

# A Review on Salt Effect on Extraction of Acetic Acid and Water.

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## ABSTRACT:

This project explores the salt effect on the extraction of acetic acid and water, a phenomenon crucial for optimizing liquid-liquid extraction processes. Through a systematic experimental approach, we investigate how different types and concentrations of salts impact the partitioning behavior of acetic acid and water between immiscible phases. The study involves varying parameters such as salt concentration, solvent type, and temperature to elucidate the underlying mechanisms driving the salt effect. Analytical techniques including titration.

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## I. Introduction:

The salt effect on the extraction of acetic acid and water refers to the influence of dissolved salts on the partitioning of these substances between two immiscible phases, typically an organic solvent and an aqueous solution. When salts are added to the aqueous phase, they can disrupt the solvation of acetic acid and water molecules, leading to changes in their distribution between the two phases.

This phenomenon is commonly observed in liquid-liquid extraction processes. The specific effects depend on factors such as the type and concentration of salts used, as well as the properties of the solvents involved. Understanding the salt effect is crucial for optimizing extraction processes in various fields including chemical engineering, pharmaceuticals, and environmental science.

Salts, such as sodium chloride (NaCl), when added to the aqueous phase, can influence the distribution of acetic acid between the two phases.

This effect occurs due to the disruption of the water structure around the solute molecules by the ions present in the salt solution.

As a result, the solubility of acetic acid in the organic solvent may change, leading to either an increase or decrease in extraction efficiency depending on factors such as the type and concentration of the salt

Acetic acid, a weak organic acid, and water, a universal solvent, form a binary mixture that often requires separation in industrial settings. This separation can be achieved through liquid-liquid

extraction, a technique reliant on the differential solubility of components in two immiscible solvents. However, the addition of salts to the system introduces complexities that impact the extraction process.

salts can also induce a salting-in effect, where the solubility of acetic acid in the aqueous phase increases due to specific interactions between the salt ions and the solute molecules. This phenomenon is often observed with certain salts at higher concentrations or under specific conditions

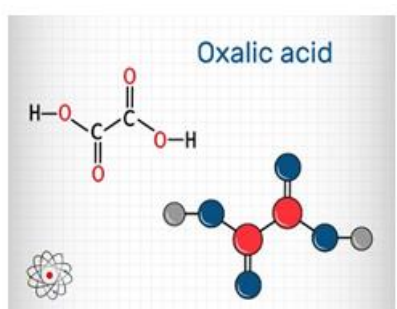
## RAW MATERIALS:

The salt effect on the extraction of acetic acid and water refers to the influence of dissolved salts on the partitioning of these substances between two immiscible phases, typically an organic solvent and an aqueous solution. When salts are added to the aqueous phase, they can disrupt the solvation of acetic acid and water molecules, leading to changes in their distribution between the two phases. This phenomenon is commonly observed in liquid-liquid extraction processes. The specific effects depend on factors such as the type and concentration of salts used, as well as the properties of the solvents involved. Understanding the salt effect is crucial for optimizing extraction processes in various fields including chemical engineering, pharmaceuticals, and environmental science.

## OXALIC ACID:

Oxalic acid has numerous industrial applications, including as a primary component in the production of various chemicals like oxalates,

formic acid, and other derivatives. It is also used in metal cleaning and rust removal processes due to its strong chelating properties. Additionally, oxalic acid is utilized in textile and wood bleaching, as well as in pharmaceuticals and cosmetics.



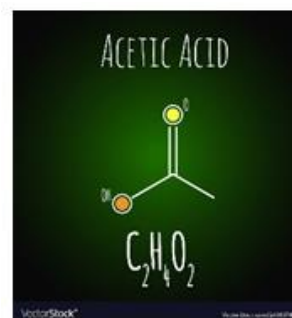
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#### ETHYL ACETATE:

Ethyl acetate is a colourless, sweet-smelling organic compound with the chemical formula  $\text{CH}_3\text{COOCH}_2\text{CH}_3$ . It is commonly known as ethyl ethanoate and is derived from ethanol (ethyl alcohol) and acetic acid. Ethyl acetate is a volatile solvent with a fruity Odor, reminiscent of pears or apples, which makes it popular in various industrial and commercial applications.

