

PROPERTIES OF PURE SUBSTANCES

Pure Substance: A substance that has a fixed chemical composition.

Prerequisite of Pure Substances

We need two things to say a substance is pure.

- A constant composition.
- A homogenous mixture.

In addition a pure substance contains only one element or multiple compounds if mixture provide prerequisite it's still a pure substance.



Figure 1. Examples of pure substance.

Phase changing is an important topic for pure substances. Some substance still pure when contains more than one phases but some are not.

For example water – ice mixture is pure because both phases contains only H_2O and it's homogenous. In contrary air – liquid air mixture is not a pure. Two phases of air contains different compositions because condensation temperature of some components in air is different.

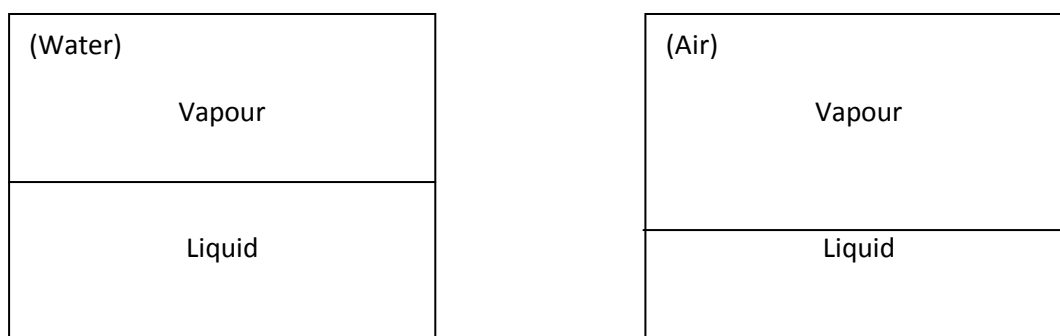


Figure 2. Examples of homogeneous and non-homogeneous mixtures.

Phases of a Pure Substance

A substance appear different phases in different temperature and pressure conditions. We define three major phases which is solid – liquid and gas. These three major phases contains sub phases. For example carbon have different allotropes (sub phases) such as graphite, graphene, nanotube etc.

In thermodynamics focus point during phase change phenomenon is molecular structure of compounds. In solid phase molecules represent (or arranged) in a three dimensional pattern which is called lattice.

Solid form: lattice is stable and cannot move because of the attractive force of molecules. Position of molecules in lattice is fixed because attractive forces between molecules and repulsive force based on the distance of molecules each other nearly equals zero. Molecules in lattice can not move, they only oscillate about their equilibrium position.

During these oscillation movement of molecules temperature designate the molecules velocity. If temperature raising is enough, high velocity values of molecules will break the bonds and solid phase changes to liquid phase. We will called **melting** this process.

Liquid form: In liquid phase molecules stil contain order but no longer in fixed position. Distance between molecules slightly increase and chunk of molecules float about each other.

Gas form: In gas phase distance between molecules are huge and we cannot talk about only any order of structure. They move randomly and continually colliding each other. In gaseous form are considerably higher energy level then liquid and solid phases.

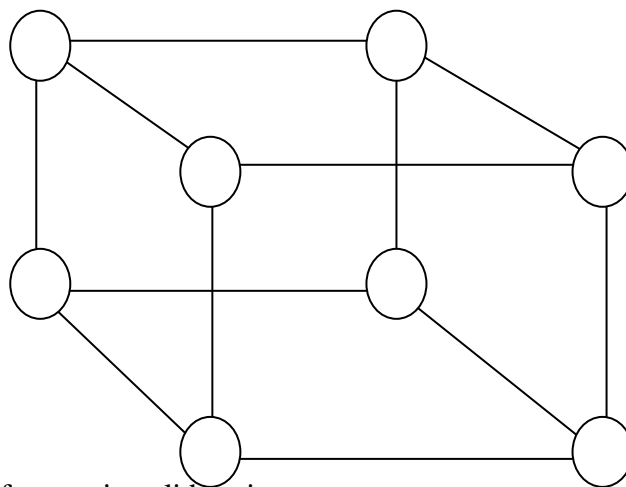


Figure 3. Arrangement of atoms in solid lattice

PHASE CHANGE PROCESSES OF PURE SUBSTANCES

Most of the pure substances can co-exist in equilibrium at different phases.

For example;

Water – ice is an example of liquid – solid co-existence.

Water – steam is an example of liquid – gas co-existence.

These two examples represent many practical situation in thermodynamics processes. Water exist in liquid – vapor in boiler and condenser of a power plants. Refrigerant exist liquid – vapor form in freezer etc.

In this course we will focus on water because it used most of the fundamental processes.