Isobaric Process

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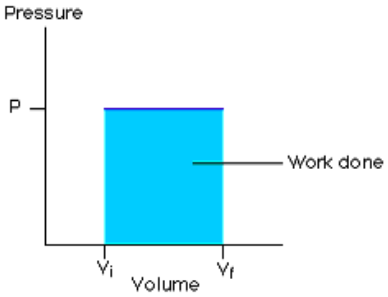
Introduction to Isobaric Processes



Thermodynamics is the study of systems in which energy is in the form of heat and work.

An isobaric process is one in which pressure remains constant.

An example of an isobaric system is a gas being slowly heated or cooled in a piston in a cylinder. The work done by the system in an isobaric process is simply the pressure multiplied by the change in volume.

P-V graph for Expansion at constant Pressure

What are Isobaric Processes?

The thermodynamic process in which pressure of the system remains constant during the supply of heat is called an **ISOBARIC PROCESS.** The heat transferred to the system does work, but also changes the internal energy of the system. An isobaric state change occurs in the boiler super heater, as the heat of the exiting steam is increased without increasing its associated pressure.

Explanation:

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isobaric_process2 Consider a cylinder fitted with a frictionless piston. The piston is free to move in the cylinder. An ideal gas is enclosed in the cylinder.

Let the initial volume of the System be V1 and initial internal energy be U1. Let **DQP** signify that the gas is heated from T1 K to T2 K. The addition of heat causes the following changes in the system:

Internal energy increases from U1 to U2. The volume of the system increases from V1 to V2. Temperature increases from T1 K to T2 K. And work (DW) is done by the gas on the piston.

According to the first law of thermodynamics:

DQ = DU+ DW

But DW = PDV

Thus we know

DQP = DU+ PDV

therefore

DV = (V2 - V1)

DQP = DU+ P (V2 - V1)

Example:

In a closed system, energy can be exchanged with its surroundings, but matter cannot. An example of this would be a sealed, clear plastic bottle of water -- i.e. light energy can pass through, but water cannot get out until the cap is taken off (which would then make it an open system). In an open system both matter and energy can be exchanged with the surroundings. As well as an opened bottle of water, other examples include cells (i.e. all life forms) and the Earth.

The Earth is somewhat of a "quasi-closed system" -- i.e. matter can be exchanged with Earth's surroundings in the form of meteorites, dust particles, and gases, while energy comes in from the Sun and leaves the planet in the form of infrared radiation. On the other hand, matter doesn't leave the Earth on a significant scale. An isolated system can exchange neither matter nor energy with its surroundings. A thermos used for hot drinks might be an example, but it is not completely isolated, since energy will eventually dissipate from it. The universe itself is, perhaps, the only true isolated system (assuming that there is only one universe, as opposed to a "multiverse").

Want to know more about isobaric processes? Click here to schedule a live session with an eAge eTutor!

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Reference links:

- http://www.en.wikipedia.org/wiki/piston
- http://www.en.wikipedia.org/wiki/heat
- http://www.physics.about.com/od/glossary/g/isobaric.htm

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