This solvent is widely used in the production of paints, coatings, adhesives, and varnishes due to its fast-evaporating properties and excellent solvency for resins and cellulose derivatives. Additionally, ethyl acetate is utilized as a solvent in the pharmaceutical and cosmetic industries, particularly in the formulation of perfumes.

Moreover, ethyl acetate is employed as an extraction solvent in food processing, such as the decaffeination of coffee and tea, and in the production of certain food additives. It is also utilized in the production of Flavors and fragrances due to its pleasant Odor and low toxicity.



#### Acetic Acid:

Acetic acid, also known as ethanoic acid, is a clear, colorless liquid organic compound with the chemical formula  $\text{CH}_3\text{COOH}$ . It is the primary component of vinegar, which typically contains around 4-8% acetic acid by volume. Acetic acid has a pungent, vinegar-like odor and a sour taste.

This organic acid is produced naturally in small quantities by certain bacteria during the fermentation of sugars and alcohol



#### SODIUM HYDROXIDE:

Sodium hydroxide (NaOH), commonly known as caustic soda or lye, is an inorganic compound consisting of sodium cations ( $\text{Na}^+$ ) and hydroxide anions ( $\text{OH}^-$ ). It is a white, odorless, and highly caustic solid at room temperature, with a molecular formula NaOH

#### DISTILLED WATER:

Distilled water is water that has undergone a process distillation to remove impurities and minerals. During distillation, water is boiled, and the steam is collected and condensed back into a liquid state, leaving behind contaminants such as minerals, salts, and organic compounds. This process effectively produces water that is nearly pure, with a significantly reduced concentration of impurities compared to tap water or other sources.

## METHODS FOR SEPARATION OF ACETIC ACID

There are several methods for separation of acetic acid from its aqueous mixture according to their composition in the feed mixture

### 1. RECTIFICATION:

It is very difficult to carry out the separation of acetic acid in its aqueous mixture by rectification. Because for this column is required with maximum number stages and high reflux ratio. So the running cost for the rectification is high

### 2. EXTRACTIVE DISTILLATION:

Extractive distillation is defined as distillation in the presence of a miscible, high-boiling. Relatively non-volatile component, the solvent, that forms no azeotrope with the other components in the mixture. The method is used for mixtures having a low value of relative volatility. Nearing unity. Such mixtures cannot be separated by simple distillation, because the volatility of the two components in the mixture is nearly the same.

Causing them to evaporate at nearly the same temperature at a similar rate, making normal distillation impractical. When the acetic acid concentration in the solution mixture is in between 50% - 70% by weight % then this method is used for the separation

### 3. LIQUID-LIQUID EXTRACTION:

Separation processes in which two immiscible or partially soluble liquid phases are brought into contact for the transfer of one or more components are referred to as liquid-liquid extraction or solvent extraction.

The processes taking place are primarily physical, since the solutes being transferred are ordinarily recovered without chemical change. On the other hand, the physical equilibrium relationships on which such operations are based depends mainly on the chemical characteristics of the solutes and solvents. When the acetic acid concentration in the solution is below than 40% by weight %. Then liquid-liquid extraction is appropriate for separation. Extraction involves the use of systems composed of at least three substances, and although for the most part the insoluble phases are chemically very different, generally all three components appear at least to some extent in 3 both phases. Thus liquid-liquid extraction is components appear at least to some extent in 3

### PROCEDURE:

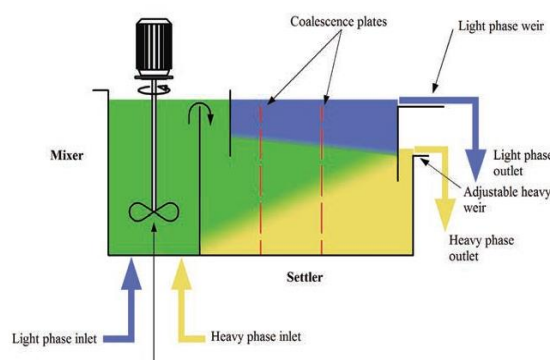
Extraction is a well-established process. In this work, the extraction process performed for the system water-acetic acid-ethyl acetate with Sand 1

both phases. Thus liquid-liquid extraction is generally represented by the tie-lines and the equilateral-triangular coordinates.

