NEHRU COLLEGE OF ENGINEERING AND RESEARCH CENTRE

(NAAC Accredited)

(Approved by AICTE , Affiliated to APJ Abdul Kalam Technological University, Kerala)

Pampady, Thiruvilwamala(PO), Thrissur(DT), Kerala 680 588

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

LAB MANUAL

CY110 ENGINEERING CHEMISTRY LAB

VISION OF THE INSTITUTION

To mould true citizens who are millennium leaders and catalysts of change through excellence in education.

MISSION OF THE INSTITUTION

NCERC is committed to transform itself into a center of excellence in Learning and Research in Engineering and Frontier Technology and to impart quality education to mould technically competent citizens with moral integrity, social commitment and ethical values.

We intend to facilitate our students to assimilate the latest technological know-how and to imbibe discipline, culture and spiritually, and to mould them in to technological giants, dedicated research scientists and intellectual leaders of the country who can spread the beams of light and happiness among the poor and the underprivileged.

ABOUT THE DEPARTMENT

♦ Established in: 2002

♦ Course offered : B.Tech in Computer Science and Engineering

                   M.Tech in Computer Science and Engineering

                   M.Tech in Cyber Security

♦ Approved by AICTE New Delhi and Accredited by NAAC
♦ Certified by ISO 9001-2015
♦ Affiliated to A P J Abdul Kalam Technological University, Kerala.

DEPARTMENT VISION

Producing Highly Competent, Innovative and Ethical Computer Science and Engineering Professionals to facilitate continuous technological advancement.

DEPARTMENT MISSION

1. To Impart Quality Education by creative Teaching Learning Process

2. To Promote cutting-edge Research and Development Process to solve real world problems with emerging technologies.

3. To Inculcate Entrepreneurship Skills among Students.

4. To cultivate Moral and Ethical Values in their Profession.

PROGRAMME EDUCATIONAL OBJECTIVES

PEO1: Graduates will be able to Work and Contribute in the domains of Computer Science and Engineering through lifelong learning.

PEO2: Graduates will be able to Analyse, design and development of novel Software Packages, Web Services, System Tools and Components as per needs and specifications.

PEO3: Graduates will be able to demonstrate their ability to adapt to a rapidly changing environment by learning and applying new technologies.

PEO4: Graduates will be able to adopt ethical attitudes, exhibit effective communication skills, Team work and leadership qualities.

CY110 ENGINEERING CHEMISTRY LAB

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSO)

PSO1: Ability to Formulate and Simulate Innovative Ideas to provide software solutions for Real-time Problems and to investigate for its future scope.

PSO2: Ability to learn and apply various methodologies for facilitating development of high quality System Software Tools and Efficient Web Design Models with a focus on performance optimization.

PSO3: Ability to inculcate the Knowledge for developing Codes and integrating hardware/software products in the domains of Big Data Analytics, Web Applications and Mobile Apps to create innovative career path and for the socially relevant issues.

PREPARATION FOR THE LABORATORY SESSION
GENERAL INSTRUCTIONS TO STUDENTS

1. Read carefully and understand the description of the experiment in the lab manual. You may go to the lab at an earlier date to look at the experimental facility and understand it better. Consult the appropriate references to be completely familiar with the concepts and hardware.

2. Make sure that your observation for previous week experiment is evaluated by the faculty member and you have transferred all the contents to your record before entering to the lab/workshop.

3. At the beginning of the class, if the faculty or the instructor finds that a student is not adequately prepared, they will be marked as absent and not be allowed to perform the experiment.

4. Bring necessary material needed (writing materials, graphs, calculators, etc.) to perform the required preliminary analysis. It is a good idea to do sample calculations and as much of the analysis as possible during the session. Faculty help will be available. Errors in the procedure may thus be easily detected and rectified.

