I

Name _____

Roll No. _____ Year 20____20____

Exam Seat No. _____

CHEMICAL GROUP | SEMESTER - III | DIPLOMA IN ENGINEERING AND TECHNOLOGY

A LABORATORY MANUAL

FOR

TECHNOLOGY OF INORGANIC CHEMICALS

(22314)



MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION, MUMBAI

(Autonomous) (ISO 9001 : 2015) (ISO / IEC 27001 : 2013)

VISION

To ensure that the Diploma level Technical Education constantly matches the latest requirements of technology and industry and includes the all-round personal development of students including social concerns and to become globally competitive, technology led organization.

MISSION

To provide high quality technical and managerial manpower, information and consultancy services to the industry and community to enable the industry and community to face the changing technological and environmental challenges.

QUALITY POLICY

We, at MSBTE are committed to offer the best in class academic services to the students and institutes to enhance the delight of industry and society. This will be achieved through continual improvement in management practices adopted in the process of curriculum design, development, implementation, evaluation and monitoring system along with adequate faculty development programmes.

CORE VALUES

MSBTE believes in the followings:

- Education industry produces live products.
- Market requirements do not wait for curriculum changes.
- Question paper is the reflector of academic standards of educational organization.
- Well designed curriculum needs effective implementation too.
- Competency based curriculum is the backbone of need based program.
- Technical skills do need support of life skills.
- Best teachers are the national assets.
- Effective teaching learning process is impossible without learning resources.

A Laboratory Manual

for

Technology of Inorganic Chemicals

(22314)

Semester-III

(CH)

Maharashtra State
Board of Technical Education, Mumbai
(Autonomous) (ISO:9001:2015) (ISO/IEC 27001:2013)

Maharashtra State Board of Technical Education,
(Autonomous) (ISO:9001:2015) (ISO/IEC 27001 : 2013)
4th Floor, Government Polytechnic Building, 49, Kherwadi,
Bandra (East), Mumbai - 400051.
(Printed on June, 2018)

MAHARASHTRA STATE

BOARD OF TECHNICAL EDUCATION

Certificate

This is to certify that Mr. / Ms. ……..…… Roll No. ……..…., of Third Semester of Diploma in ……..…… of Institute, ……..…….……..… (Code: ……...) has completed the term work satisfactorily in course **Technology of Inorganic Chemicals (22314)** for the academic year 20…….. to 20…….. as prescribed in the curriculum.

Place: …… Enrollment No:.……

Date: …… Exam. Seat No: ……

Subject Teacher **Head of the Department** **Principal**

Seal of Institution

Preface

The primary focus of any engineering laboratory/ field work in the technical education system is to develop the much needed industry relevant competencies and skills. With this in view, MSBTE embarked on this innovative 'I' Scheme curricula for engineering diploma programmes with outcome-base education as the focus and accordingly, relatively large amount of time is allotted for the practical work. This displays the great importance of laboratory work making each teacher; instructor and student to realize that every minute of the laboratory time need to be effectively utilized to develop these outcomes, rather than doing other mundane activities. Therefore, for the successful implementation of this outcome-based curriculum, every practical has been designed to serve as a ***'vehicle'*** to develop this industry identified competency in every student. The practical skills are difficult to develop through 'chalk and duster' activity in the classroom situation. Accordingly, the 'I' scheme laboratory manual development team designed the practicals to ***focus*** on the ***outcomes***, rather than the traditional age old practice of conducting practicals to 'verify the theory' (which may become a byproduct along the way).

This laboratory manual is designed to help all stakeholders, especially the students, teachers and instructors to develop in the student the pre-determined outcomes. It is expected from each student that at least a day in advance, they have to thoroughly read through the concerned practical procedure that they will do the next day and understand the minimum theoretical background associated with the practical. Every practical in this manual begins by identifying the competency, industry relevant skills, course outcomes and practical outcomes which serve as a key focal point for doing the practical. The students will then become aware about the skills they will achieve through procedure shown there and necessary precautions to be taken, which will help them to apply in solving real-world problems in their professional life.

This manual also provides guidelines to teachers and instructors to effectively facilitate student-centered lab activities through each practical exercise by arranging and managing necessary resources in order that the students follow the procedures and precautions systematically ensuring the achievement of outcomes in the students.

During their course of work they have to deal with various aspects of manufacturing technology. It is essential for them to giving maximum output with minimum cost and pollution.

Although best possible care has been taken to check for errors (if any) in this laboratory manual, perfection may elude us as this is the first edition of this manual. Any errors and suggestions for improvement are solicited and highly welcome

Programme Outcomes (POs) to be achieved through Practical of this Course:

Following POs and PSO are expected to be achieved through the practicals of the chemical enginnering..