## TYPES OF CONTACTORS:

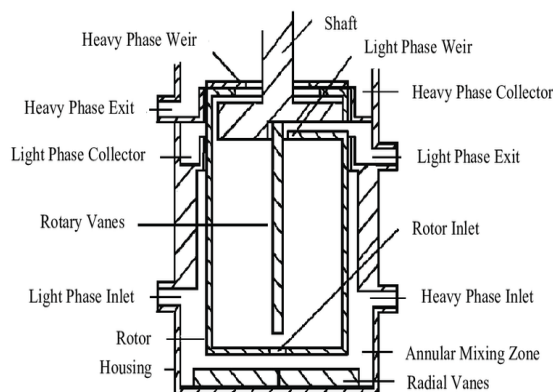
### 1. MIXER SETTLER:

A mixer-settler consists of a mixer (agitated tank) in which the aqueous and organic liquids are contacted, followed by gravity separation in a shallow basin called a settler, where the liquids disengage into individual layers and are discharged separately.



### 2. CENTRIFUGAL CONTACTOR:

In centrifugal extractors, the two immiscible liquids of different densities are rapidly mixed in the annular space between a rotor and the stationary housing. The separation efficiency is very much higher in the centrifugal extractor than in a mixer-settler



0% NaCl salt effect. In this, we first consider the mixture of acetic acid and water (with and without salt) and ethyl acetate as a solvent.



### Comparison of Theoretical and Experimental Normality of Acetic Acid.

**1 BATCH EXTRACTION:** The simplest extraction operation is single-contact batch extraction in which the initial feed solution is agitated with a suitable solvent, allowed to separate into two phases after which the Physical\ component properties Water Acetic acid Ethyl acetate Formula  $H_2O$   $CH_3COOH$   $CH_3COC_2H_5$  Boiling point  $100^\circ C$   $118^\circ C$   $75-78^\circ C$  Melting point  $0^\circ C$   $17^\circ C$  -  $83.5^\circ C$  Density  $1000Kg/m^3$   $1049Kg/m^3$   $902Kg/m^3$  Solubility Soluble in water & ethyl acetate Partially soluble in water Vapor pressure  $17.535mmHg$   $16hPa(20^\circ C)$   $77.2563mmHg(20^\circ C)$  Color . Colorless Molecular weight 18 60.05 88.11 7 solvent containing the extracted solute is decanted. This is analogous to the laboratory procedure employing a separating funnel. On an industrial scale, the extraction operation more usually involves more than one extraction stage and is normally carried out on a continuous basis.

The equipment may be comprised of either discrete mixers or settlers or some form of column contactor in which the feed and solvent phases flow counter currently by virtue of the density difference between the phases. Final settling or phase separation is achieved under gravity at one end of the column by allowing an adequate settling volume for complete phase disengagement. any one extraction operation gives rise to two product streams: the extracted feed solution, more usually termed the raffinate phase, and the solvent

containing extracted solute termed the extract phase. The continuous extraction has several advantages that, the process does not stop in intermediate stage up to which desired equilibrium is not achieved. But this operation required huge capacity equipment or contactor. For maintaining the contact between the components in the mixture feed flowrate and the solvent flowrate should be fixed first. Continuous extraction operation' mostly carried out in agitating vessels or contactors such as rotary agitated contactor, Siebel column, old Shue Rushton column, rotating Disc contactor, Kunhi column.

**3.SELECTION OF SOLVENT:** No single criterion can be used to assess the suitability of a solvent for a particular application the final choice is invariably a compromise between competing requirements. Thus, not only should the solvent be selective for the solute being extracted but it should also possess other desirable features such as low cost, low solubility in the feed-phase and good recoverability as well as noncorrosive and noninflammable. Furthermore, interfacial tension between the two phases should not be so low that subsequent phase disengagement becomes difficult and the density difference between the phases should be large enough to maintain counter current flow of the phases under the influence of gravity.

**DENSITY:** Density of lighter phase generally at least 5% less than that of heavier phase in order to ensure smooth phase of operation.

**VISCOSITY:** Viscosity of solvent should be low. This reduces power consumption for mixing phases. Nontoxic, non-corrosive, less expensive, low volatility, low flexibility.

#### SELECTIVITY:

Selectivity or separation factor is analogous to the relative volatility in distillation. Selectivity of a solvent B for C reflects the ability of the solvent B to dissolve C in preference to A when a mixture of A and C is treated with B. It is defined as the ratio of C to A in the extract phase to the ratio of C to A in the raffinate phase at equilibrium. For separation by extraction to be possible, its value should be different from unity.