5. Please actively participate in class and don't hesitate to ask questions. Please utilize the teaching assistants fully. To encourage you to be prepared and to read the lab manual before coming to the laboratory, unannounced questions may be asked at any time during the lab.

6. Carelessness in personal conduct or in handling equipment may result in serious injury to the individual or the equipment. Do not run near moving machinery/equipment. Always be on the alert for strange sounds. Guard against entangling clothes in moving parts of machinery.

7. Students must follow the proper dress code inside the laboratory. To protect clothing from dirt, wear a lab coat. Long hair should be tied back. Shoes covering the whole foot will have to be worn.

8. In performing the experiments, please proceed carefully to minimize any water spills, especially on the electric circuits and wire.

9. Maintain silence, order and discipline inside the lab. Don't use cell phones inside the laboratory.

10. Any injury no matter how small must be reported to the instructor immediately.

11. Check with faculty members one week before the experiment to make sure that you have the handout for that experiment and all the apparatus.

AFTER THE LABORATORY SESSION

1. Clean up your work area.

2. Check with the technician before you leave.

3. Make sure you understand what kind of report is to be prepared and due submission of record is next lab class.

4. Do sample calculations and some preliminary work to verify that the experiment was successful

MAKE-UPS AND LATE WORK

Students must participate in all laboratory exercises as scheduled. They must obtain permission from the faculty member for absence, which would be granted only under justifiable circumstances. In such an event, a student must make arrangements for a make-up laboratory, which will be scheduled when the time is available after completing one cycle. Late submission will be awarded less mark for record and internals and zero in worst cases.

LABORATORY POLICIES

1. Food, beverages & mobile phones are not allowed in the laboratory at any time.

2. Do not sit or place anything on instrument benches.

3. Organizing laboratory experiments requires the help of laboratory technicians and staff. Be punctual.

ESTIMATION OF TOTAL HARDNESS IN A GIVEN SAMPLE OF WATER

OBJECTIVE
To estimate the amount of total hardness in a given sample of water using approximately M/100 EDTA solution and 2.50 grams of $MgSO_4.7H_2O$ per litre

PRINCIPLE
The EDTA solution is standardized by titration with standard $MgSO_4.$ Solution. The hardness of the water sample is then estimated by complexometric titration using EDTA as titrant and EBT as indicator.Sodium salt of EDTA is used in the estimation because of the limited solubility of EDTA. The sodium salt forms the complex forming ion H_2Y^{2-} in aqueous solution where $Y=\{CH_2-N-(-CH_2-COO^-)_2\}_2.$ It reacts with divalent metal ion in a 1:1 ratio at $p^H 10$

$$M^{2+} + H_2Y^{2-} \longrightarrow MY^{2-} +2H^+$$
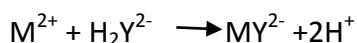
$NH_4Cl- NH_4OH$ buffer is added to maintain the p^H at 10.EBT forms weak wine red complexes with metal ions.When EDTA is added to hardwater during titration it first combines with Ca^{2+} and Mg^{2+} ions to form stable soluble and colourless complexes.At the endpoint EDTA displaces EBT from unstable Ca-EBT and Mg-EBT complexes leaving the indicator free.Hence there is colour change from wine red to blue at the end point

$$M\text{-}EBT + EDTA \longrightarrow M\text{-}EDTA+EBT$$
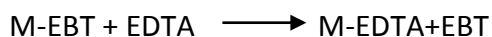
MATERIALS AND METHODS
APPARATUS USED
Burette, Pipette, 250 ml conical flask
CHEMICALS USED
$MgSO_4.$ Solution, EDTA solution, EBT solution, $NH_4Cl- NH_4OH$ buffer,
Hard water sample

