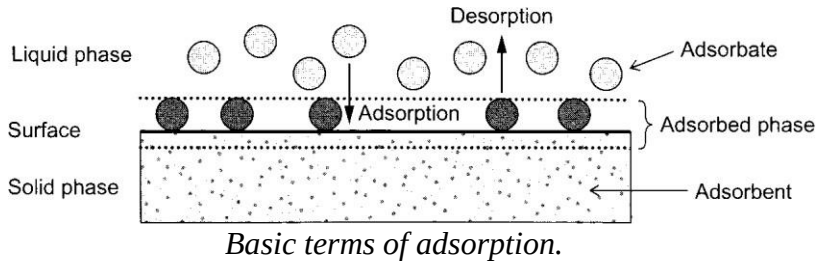
CHZ 224 SURFACE AND COLLOID CHEMISTRY

EXPERIMENT #4: MEASUREMENT OF ADSORPTION

1. Introduction

Adsorption is a phase transfer process that is widely used in practice to remove substances from fluid phases (gases or liquids) and collection on solid phase. Some examples of adsorbents commonly used in experiments of this kind are charcoal, silica gel, alumina, zeolites, and molecular sieves.

In adsorption theory, the solid material that provides the surface for adsorption is referred as *adsorbent*; the species that will be adsorbed are named as *adsorbate*. By changing the properties of the liquid phase (e.g. concentration, temperature, pH) adsorbed species can be released from the surface and transferred back into liquid phase. This reverse process is referred as **desorption**.



Basic terms of adsorption.

Figure 1. Schematic illustration of adsorption

Adsorption can result either from the universal van der Waals interactions *physical adsorption, physisorption* or it can have the character of a chemical process *chemical adsorption or chemisorption*. Contrary to physisorption, chemisorption occurs only as a monolayer. Physical adsorption can be compared to the condensation process of the adsorptive. As a rule, it is a reversible process that occurs at a temperature lower or close to the critical temperature of an adsorbed substance.

On the other hand, the adsorption isotherm is one of the most important criteria for an adsorption process that amount or pressure of reactant adsorbed for a given temperature is described by these parameters. However in this experiment, we will mainly focus on the adsorption mechanisms where the amount of adsorbate adsorbed on the adsorbent (***qe***) is calculated from a mass balance:

$$qe = (C_0 - C_e)\frac{V}{W}$$

Where C_0 is the initial adsorbate concentration (ppm), ***Ce*** is the final adsorbate concentration (ppm) ***V*** is the volume of the solution (L), and ***W*** is the mass of the adsorbent (mg).

2. Materials and Methods

In this experiment, adsorption measurements will be carried out for activated carbon and methylene blue solution. The adsorption of methylene blue will be analyzed by UV Spectrophotometer.

3. Experimental Procedure

1) Prepare 1L of methlyene blue (MB) stock solution (20 ppm) and measure the absorbance of 20,10,5 ppm MB concentrations with UV Spectrophotometer.
2) Weigh 1 g activated carbon and place it in to flask.
3) Add 30 mL 20 ppm of methlyene blue solution on to activated carbons.
4) Put flask into shaker and shake it for 5 min and finally 5 min to centrifugation to obtain pure solution.
5) Analyze the solution with UV Spectrophotometer for residual methlyene blue concentration.
6) Calculate the quantity of methlyene blue that was adsorbed by the activated carbon (mg of methlyene blue adsorbed / gram of carbon).

3.1.Calculations

1) Plot the calibration curve by using absorbance data of standard solutions (concentration vs absorbance) and obtain the regression equation for calibration curve.
2) Calculate the final concentration of MB (Ce, mg/L). Calculate the residual MB concentration using this model.
3) Prepare tables shoving the values of C_0, V, W, Ce, qe, log Ce, log qe.

4. Report

1) Write step by step how you performed the experiment.
2) List possible reasons for measuring adsorption in a few sentences of your own words.
3) Comment on your result for each case.
4) What is the basic difference between Langmuir and Freundlich isoterms?