2 \pi n \tau \quad (18)$$

Moving Boundry Work

In many thermodynamics applications we encountered expansion or compression processes. Thistype of Works called a moving boundry work.

$$\delta W_b = F\, ds = P * A * ds \quad (19)$$

Here ds * A is equal to the volume, so;

$$\delta W_b = P\, dV \quad (20)$$

Because of expressin of moving boundry work in eq. 20 this type of work also called a PdV work.