PROCEDURE

a) Standardisation of EDTA

- 20 ml of the given $MgSO_4$. Solution is pipetted out into a conical flask, add 3 ml of buffer solution and 3-4 drops of EBT indicator.The solution turns wine red.
- The burette is filled with EDTA
- The reaction mixture in the conical flask is titrated against the EDTA solution till the wine red colour just turns blue.Titrations are repeated to get concordant value
- The molarity of EDTA is calculated

b) Estimation of total hardness

- 60 ml of the hard water sample is then pipette into a conical flask, 3 ml of buffer solution added and 6 drops of EBT indicator
- The solution in the conical flask is titrated against the standardized EDTA solution in the burette till the wine red colour just changed to blue.The titrations are repeated for concordance
- The hardness of water sample is estimated in terms of $CaCO_3$ equivalents

RESULT AND DISCUSSION

Amount of total hardness of water sample in ppm=

The amount of hardness is estimated in terms of equivalent calcium carbonate

CONCLUSION

The quick, complete and one step interaction of EDTA with metal ions to yield stable complexes is the basis of this complexometric titration

VIVA QNS:

1. What is the chemical reason behind Water hardness?
2. Why we have to use buffer here?What type of buffer is used.
3. What is EDTA?write its chemical formula.
4. Write the complex forming ratio of metal and EDTA?
5. What do you mean by complexometric titration

EXPT NO:2   **DATE:**

## ESTIMATION OF IRON IN IRON ORE(HAEMETITE)

OBJECTIVE

To estimate the amount of iron in the given sample of haemetite using 0.05N $K_2Cr_2O_7$ solution with potassium ferricyanide as external indicator.

PRINCIPLE

0.5g of haemetite is dissolved in conc.HCl .The ferric chloride solution is reduced to ferrous chloride using stannous chloride in HCl.

$$2FeCl_3+SnCl_2 \longrightarrow 2FeCl_2+SnCl_4$$
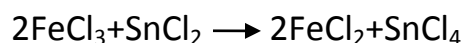
Excess of stannous chloride is removed by adding mercuric chloride($HgCl_2$)

$$SnCl_2+2HgCl_2 \longrightarrow Hg_2Cl_2 \downarrow + SnCl_4$$
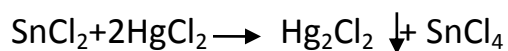
The ferrous ion is then estimated by titration with std. $K_2Cr_2O_7$ solution using potassium ferricyanide as external indicator. Ferrous ion gives a deep blue colour with ferricyanide while ferric ion doesn't.

$$3Fe^{2+}+2[Fe\ (CN)_6]^{3-} \longrightarrow Fe_3[Fe(CN)_6]_2$$

$\qquad\qquad$ Ferricyanide $\qquad\qquad$ Turn bull's blue
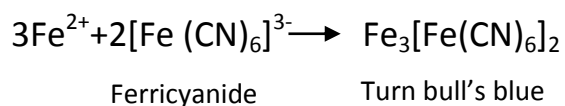
MATERIALS AND METHOD

APPARATUS USED

Burette,pipette,100 ml std.flask,conical flask,250 ml beaker,glass rod,porcelain tile.

CHEMICALS USED

Haemetite, HCl, $K_2Cr_2O_7$,Stannous chloride,$HgCl_2$,Potassium ferricyanide.

PROCEDURE

- The given iron solution is made upto 100 ml in a std.flask and shaken well.
- The burette is filled with std 0.05N $K_2Cr_2O_7$
- A number of drops of external indicator are arranged on a clean porcelain tile using a thin glass rod.

- A beaker filled with water is kept by the side for cleaning the glass rod after mixing.
- 20 ml of the made up solution is pipetted out into the conical flask.20 ml of dil.HCl is added and the solution is diluted to 100 ml using distilled water.
- About 12 ml of $K_2Cr_2O_7$ solution is added into the titration flask in one step without testing. Then a drop of the reaction mixture is taken at the end of a thin glass rod is mixed with a drop of indicator on the tile. A blue colour indicates ferrous ion.The testing is continued after the addition of each 1 ml till a drop of the reaction mixture fails to give a blue colour with the indicator.The range at which end point occurs is noted.
- In the second titration 1 ml less than the previous volume of dichromate is added from the burette without testing.Then testing is continued after the addition of each 2 drops until a drop of reaction mixture failed to give a blue colour with the indicator.
- Titrations are repeated till concordant values are obtained.

