Abstract

The social, economic, and political atmosphere in which modern industry exists calls for an ever increasing purity and decreasing costs in the separation of materials. Among the factors leading to these more stringent requirements are concerns over environmental pollution, more stringent purity specifications for intermediate and end-use materials, and increased cost of energy sources and raw materials.

Pollution control is one of the major problems in the modern era. Water is an important and integral part of almost all the industrial operations. With increase industrialization, the water quality of the major sources is deteriorating. We make a modest effort in solving the wastewater problems through this project.

Generally, for effluents generated from various industries, the normal practice is to provide primary and biological treatments. But in some cases, contaminants cannot be easily removed by these conventional treatments and some special techniques are required.

Liquid-liquid extraction (LLE) can be applied for waste management or environmental separation for removal of various organic contaminants. Actually, LLE involves addition of another phase, i.e. solvent, to accomplish the desired separation process that has obvious environmental implications. Finally the solute has to be separated again from the solvent to reuse the solvent in the same operation. For this reason, LLE is not considered as a stand-alone process, but generally used in combination with some other unit operations for wastewater treatment. Also stripping is a common method for reducing levels of contaminants, especially when the boiling point of the contaminant is lower than that of water. But in some cases, when the boiling point is higher than water, the contaminant forms a hydrogen bond with water; contaminants are present in low concentration, etc. Here, stripping becomes impractical and LLE becomes the best choice.

The key to an effective extraction process is the selection of a suitable solvent for a particular operation. In addition to being nontoxic, inexpensive and easily recoverable, a good solvent should be relatively immiscible with feed components other than the solute and have a different density from the feed to facilitate phase separation.

Initially literature survey has been carried out to identify various applications of LLE for wastewater treatment and from this literature survey; some systems are identified for further work. These systems include Phenol and Acetic acid removal from effluent and a case study of alkaline waste water treatment produced from Caprolactum plants.

Various theoretical concepts regarding the use of extraction are discussed in this project. Caprolactum case study has been described with details of the manufacturing process, and treatment provided for the effluent generated from the plant. The required extraction step is also discussed in detail with the results of experiments carried out that are available in literature.

The application of LLE for removal of phenol and acetic acid has been described. The most important part in the extraction process i.e. Solvent selection has also been discussed for these cases. These are the systems for which actual experiments are to be carried out.

The knowledge of Liquid-Liquid Equilibrium data is also necessary along with Mass Transfer Coefficients for designing of an extractor. So, Liquid-Liquid Equilibrium data has been obtained for various systems containing phenol and acetic acid in various concentration and the details are discussed in this project.

Attempt has been made to obtain equilibrium values for different systems containing single contaminants as well as mixture of two contaminants under consideration (phenol and acetic acid), which later on can be utilized conveniently while estimating rates of extractions and mass transfer coefficient data.

Key Words : Liquid Effluent Treatment, Liquid-Liquid Equilibrium.