Thus,

$B = \frac{\text{Weight fraction of C in extract} / \text{Weight fraction of A in extract}}{\text{Weight fraction of C in raffinate} / \text{Weight fraction of A in raffinate}}$

#### SALT EFFECT ON LIQUID-LIQUID EXTRACTION

The addition of a salt to an aqueous solution of a volatile non electrolyte has a marked



effect upon the liquid-liquid and vapor-liquid equilibria of the solution. The presence of the salt may either raise or lower the relative volatility of the nonelectrolyte or in extreme cases cause the formation of the two liquid phases. The observed effects depend upon the nature and concentration of both the salt and nonelectrolyte

#### SALTING IN EFFECT:

When polar solvent is added to an aqueous salt solution and is preferentially solvent the water and breaks the hydration cages previously formed around the salt ions. It is used to recover salts from concentrated aqueous solution and it is also important in biological separation processes such as purification of proteins, enzymes, nucleic acid and other.

**HYDRATION THEORY:** 10 According to this theory each salt ion binds a constant number of water molecules as a shell of oriented water dipoles surrounding the ion. There by decreasing the activity of the water. This bound water is then unavailable as solvent for the electrolyte. "The number of water molecules so bound by each ion is called the Hydration number of the ion." Considering the wide variation in hydration number, this concept permits only a quantitative estimation of the magnitude of the salt effect.

Hydration theory does not allow the occurrence of salt in effect. It explains difference in effect due ion by assuming each orients water molecules in right direction. If orientation favorable to tnonelectrolyte's molecule, salting in occurs and unfavorable salting out occurs.

The addition of a salt to liquid-liquid equilibrium introduces ionic forces that affect the equilibrium. When the ions are solvated, part of the water molecules becomes unavailable for the solution and they are salted out from the aqueous phase.

This salt effect can be used for removing organic compounds from water



#### ELECTROSTATIC THEORY:

This theory was proposed by Meranda and Furter in 1974 but later it was developed by Debye and Mc Auley. It was based on the amount of work necessary to discharge the ions in the solvent and to recharge them in a solution containing non-electrolyte. This quantity yields the electrostatic contribution to the chemical potential of the neutral solute. The theory thus takes into account only electrostatic effects. It does not allow for the influence of dispersion type forces between the ion and the solute molecules or for the alteration which the ion may produce in the hydrogen bond interactions between neighboring water molecules.

This theory says that the addition of relatively small amount of salt may exerts large effects on the relative volatility of components. The salt dissolved in mixed solvent may affect the boiling point, the mutual solubilities of the two liquid components.

Generally, the particles (no dissociated molecules or ions or both) of dissolved salts tend to attract preferentially one type of solvent molecules more strongly than the other. Usually, the molecules of the more polar components are preferentially attracted by the electrostatic field of the ions and hence the vapor composition is enriched by the less polar solvent, in which the salt is less soluble. Kirk wood taking into account the repulsion between the ionic charges and an image charge induced in the cavity created in the solvent by the electrolyte molecule calculated the ion nonelectrolyte interaction energy.

He derived an equation quite similar in form to that of Debye and Mc Auley.

The electrostatic theory basically considers only the action of columbic forces and omits other

factors. Because of simplification and approximations made in its derivation, the Debye-Mc Auley equation is a limiting equation only. Butler, using a similarly simplified 11 model, obtained an equation virtually identical with that of Mc Auley. later Debye, taking into account the heterogeneity of the mixture of water and neutral solute, expressed the total free energy of the system, including the contribution due to the field of ion, as a function of distance from the ion these electrostatic theories treats the solvent as a structural continuum, through which the electrostatic ions are determined solely by their macroscopic electric constants

#### **VANDERWAALS FORCES THEORY:**

A given non-electrolyte may be salted-in by some electrolyte and salted-out by other in same solvent. This fact suggested that short range dispersion forces might also be applicable in determining salt effect especially at finite concentration. Long and McDavid in an attempt to allow for the trends towards salting-in of the non-electrolyte by large ions, proposed a modified version of the Kirkwood and Debye equation to account for dispersion and displacement of forces.

They concluded that this theory was included in establishing the note of dispersion forces. Since the electrostatic interaction between an ion and a neutral molecule is short range in nature, additional interaction or Vander Waals type must be considered more fully.