From the titre value the normality of ferrous ion and its mass are estimated.

RESULT AND DISCUSSION

Percentage of iron in haemetite sample   =   %

CONCLUSION

When all the Fe^{2+} ion is oxidized by dichromate, at the end point a drop of iron solution fails to give blue colour with potassium ferricyanide.

VIVA QNS:

1. What is the chemical name for Haemetite?

2. Why we dilute the reaction mixture before titration?

3. What is the chemical name for the product obtain at the end point?

4. Write the chemical formula for turn bull's blue?

5. What happens if external indicator is added internally by mistake?

## ESTIMATION OF COPPER IN A SAMPLE OF BRASS

OBJECTIVE

To estimate the amount of copper with given solution of brass using approximately 0.05N sodium thiosulphate and standard 0.05N potassium dichromate.

PRINCIPLE

Brass is an alloy of copper (60-80%) and zinc (20-40%).The given amount of brass is diluted in 1:1 nitric acid when the following reactions take place

$$Cu + 4HNO_3 \longrightarrow Cu(NO_3)_2 + 2NO_2 \uparrow + 2H_2O$$

$$Zn + 4HNO_3 \longrightarrow Zn(NO_3)_2 + 2NO_2 \uparrow 2H_2O$$
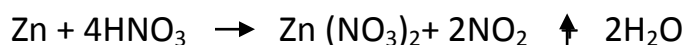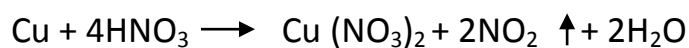
A definite volume of the solution is treated with excess of potassium iodide solution. After neutralization the liberated iodine is titrated with standard sodium thiosulphate using starch as indicator.

$$2Cu^{2+} + 4I^- \longrightarrow Cu_2I_2 \downarrow + I_2$$

$$I_2 + 2S_2O_3^{2-} \longrightarrow S_4O_6^{2-} + 2I$$
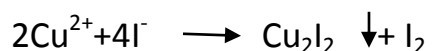
MATERIALS AND METHOD

APPARATUS USED

Burette, pipette, standard measuring flask, titration flask

CHEMICALS USED

Brass solution, 0.05 N $K_2Cr_2O_7$, approximately 0.05N sodium thiosulphate ($Na_2S_2O_3$),dil.NH_4OH, dil CH_3COOH, potassium iodide solution and starch solution.

PROCEDURE

a) Standardisation of sodium thiosulphate

- 20 ml of standard 0.05N $K_2Cr_2O_7$ is pipette out into a conical flask
- 10 ml of dil H_2SO_4 and 10 ml of 5% KI solution are added then the solution is diluted to 100 ml.The reaction mixture in the flask is titrated against sodium thio sulphate solution
- When the solution turns pale yellow 2 ml of freshly prepared starch solution is added.A blue colour is seen.Titrations are continued by adding thiosulphate solution drop by drop until the colour just change from blue to light green.Titrations are repeated to get concordant values.Normality of $Na_2S_2O_3$ is calculated.

b) Estimation of copper in brass solution

- The brass solution is made up to 100 ml in a standard flask and shaken well.
- The standard thiosulphate is taken in the burette.
- 20 ml of the made up solution is pipette out into a titration flask. Ammonium hydroxide is added drop by drop which is shaken till a light blue precipitate is formed. The precipitate is dissolved by adding dil acetic acid (CH_3COOH) drop wise with shaking. About 10 ml of 10 % KI solution is added, the mixture turns dark brown.
- The brown reaction mixture is titrated against standard sodium thiosulphate in the burette till it is pale yellow.2ml of freshly prepared starch solution is added and the titration is continued adding thiosulphate solution drop by drop until there is a colour change from blue to white. Titrations are repeated to get concordant values.
- Normality of Cu^{2+} in the brass solution is calculated .Equivalent mass of copper is 63.54.The mass of copper and its percentage in brass sample are calculated.

