CEN 202 Thermodynamics

Introduction to Chemical Engineering Thermodynamics

8th Edition
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CEN 202 Thermodynamics

INTRODUCTION

Short reminders:
Dimensions and units of measures
Force and pressure
Temperature
Work and heat
Mechanical energy and its conservation.

The Scope of Thermodynamics: The science of thermodynamics was developed in the 19th century as a result of the need to describe the basic operating principles of the newly invented **steam engine** and to provide a basis for relating the work produced to the heat supplied.

From heat → power; Steam engines → Determining the principles
From the study of steam engines (principles) → Definition of The First and Second Laws of Thermodynamics.

The First and Second Laws of Thermodynamics → Derivation of equations

→ Application to all branches of science and engineering.

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System: Application of thermodynamics to any real problem takes place on a "system" (space or body of matter).

Surroundings: Everything outside the system.

System (its state)→ the macroscopic and the microscopic

The macroscopic→ relates to quantities such as composition, density, temperature and pressure

The microscopic → depends on the existence and behaviour of molecules, is not directly related to our sense perception (quantities cannot routinely be directly measured).

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Work:

Work is performed whenever a force acts through a distance.

$$dW = Fdl = PAd\frac{V}{A} = PdV$$

integration yields

$$W = -\int_{V_1}^{V_2} PdV$$

Energy:

Kinetic Energy: $E_k = \frac{1}{2}mu^2$

Potential Energy: $E_p = mzg$

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Energy Conservation

The work done on an accelerating body produces a change in its kinetic energy: As reported above;

$$W = \Delta E_K = \Delta\left(\frac{mu^2}{2}\right)$$

$$\boldsymbol{W = \Delta E_P = \Delta(mgz)}$$

If an elevated body is allowed to fall freely (without friction or other resistance), it gains in kinetic energy what it loses in potential energy. Mathematically,

$$\Delta E_K + \Delta E_P = 0$$

$$\frac{mu_2^2}{2} - \frac{mu_1^2}{2} + mz_2g - mz_1g = 0$$