

# Lecture

Course Code: Chem484/673

Course Title: Surface phenomena

Class: BS(VII)/M.Sc(III)

## Difference Between Absorption and Adsorption

### Content: Absorption Vs Adsorption

1. Definition
2. Comparison Chart

**Absorption** is the process which takes place, when one substance enters the volume or bulk of another substance, while **adsorption** is the condition which occurs on the surface of the substrate. In the case of adsorption, there are the intermolecular forces, which make the molecules to hold each other, but in absorption, there is soaking of the liquid or gas by the solid rather any forces applied on molecules.

### Definition of Absorption

The absorption is the bulk process which means that the substance or absorbate like any ion, molecule or compound diffuse completely into another medium or substance which can be solid, liquid or gas.

The absorbing material (absorbate) remain intact in another substance (absorbent) due to the presence of space within the substance but do not have any chemical relation with each other. Once the substance or absorbent get absorbed into another substance, it cannot be separated easily. Commercially they are used in the cooling system, cold storage, refrigerants.

## What is Adsorption?

The term Adsorption was first coined in 1881 by a German physicist named Heinrich Kayser. Adsorption is often described as a surface phenomenon where particles are attached to the top layer of material. It normally involves the molecules, atoms or even ions of a gas, liquid or a solid in a dissolved state that are attached to the surface.

Adsorption is mainly a consequence of surface energy. Generally, the surface particles which can be exposed partially tend to attract other particles to their site. Interestingly, adsorption is present in many physical, natural, biological and chemical systems and finds its use in many industrial applications

Adsorption is a process which involves the accumulation of a substance in molecular species in higher concentration on the surface. If we look at Hydrogen, Nitrogen and Oxygen, these gases adsorb on activated charcoal. Meanwhile, we have to note that adsorption is different from absorption. The two processes involve totally different mechanisms.

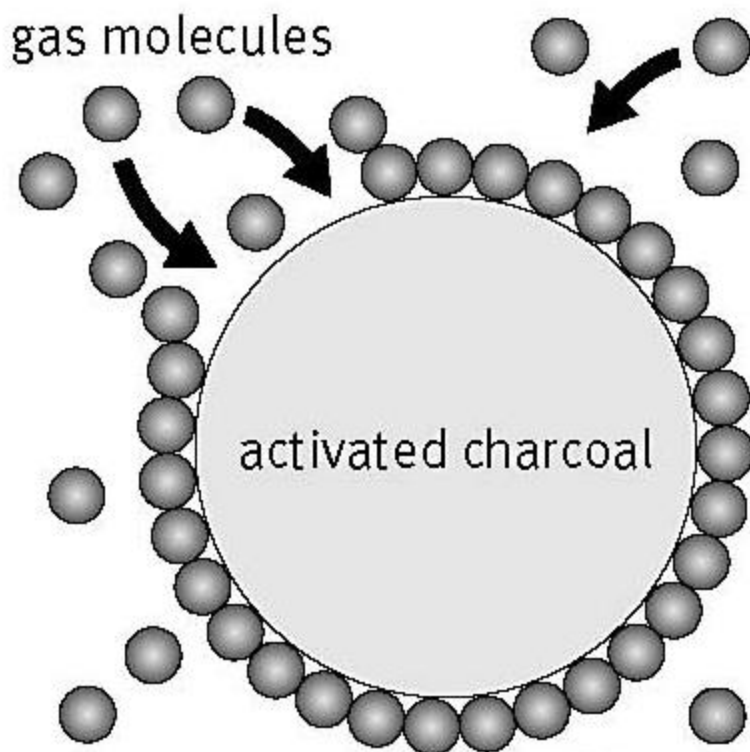
For the adsorption process, two components are required,

- **Adsorbate:** Substance which is deposited on the surface of another substance. For example,  $H_2$ ,  $N_2$  and  $O_2$  gases.
- **Adsorbent:** Surface of a substance on which adsorbate adsorbs. For example, Charcoal, Silica gel, Alumina.

### Definition of Adsorption

Adsorption is the surface phenomenon, in this condition, there is the accumulation of the substance (adsorbate) like solid, liquid or gas on the surface of another substance (adsorbent) which can be solid or liquid.

**Adsorption** is defined as the deposition of molecular species onto the surface. The molecular species that gets adsorbed on the surface is known as adsorbate and the surface on which adsorption occurs is known as adsorbent. Common examples of adsorbents are clay, silica gel, colloids, metals etc.