RESULT AND DISCUSSION

Percentage of copper in brass solution =   %

Zn^{2+} in the brass solution does not interfere in the above estimation

CONCLUSION

Before the addition of KI, Cu^{2+} solution has to be neutralized by adding NH_4OH in slight excess until a small amount of Cu $(OH)_2$ is precipitated. This is dissolved in acetic acid before the estimation. The liberated iodine is equivalent to Cu^{2+} present in the solution.

VIVA QNS:

1. What is the composition of Brass?
2. Whether the zinc present in Brass interferes in Copper estimation?
3. Why the indicator starch is added near the end point?
4. What is the product obtained at the end point? What is its colour?
5. Why we have to neutralize the brass solution before estimation?

ESTIMATION OF CHLORIDE IN DOMESTIC WATER

OBJECTIVE

To estimate the amount of chloride in the given sample of domestic water, being supplied with approximately N/40 $AgNO_3$ and N/40 NaCl solution.

PRINCIPLE

Chloride ions in a given water sample are estimated by argentometric titration (Mohr's method). The indicator used is a solution of potassium chromate (K_2CrO_4). When silver nitrate solution is added to a solution of sodium chloride containing few drops of K_2CrO_4, white silver chloride is precipitated initially. The moment all the chloride ions have been precipitated out, a drop of silver nitrate added in excess gives a red precipitate of silver chromate $AgCrO_4$. This indicates the end point

$$AgNO_3 + NaCl \longrightarrow AgCl \downarrow + NaNO_3$$

$$2Ag^+ + CrO_4^{2-} \longrightarrow Ag_2CrO_4 \downarrow$$
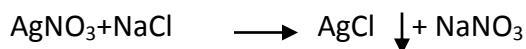
MATERIALS AND METHOD

APPARATUS USED

Burette, Pipette, conical flask

CHEMICALS USED

$AgNO_3$ solution, N/40 NaCl solution, K_2CrO_4 indicator.

PROCEDURE

a) **Standardization of $AgNO_3$ solution**
   - The burette is filled with $AgNO_3$ solution
   - 20 ml of std.N/40 NaCl solution is pipette out and 10 drops of K_2CrO_4 is added.
   - The yellow solution in the conical flask is then titrated against the $AgNO_3$ solution until a permanent reddish brown colour is obtained. Titrations are repeated to get concordant values.
   - The normality of $AgNO_3$ is thus calculated.

b) **Estimation of Chloride**

- 20ml of the water sample is pipetted out into a conical flask and 10 drops of K_2CrO_4 indicator is added to get an yellow solution

- The reaction mixture in the conical flask is then titrated against standardized $AgNO_3$ solution in the burette till a permanent reddish brown colour is obtained. Titrations are repeated for concordance.

- The normality and the amount of chloride ions in the water sample is calculated

RESULT AND DISCUSSION

The mass of chloride ions in the given water sample=

CONCLUSION

The solubility product,K_{sp} AgCl < K_{sp} Ag_2CrO_4 .Hence as long as chloride ions are available only the insoluble AgCl is precipitated.When all the chloride ions have been precipitated, a slight excess of Ag^+ produces insoluble Ag_2CrO_4 which is red in colour.

VIVA QNS:

1. What is argentometry titration?
2. Explain solubility product?
3. What is the colour change at the end point? Explain chemical reaction behind it?
4. Whether solubility product of Silver Chloride or Silver Chromate is high. Why?
5. What is the White Preciptate formed as the intermediate?