These terms involve the polarizability of salt ions, solvent molecules, and non-electrolytes solute molecules, as higher selectivity in extraction system with salt. The lower distribution coefficient of water can be means a good attributed to the association of water molecules in unrestricted salt in the aqueous phase, which impedes a transfer of water to the organic phase. From practical point of view resulting higher selectivity well as the special force fields originating from any component dipoles that may be present.

#### **INTERNAL PRESSURE THEORY:**

According to the internal pressure concept proposed by Tammann and applied by Mc Davit and Long. The concentration in total volume upon the addition of salt to water can be thought of as a compression of the solvent. This compression makes the introduction of a molecule of non-electrolyte more difficult, and this result in salting out. An increase in total volume upon the addition of salt would produce the counter effect known as salting in. Mc. Davit and Long. Applying the internal pressure concept of Tammann to nonpolar nonelectrolytes, calculated the free energy of the

transfer of the latter from pure water to the salt solution.

Liquid extraction is the process where solute is separated from its homogeneous feed mixture by using of suitable solvent. In this work, the well-known mixture of acetic acid and water is to be separated by a suitable solvent and by applying salt effect to enhance the separation. Most 12 of chemical industry has acetic acid water mixture as source of outlet or effluent of the process from which they want to separate the acetic acid.

This project work has an objective to separate the acetic acid from the mixture by using salt effect and various solvent. (Mahendra Kumar khuntia, etl, D. Laiadi, A. Hasseine, A. Merzougui(2012) studied on Homotopy method to predict liquid liquid equilibria for ternary mixtures of (water + carboxylic acid +organic solvent). Liquid liquid equilibrium (LLE) measurements of the solubility (binodal) curves and tie-line end compositions were carried out for the ternary systems (water + acetic acid + dichloromethane), (water +acetic acid + methyl isobutyl ketone). (water + lactic acid + methyl isobutyl ketone) at T =294. 15 K and atmospheric pressure. The reliability of the experimental tie-line data was ascertained by means of the Othmer-Tobias and Hand correlations. For the extraction effectiveness of solvents, the distribution and selectivity curves were plotted. In addition, the interaction parameters for the UNIQUAC and NRTL models were retrieved from the obtained experimental results by means of a combination of the homotopy method and the genetic algorithms. I.H. Alamin, G. A. Gasmelseed, M. A Ahmed.2014.

Studied experimental LLE data for the ternary systems: (chloroform-acetic acid-water) and (water acetic acid-Ethyl acetate) and its solubility. In this study of acetic acid was chosen as the solute in both systems and LLE data were measured at 303.5K and atmospheric pressure. The distribution of acetic acid and solute between the organic phase and the aqueous phase was investigated. The reliability of tie lines generated from the composition data as tested and verified by three correlation models.

## MATERIALS

The chemicals, sodium chloride pellets (S. D. Fine chemicals), Ethyl Acetate AR grade 99.9% (Loba Chemic.), Acetic acid 99.9% AR grade (Loba Chemic.). Double distilled water and Oxalic acid 0.1 N (S.D. Fine chemical) were used as received without further purification.

## STANDARDIZATION OF NAOH:

The sodium hydroxide is standardized by oxalic acid with phenolphthalein indicator. The 2ml of 0.1N oxalic acid is taken in 100ml conical flask with one drop of phenolphthalein indicator and it titrated against the prepared NaOH solution up to color changes from colorless to pink. And validate its normality. By given equation,  $N_1 \times V_1 = N_2 \times V_2$  Here,  $N_1$  - Normality's of Oxalic acid and NaOH.  $V_1$  - Volume of Oxalic Acid taken.  $V_2$  - Volume of NaOH Burette reading.

## TERNARY EQUILIBRIUM DATA EXPERIMENTS:

Ternary equilibrium data gives us an idea about at which stage or composition the separation of solute occur the curve obtained from the equilibrium data shows that the heterogeneity of the components.

The part below the curve shows the heterogeneous region of system and the upper part of binodal curve shows that homogeneous region of system.

Maximum heterogeneous region gives us a maximum separation of solute from the feed mixture. The equilibrium curve is plot on equilateral triangular graph in which three corner of triangle shows the composition of the component involve in the ternary system.

In equilateral triangle corner A denote inert component which will be the raffinate after the extraction, corner C denote the solute composition and corner B denotes composition of solvent. The example of triangular equilibrium plot is given below in figure 3.2. The curve LPM is the binodal curve or ternary equilibrium curve. Where P is the plait point. It is a point at which both extract and raffinate phases meet with each other. Afterward no separation happen.