## 2. Comparison Chart

BASIS FOR COMPARISON	ABSORPTION	ADSORPTION
Meaning	The condition in which any substance (atoms, ions or molecules) is taken by or absorbed by another substance, especially in the solid or liquid material.	In this condition the substances like gas, liquids or dissolved solids loosely adhere or stick to the surface of another substance which can be solid or liquid.
Kind of	Bulk phenomenon	Surface phenomenon

phenomenon		
Reaction Rate	The reaction occurs at the uniform rate.	The reaction rate increases slowly and attains equilibrium.
Heat exchange process	Endothermic process.	Exothermic process.
Concentration	Does not change is constant throughout the medium.	The concentration changes from bulk to the bottom of the absorbent.
Temperature	No effect of temperature.	Adsorption works at the lower temperature.
Application	Cold storage, ice production, turbine inlet cooling, refrigerants.	Air conditioning, water purification, synthetic resin, chillers.

It is not spontaneous.	Adsorption of gas on solid is spontaneous.
Greater molecular interaction.	Less molecular interaction.
It involves the application of potential in the absorption of water by root hairs.	There is no involvement of potentials during adsorption.
It is not subdivided.	Surface absorption is adsorption it is subdivided.

## **Sorption:**

Sorption describes the actions of absorption and adsorption - desorption is the opposite of sorption. Adsorption and absorption are important processes that occur in chemistry and biology. It is important to have an understanding of both processes and the differences between them when considering separation protocols, particularly in gas and liquid chromatography.

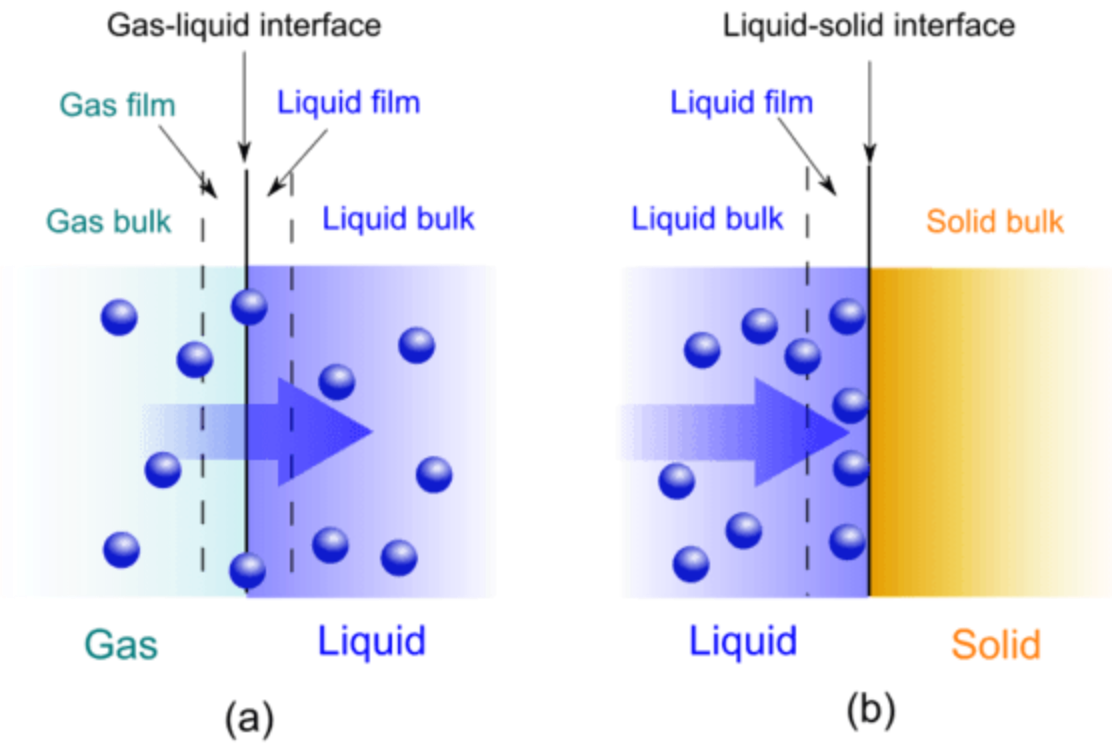
## **Desorption**

Desorption is the release of one substance from another, either from the surface or through the surface. Desorption can occur when an equilibrium situation is altered. Imagine a tank of water in equilibrium with its surroundings. The amount of oxygen entering and leaving the water from the air will be the same — and the oxygen concentration in the water will be constant. If the water temperature increases, the equilibrium and solubility are changed, and the oxygen will desorb from the water — lowering the oxygen content.

## **Process**

Adsorption and absorption are both sorption processes.

Absorption occurs when atoms pass through or enter a bulky material. During absorption, the molecules are entirely dissolved or diffused in the absorbent to form a solution. Once dissolved, the molecules cannot be separated easily from the absorbent.



*Gas-liquid absorption (a) and liquid-solid adsorption (b) mechanism. Blue spheres are solute molecules*