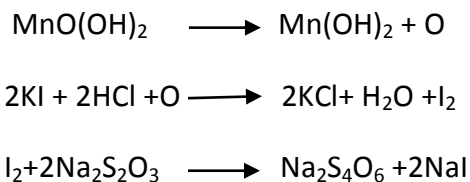## ESTIMATION OF DISSOLVED OXYGEN IN WATER

OBJECTIVE

To estimate the amount of dissolved oxygen in the given sample of water.

PRINCIPLE

Dissolved oxygen in a sample of water is estimated by Winkler's method. As the dissolved oxygen in water is in the molecular state it cannot oxidize KI as such. Hence $Mn(OH)_2$ is used as an oxygen carrier. $Mn(OH)_2$ is obtained by the action of NaOH in $MnSO_4$. Manganous hydroxide reacts with oxygen to give a brown precipitate of manganic hydroxide.

$$MnSO_4 + 2NaOH \longrightarrow Mn(OH)_2 + Na_2SO_4$$

$$2Mn(OH)_2 + O_2 \longrightarrow 2MnO(OH)_2 \downarrow$$
$$\text{Manganic hydroxide}$$
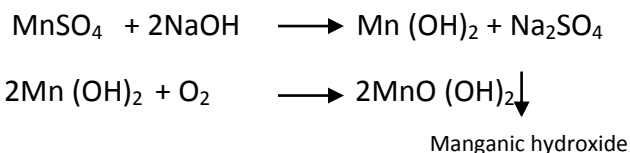
The precipitate is dissolved in HCl and treated in the KI solution. The liberated iodine is titrated against standard sodium thiosulphate solution using starch as indicator.

$$MnO(OH)_2 \longrightarrow Mn(OH)_2 + O$$

$$2KI + 2HCl + O \longrightarrow 2KCl + H_2O + I_2$$

$$I_2 + 2Na_2S_2O_3 \longrightarrow Na_2S_4O_6 + 2NaI$$

MATERIALS AND METHODS

APPARATUS USED

250ml stoppered bottle, Burette, Pipette,conical flask

CHEMICALS USED

Water sample, MnSO4, NaOH, KI, N/100 $Na_2S_2O_3$ solution, Starch solution,

 Conc. HCl

PROCEDURE

- 200 ml of the water sample is taken in a stopperd bottle
- 4ml of $MnSO_4$ solution and 4 ml of alkaline KI are added.The bottle is stopperd and the contents are thoroughly shaken.The precipitate formed is allowed to settle

- 2ml of Conc.HCl is added to dissolve the precipitate and the bottle is shaken well.The brown solution so formed is allowed to stand for 5 minutes.
- 100 ml of this solution is titrated against 0.01 N sodium thoisulphate. When the solution is pale yellow, about 2 ml of freshly prepared starch solution is added and the titration is continued until the blue colour is just permanently discharged
- Titrations are repeated for concordance.The normality of dissolved oxygen as well as the amount of oxygen are calculated

RESULT AND DISCUSSION

The amount of dissolved oxygen in the water sample   =   ppm

CONCLUSION

The solubility of oxygen in fresh water is 5-7 ppm at 30^0 C

VIVA QNS:

1. How much quantity of dissolved Oxygen is normaly present in water?
2. Which indicator is used here?
3. Which is the oxygen carrier used in this titration?
4. What is the nature of titration used here?
5. Whether dissolved oxygen is present in molecular state or in atomic state?

PREPARATION OF UREA FORMALDEHYDE RESIN

OBJECTIVE

To prepare urea formaldehyde resin by condensation polymerization

PRINCIPLE

Formaldehyde reacts with urea in alkaline or acidic medium yielding methylol urea. The methylol urea undergoes condensation reaction by themselves or with urea giving rise to a cross linked network polymer similar to the phenolformaldehyde resin

