

Introduction

Wastes have been considered to be a serious worldwide environmental problem in recent years. Because of increasing pollution, these wastes should be treated. However, industrial wastes can contain a number of valuable organic components. Recovery of these components is important economically. Using conventional distillation techniques, the separation of acetic acid and water is both impractical and uneconomical, because it often requires large number of trays and a high reflux ratio. In practice special techniques are used depending on the concentration of acetic acid.

Between 30 and 70% (w/w) acetic acid contents, extractive distillation was suggested. Extractive distillation is a multicomponent-rectification method similar in purpose to azeotropic distillation. In extractive distillation, to a binary mixture which is difficult or impossible to separate by ordinary means, a third component termed an entrainer is added which alters the relative volatility of the original constituents, thus permitting the separation. In our department acetic acid is used as a solvent during the obtaining of cobalt(III) acetate from cobalt(II) acetate by an electrochemical method.

After the operation, the remaining waste contains acetic acid. In this work, acetic acid which has been found in this waste was recovered by extractive distillation. Adiponitrile and sulfolane were used as high boiling solvents and the effects of solvent feed rate/solution feed rate ratio and type were investigated. According to the experimental results, it was seen that the recovery of acetic acid from waste streams is possible by extractive distillation.

There are many methods available for the separation of acetic acid like, solvent extraction, distillation, adsorption, pervaporation and ion exchange.

Why pH is important?

If we take one of the separation technique as an example say using liquid membrane for separation. The vegetable oil being hydrophobic in nature allows the selective transport of acetic acid through it from the feed phase to the strip phase. Acetic acid is transported across the membrane from the feed phase in its unionized molecular form and not in its ionic form that is acetate. This required that the pH of the feed phase is lower than the pKa value of acetic acid which is 4.76 (at 25 degC). At pH above 4.76 acetate ion is formed, which cannot be permeate through the liquid membrane.

The pH value of the feed phases of 0.1 M, 0.05 M and 0.01 M concentrations of acetic acid was found to be 3.23, 3.65 and 4.05 respectively. These pH values are lower than the pKa value of acetic acid, enabling permeation of acetic acid across the membrane.

Critical area: Pure acetic acid service, which will have low conductivity. Acetic acid (systematically named ethanoic acid is an organic compound with the chemical formula CH_3COOH (also written as $\text{CH}_3\text{CO}_2\text{H}$ or $\text{C}_2\text{H}_4\text{O}_2$). It is a colorless liquid that when undiluted is also called glacial acetic acid. Acetic acid has a distinctive sour taste and pungent smell. Although it is classified as a weak acid, concentrated acetic acid is corrosive. Acetic acid is the second simplest carboxylic acid (the simplest is formic acid) and is an important chemical reagent and industrial chemical.

Typical process details:

Pure acetic acid service, more than 30%
Water even less than <1%.

Typical problems:

The acid has very low conductivity so measurement is difficult.

Remedies:

To use a flowing special sensor to get a good electrolytical contact between reference cell and process.

Product Recommendations Measurement System

Process Liquid Analyzer:

- 2-wire FLEXA pH/ORP Analyzer



- 4-wire FLXA402 pH/ORP Analyzer



Features

- Dual sensor measurement on 2-wire type analyser
- Redundant system on dual sensor measurement
- Easy touch screen operation on 2-wire type analyzer

Features

- Connectable to upto five sensor
- Easily viewable color LCD
- Touch screen operation

Sensor Selection:

Yokogawa sensor SC21C-AGC55 can be the solution.



This flowing electrolyte sensors uses a ceramic reference junction, with the electrolyte (3.3 molal KCl). The flow of electrolyte through the junction, while small, remains the safest way to prevent clogging and to protect the internal reference against poisoning and diffusion.

pH in Acetic Acid

Features for type SC21C-AGC55

- For tough application where pollution of the reference system is to be expected
- Low ionic application where the positive flow of electrolyte provides the conductivity needed to measure pH (< 50 $\mu\text{S}/\text{cm}$)
- Heavy duty pH sensitive glass.
- Flowing reference system for pollution resistance, and highly stable reference potential.
- Use in combination with the pressurisable electrolyte reservoir to obtain a positive flow towards the process (K1500YA)

Cables used:

WU20-LT** Qty1 + WU20-PC** Qty1

Flow fitting:

F*20 various type of flow fittings can be used

Temperature Sensor

SM60-T1 SERIES - For accurate pH measurement temperature compensation is required. Either a Pt100 or a Pt 1000 temperature electrode can be selected.



Tangible benefit

Save down time in cleaning, repeated calibration, improve end product quality.

Note: For additional information on this application contact the local Yokogawa Process Liquid Analyzer Department

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