

Property diagrams of pure substances essay sample



**ASSIGN
BUSTER**

* Characteristics by which physical properties of system may be described. e. g. pressure, volume, temperature, entropy, enthalpy etc. * Properties are the coordinates by which state of the system is described. * Any operation in which one or more properties of system may change is called change of state. * Thermodynamic properties are of two types :

Extensive properties- that depend on mass of the system.

Intensive properties - that are independent of mass of the system. Phase and pure substance

* The term phase refers to a quantity of matter that is homogeneous throughout in both chemical composition and physical structure. * Examples: Air, liquid+water vapor, oxygen+nitrogen gas mixture, alcohol+water mixture, oil+water mixture * Two phases can coexist during phase change.

* Pure substance is one that is uniform and invariable in chemical composition. A pure substance can exist in more than one phase but its chemical composition must be the same in each phase. * Examples: liquid water+vapor water at a fixed composition, A uniform mixture of gases, Air at cryogenic temperature, Air at room temperature

Diagrams or graphs:

* When any of the thermodynamic property is plot against another thermodynamic property , keeping third thermodynamic property constant during the analysis process a diagram is obtained. * This diagram is used to study about the phase change process for a substance. * This diagrams also give information about work done, quality of steam (in case of water), isotherm, critical point etc.

P-V diagram

* A PV diagram plots the change in pressure P with respect to volume V for some process or processes. * Typically in thermodynamics, the set of processes forms a cycle, so that upon completion of the cycle there has been no net change in state of the system; ie, the device returns to the starting pressure and volume.

* A key feature of the diagram is that the amount of energy expended or received by the system as work can be estimated as the area under the curve on the chart. * For a cyclic diagram, the net work is that enclosed by the curve.

P-T diagram

* Three curves can be drawn on the PT diagram

Fusion curve

Vaporization curve

Sublimation curve

* The curves bound three distinct regions, one for each phase * Junction of the three curves is the triple point where all three coexist * An isobar at standard atmospheric pressure intersects the normal boiling and melting points * The critical point is on the vaporization curve

* Gas above critical T is called " gas", below it is called " vapour"

P-V-T surface

* It is possible to envision three-dimensional (3D) graphs showing three thermodynamic quantities. * The solid-vapour, solid-liquid, and liquid-vapour surfaces collapse into three corresponding curved lines meeting at the triple point, which is the collapsed orthographic projection of the triple line.

* An orthographic projection of the 3D P-v-T graph showing pressure and temperature as the vertical and horizontal axes effectively collapses the 3D plot into a 2D pressure-temperature diagram.

T-S diagram

* A temperature entropy diagram, or T-s diagram, is used in thermodynamics to visualize changes to temperature and specific entropy during a thermodynamic process or cycle. * It is a useful and common tool, particularly because it helps to visualize the heat transfer during a process.

* For reversible (ideal) processes, the area under the T-s curve of a process is the heat transferred to the system during that process. * An isentropic process is depicted as a vertical line on a T-s diagram, whereas an isothermal process is a horizontal line.

Mollier diagram

* An enthalpy-entropy chart, also known as the h-s chart or Mollier diagram plots the total heat against entropy, describing the enthalpy of a thermodynamic system. * On the diagram, lines of constant pressure, constant temperature and volume are plotted, so in a two-phase region, the lines of constant pressure and temperature coincide.

* The work done on vapour cycles is represented by length, so it can be measured directly, whereas in a T-s diagram it is shown as an area. * A typical chart covers a pressure range of 0.01 - 1000 bar, and temperatures up to 800 degrees Celsius.[3] It shows enthalpy h in terms of internal energy u , pressure P and volume v using the relationship .

References:

- * Nag P. K, " Engineering Thermodynamics"; Properties of pure substances. * http://en.wikipedia.org/wiki/Phase_diagrams
- * http://www.engineersedge.com/thermodynamics/table_contents.htm *
- <http://www.engr.sjsu.edu/ahashemi/Pure%20Substance.pdf>