MATERIALS AND METHOD

REAGENTS

Urea (10g), formaldehyde (40%),

PROCEDURE

- 10 g of urea and 20 ml of 40% formaldehyde solution are taken in a 250 ml beaker
- The mixture is stirred well with a glass rod until a saturated solution is obtained
- 2-3 drops of conc. H_2SO_4 is added with stirring
- The solid resin is formed
- It is filtered,dried and powdered
- The appearance and yield are noted

RESULT AND DISCUSSION

Appearance   :

Yield   :

CONCLUSION

UF resin is a condensation polymer of Urea and Formaldehyde

PREPARATION OF PHENOL FORMALDEHYDE RESIN

OBJECTIVE

To prepare phenol formaldehyde resin by condensation polymerization

PRINCIPLE

When phenol is heated with formaldehyde a crosslinked resin, Bakelite is formed

MATERIALS AND METHOD

REAGENTS

Phenol-8g,Water -25ml, formaldehyde (40%)-10g, Ba(OH)$_2$-0.4g, oxalic acid -2g

PROCEDURE

- 8 g phenol,25ml of water,10g of formaldehyde and 0.4 g of Ba(OH)$_2$ are taken in a 100ml beaker
- The reaction mixture is stireed well with a glass rod and maintained at 70^{0}C in a water bath for ten hours
- Sufficient oxalic acid is added to the mixture to bring the pH to 6.7
- Water is removed by evaporation from the resin by heating over a water bath
- The end product is taken out and placed at 160^{0}C on a hot plate
- The appearance and yield of the resin are noted

RESULT AND DISCUSSION

Appearance   :

Yield   :

CONCLUSION

Bakelite is the condensation polymer of phenol and formaldehyde

CALIBRATION AND DETERMINATION OF P^H OF A SOLUTION

AIM

To become familiar with the principles of P^H analysis, calibration of P^H meter and determination of P^H unknown samples

THEORY

The P^H value of a solution is defined as negative logarithm of hydrogen ion concentration .It is expressed in Gram/Ion Lit.

P^H= -log [H+]

At 25 ^{0}c the ionic product of water

Kw= [H+] [OH-] =10 $^{-14}$

Also In Pure Water = [H+] = [OH-]

In neutral solution [H+] = [OH-]

The value of P^H zero to less than 7 are termed as acidic

The values of p^H little above 7 to 14 are termed as basic

When the concentration of H+ and OH- are equal, then it is termed as neutral

PRINCIPLE

The P^H electrode used for determination is a combined glass electrode, consists of sensing half-cell and reference half-cell together form an electrode system. The sensing half-cell consist of two solutions

   i)   Outer sample solution
   ii)   A solution of known enclosed inside

   These two solutions are separated by a semipermeable membrane. The potential difference created between these two solutions is measured and is given as the P^H of the sample

APPARATUS AND REAGENTS

1. P^H meter

2. Standard flask

3. Magnetic stirrer

4. Funnel

5. Beaker

6. Buffer solutions of P^H 4, .7 & 9.2 KCL and distilled water

PROCEDURE

a) Preparation of reagents: a buffer tablet of P^H 4 is taken, dissolved in distilled water, and made up to 100 ml in a standard flask. Similarly buffer solutions of P^H 7 and 9.2 are prepared.
b) Calibration of P^H meter: in a 100 ml beaker P^H 9.2 buffer is taken, the P^H electrode is placed in it and the reading is noted. If the instrument is not showing P^H value of 9.2 using the calibration knob adjust the reading to 9.2.take the electrode from the buffer wash it with distilled water and wipe it with soft tissue .Similarly using P^H buffer solution 7 and 4.01 ,the P^H meter is calibrated.
c) Testing of sample
    - Take the sample solution in 100 ml beaker.
    - Dip the P^H electrode in the beaker and note down the P^H
    - Then take the another solution in a beaker dip the electrode and note P^H of solution
    - Take the four different reading of four different solutions and write the result either the solution are acidic, basic or neutral

RESULT

i) P^H of the sample I   =
ii) P^H of the sample 2   =
iii) P^H of the sample 3   =