CHAPTER 1

INTRODUCTION

1.1 Separation process

Barring a few exceptions, almost every element or compound is found naturally in an impure state such as a mixture of two or more substances. Many times the need to separate it into its individual components arises. These mixtures should be separated into components or groups of components. Separation applications in the field of chemical engineering are very important.

Separation process is defined as a process that transforms a mixture of substances into two or more compositionally-distinct products. It is also defined as any set of operation that separate of two or more components into two or more products that differ in composition [1].Many chemical process materials and biological substances occur as mixtures of different components in the gas, liquid, or solid phase. In order to separate or remove one or more of the components from its original mixture, it must be contacted with another phase. The two phases are bought into more or less intimate contact with each other so that a solute or solutes can diffuse from one to the other. The two bulk phases are usually only somewhat miscible in each others. During the contact of the two phases the components of the original mixture redistribute themselves between the two phases [3]. The phases are then separated by simple physical methods. By choosing the power conditions and phases, one phase is enriched while the other is depleted in one or more components.

1.2 Distillation

Distillation is one of the oldest and the most universal process of chemical technology and other branches of industry incorporating separation of mixtures. Distillation is one of the separation processes which are defined as a process in which a liquid or vapour mixture of two substances separated into its components fractions of desired purity, by the application and removal of heat. In the distillation process, a volatile vapour phase and liquid phase that vaporizes are involved. The resultant condensed liquid, the distillate, is richer in the more volatile components and the residual un-vaporized bottoms are richer in the less volatile components. Owing to the low-scale production and flexibility requirements for purifying different multi-component mixtures, batch distillation is one of the most important separation processes used in many chemical industries. Multi-component mixtures may be separated in a single-batch distillation column, whereas a number of interconnected conventional columns would be required to continuously separate the same mixture.

1.3 Azeotropic Distillation

An azeotrope is a mixture of two or more solvents in such a ratio that its composition cannot be changed by simple distillation. There are times when a mixture of two or more compounds forms a constant boiling point mixture and will not separate any further during distillation [2]. This is because Azeotropes are mixtures with critical composition where the vapour has the same composition as the liquid; in which no change occurs on boiling. Thus special methods are necessary to effect separation of the mixtures. Therefore, in most cases, azeotropic mixtures require special methods to facilitate their separation. Such methods utilize a mass separating agent other than energy that causes or enhances a selective mass transfer of the azeotrope-forming components. This agent might be a membrane material for pre-evaporation or an entrainer for extractive distillation. Extractive and azeotopic

distillation are the most common methods, and are described in more detail in a separate section in next chapter.

An azeotrope may be defined also; as liquid mixture that is characterized by a constant maximum or minimum boiling point which is lower or higher than that of any of the components and that distils without change in composition. The boiling point of an azeotrope is either less than the boiling points of any of its constituents which are Positive azeotropes are also called minimum boiling mixtures. It shows in the figure 1.1. Or greater than the boiling point of any of its constituents which are Negative azeotropes are also called maximum boiling mixtures. The figure 1.2 below shows the maximum boiling point azeotrope.

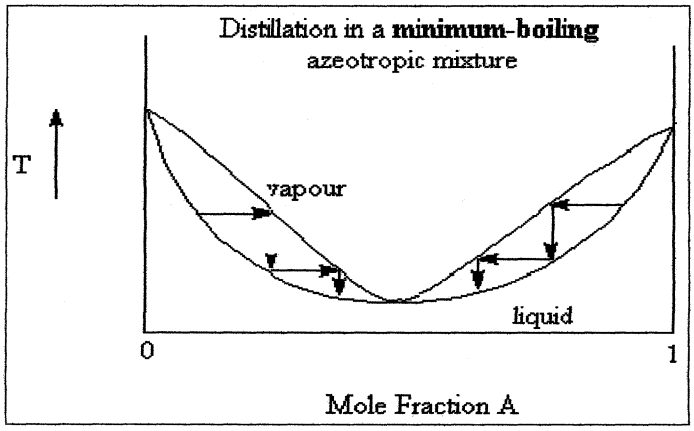

Figure 1.1: Minimum boiling point azeotrope

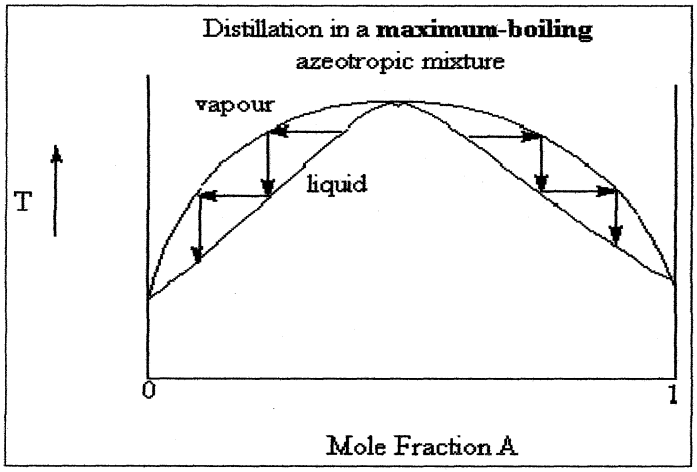

Figure 1.2: Maximum boiling point azeotrope