Line ER is the tie line formed by joining the one point of extract and one point of raffinate. To generate the ternary equilibrium data by doing several experiments on the system acetic acid, ethyl acetate and water with 5% NaCl and 10%NaCl.

To study the salt effect on the separation. For the experimentation of ternary data well known method is used, which is nothing but cloud point method.

## EXPERIMENTATION OF DISTRIBUTION OF ACETIC ACID IN ETHYL ACETATE WITH 0%NaCl.

Heterogeneous ternary mixture was prepared by taking predetermined quantities of the three component i.e. 10ml of water with 0%NaCl + 10ml solvent (Ethyl Acetate) + 0.5 to 30ml of solute (Acetic Acid) in a 100ml stoppered conical flask.

Mixture thoroughly agitated for two hours in magnetic stirrer at room temperature of about 28°C. After two hours of stirring there was no appreciable change of composition of component in two phases. Then it allow to settle for two hour to attain the equilibrium in conical flask.

After attain equilibrium the existing two layer was collected for the analysis. To determine the acid content in the exiting aqueous layer and organic layer, 2ml of sample taken for analysis and titrated against standard NaOH solution with phenolphthalein as a indicator.

## EXPERIMENTATION OF DISTRIBUTION OF ACETIC ACID IN ETHYL ACETATE AND WATER WITH 5%NaCl •

Heterogeneous ternary mixture was prepared by taking predetermined quantities of the three component i.e. 10ml of water with 5%NaCl + 10ml solvent (Ethyl Acetate) + 0.5 to 30ml of solute (Acetic Acid) in a 100ml stoppered conical flask. • Mixture thoroughly agitated for two hours in magnetic stirrer at room temperature of about 28°C. •

After two hours of stirring there was no appreciable change of composition of component in two phases. Then it allow to settle for two hour to attain the equilibrium in conical flask.

After attain equilibrium the existing two layer was collected for the analysis. To determine the acid content in the exiting aqueous layer and organic layer, 2ml of 25 sample taken for analysis and titrated against standard NaOH solution with phenolphthalein as a indicator By observing experimental results in Table 3.8 of 5% salt addition and comparing with Table 3.7 of 0% Salt we can see that in Table 3. the batch from 7 to 9 got homogeneous mixture but in 5% Salt addition only batch 9 gives us a homogeneous mixture with solvent addition. So from this we can say that with salt addition the heterogeneity within the mixture increases and we can study the distribution

## Experimentation of distribution of Acetic acid in heterogeneous mixture with 10%NaCl.

Heterogeneous ternary mixture was prepared by taking predetermined quantities of the three component i.e. 10ml of water with 10%NaCl + 10ml solvent (Ethyl Acetate) + 0.5 to 30ml of solute (Acetic Acid) in a 100ml stoppered conical flask. mixture thoroughly agitated for two hours in

magnetic stirrer at room temperature of about 28°C. After two hours of stirring there was no appreciable change of composition of component in two phases. Then it allow to settle for two hour to attain the equilibrium in conical flask.

After attain equilibrium the existing two layer was collected for the analysis. To determine the acid content in the exiting aqueous layer and organic layer, 2ml of sample taken for analysis and titrated against standard NaOH solution with phenolphthalein as an indicator.



## II. RESULT ANALYSIS:

The acetic acid distribution in between ethyl acetate and water with and without salt addition was studied by Several batch extraction experiment.

If we see the distribution of solute in ethyl acetate and water without addition of 27 salt gives the less distribution as compare to salt addition. From experiment we say that the distribution of solute is more favourable in salt addition of 10% NaCl. Veera M. Boddu et.al. 2001 which has been studied on liquid liquid equilibria of benzene acetic acid and water with salt addition of 5,10 and 20% calcium chloride and salted out the 48.5% of benzene as compare to this we also get better result by addition of salt.

### PREPARATION OF NAOH SOLUTION:

For the analysis of solute concentration the NaOH is required so, before doing analysis preparation of 0.3N NaOH has done by doing component mass balance. 40 gm of NaOH pellets = IN NaOH of 1000ml. X gm of NaOH pellets = 0.3N NaOH of 1000ml.  $X = 40 \times 0.3 = 12$  gm of NaOH Pellets.

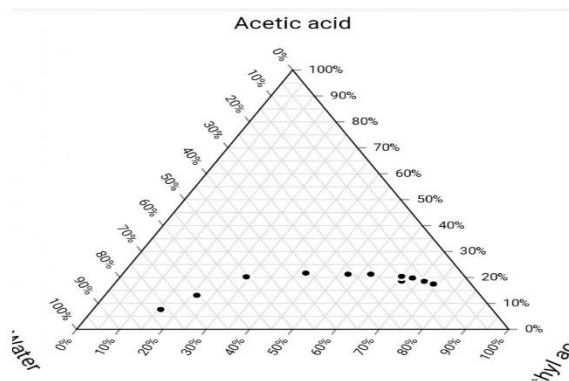
### ANALYSIS OF AQUEOUS PHASE:

The analysis of aqueous phase is to be done by using standardized NaOH solution. Concentration of acetic acid in aqueous phase can be determined by titrating with known solution of NaOH.  $N_1 V_1 = N_2 V_2$   $N_1 = \text{Normality of NaOH}$   $V_1 = \text{Volume of NaOH (burette reading)}$   $N_2 = \text{Normality of acetic acid}$   $V_2 = \text{Volume of acetic acid (pipette out volume)}$

### 3.5.3. ORGANIC PHASE ANALYSIS:

The analysis of organic phase (Ethyl acetate phase ) has been done NaOH solution. NaOH solution is prepared by dissolving pellets in conical flask.

The concertation of acetic acid in organic phase has been has been determined by titrating it with known solution of NaOH.  $N_1 \times V_1 = N_2 \times V_2$   $N_1 = \text{Normality of NaOH}$   $V_1 = \text{Volume of NaOH (Burette Reading)}$   $N_2 = \text{Normality of Acetic Acid}$   $V_2 = \text{Volume of Acetic Acid (Pipette Out Volume)}$





### FRACTIONAL EFFICIENCY:

The distribution coefficients are dependent on the particular solute of interest, the ionic strength of water phase, and the temperature pH can also play an important role, because it may result in change in chemical form of solute, from charged to uncharged, or the reverse.

In general, charged species have extremely low distribution coefficients. A useful measure of the effectiveness of an extraction is the Fractional efficiency. Fe. by definition, the value is equal to the mass of the solute in solvent phase, divided by the total mass in both phases.

$F_e = \frac{\text{mass of solute in solvent phase}}{\text{total mass of solution both phases}} = \frac{m_s}{m_s + m_a}$  Here,  $F_e$  - Fractional Efficiency  $m_s$  - Mass of solute in solvent phase.  $m_a$  - Mass of solute in aqueous phase Sample calculation for fraction efficiency for ethyl acetate acetic acid and water without salt,  $F_e = 0.99/1.42$

### RESULT:

Binodal curve obtained from the experimental data and from literature of L.H. Alamin, G. A. Gasmelseed, and M. A. Ahmed. From this we can see that, the curve of 0% NaCl is complete curve with less heterogeneous region.

Has large heterogeneous region. It means that, the by addition of salt in the mixture which increase the heterogeneous region. The comparison of these three binodal curve is given.

By comparing these three binodal curve of ternary equilibrium, we can see that the heterogeneous region of ethyl acetate without salt addition has less than the 5 and 10% salt addition.

The salt addition is effective because of the ionic bond between H<sup>+</sup> and Cr is stronger than the bond between water and acetic acid, so the bond between water and acetic acid breaks and acetic acid transfer to solvent ethyl acetate.

### III. CONCLUSION:

The present study revealed that the performance for extraction of acetic acid from water is superior or 10% NaCl salt addition than the 5% and 0% NaCl salt addition.

As the concentration of salt increases the nonelectrolyte component acetic acid is attracted towards organic solvent ethyl acetate and got better yield than the conventional method.

This salt addition is more effective than the conventional batch extraction.

In this present study the distribution coefficient also increases from 0.66 to 1.25 while addition of salt. So that, the addition of salt has an advantage for

extraction of aqueous mixture than the traditional one and also conclude that as salt concentration in the homogeneous mixture increases the heterogeneity of component increases as solvent is added. The fractional efficiency is increases from 0.4096 to 0.5588 which is big advantages of salt addition. From this conclude that by using ionic solvent maximize the fraction efficiency up to 15% that of the without salt.

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