PO1. **Basic knowledge:**. Apply knowledge of basic mathematics, sciences and basic engineering to solve the **Chemical Engineering** problems

PO2. **Discipline knowledge** Apply **Chemical Engineering** knowledge to solve industry based Chemical Engineering problems.

PO3. **Experiments and practice** Plan to perform experiments and practices to use the results to solve technical problems related to **Chemical Engineering**.

PSO1. **Program Specific Outcomes (PSO2) Material management and quality control:** Demonstrate knowledge and understanding for selection, material management and quality control in Chemical engineering.

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List of Industry Relevant Skills

The following industry relevant skills of the competency ‘qulitative & analytical skills.’ are expected to be developed in you by undertaking the practicals of this practical manual.

1. Get idea to select proper chemical
2. Use Hydrometer, theometer.
3. Follow the safety norms.

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Practical- Course Outcome matrix-

Course Outcomes (COs)

a. Manufacture the Inorganic acids in chemical process industries
b. Prepare Ammonia based fertilizers in chemical process industries
c. Select the raw material for Phosphate based fertilizer manufacturing.
d. Prepare Caustic soda in chemical process industries
e. Synthesis the Cement of known composition

S. No.	Practical Outcome	CO a.	CO b.	CO c.	CO d.	CO e.	CO f.
1.	Determine percentage purity of commercial grade hydrochloric acid by physical and chemical method.Part - I	√	-	-	-	-	-
2.	Determine percentage purity of commercial grade hydrochloric acid by physical and chemical method.Part - II	√	-	-	-	-	-
3.	Determine percentage purity of commercial grade sulfuric acid by physical and chemical method. Part - I	√	-	-	-	-	-
4.	Determine percentage purity of commercial grade sulfuric acid by physical and chemical method. Part - II	-	√	-	-	-	-
5.	Determine percentage purity of commercial grade Nitric acid by physical and chemical method. Part - I	-	√	-	-	-	-
6.	Determine percentage purity of commercial grade Nitric acid by physical and chemical method. Part - II	-	√	-	-	-	-
7.	Determine the strength of given Nitric acid by pH meter. Part-I	-	√	-	-	-	-
8.	Determine the strength of given Nitric acid by pH meter. Part-II	-	√	-	-	-	-
9.	Determine the strength of given Hydrochloric acid by pH meter. Part-I	-	-	√	-	-	-
10.	Determine the strength of given Hydrochloric acid by pH meter. Part-II	-	-	-	√	-	-

11.	Determine ammonia content in given sample of fertilizer of ammonium nitrate. Part - I	-	-	-	√	-	-
12.	Determine ammonia content in given sample of fertilizer of ammonium nitrate. Part - II	-	-	-	√	-	-
13.	Determine ammonia content in given sample of fertilizer of ammonium sulphate. Part - I	-	-	-	√	-	-
14.	Determine ammonia content in given sample of fertilizer of ammonium sulphate. Part - II	-	-	-	√	-	-
15.	Determine ammonia content in given sample of fertilizer of ammonium chloride. Part - I	-	-	-	√	-	-
16.	Determine ammonia content in given sample of fertilizer of ammonium chloride. Part - II	-	-	-	-	-	√
17.	Determine nitrogen content in given sample of ammonium fertilizer. Part - I	-	-	-	√	-	-
18.	Determine nitrogen content in given sample of ammonium fertilizer. Part - II	-	-	-	√	-	-
19.	Determine ammonia content in given sample of ammonium phosphate. Part - I	-	-	-	√	-	-
20.	Determine ammonia content in given sample of ammonium phosphate. Part - II	-	-	-	-	-	√
21.	Determine the percentage of CaO in given sample of lime stone. Part - I	-	-	-	√	-	-
22.	Determine the percentage of CaO in given sample of lime stone. Part - II	-	-	-	√	-	-

23.	Determined the percentage purity of given sample of caustic soda. Part - I	-	-	-	√	-	-
24.	Determined the percentage purity of given sample of caustic soda. Part - II	-	-	-	-	-	√
25.	Determined percentage purity of given sample of soda ash. Part - I	-	-	-	√	-	-
26.	Determined percentage purity of given sample of soda ash. Part - II	-	-	-	√	-	-
27.	Determine the calcium content in cement. Part - I	-	-	-	√	-	-
28.	Determine the calcium content in cement . Part - II	-	-	-	-	-	√
29.	Determine the insoluble ingredients in cement. Part - I	-	-	-	√	-	-
30.	Determine the insoluble ingredients in cement. Part - II	-	-	-	√	-	-
31.	Determine the carbon dioxide from given sample of water. Part - I	-	-	-	√	-	-
32.	Determine the carbon dioxide from given sample of water. Part - II	-	-	-	-	-	√

Guidelines to Teachers

1. Teacher need to ensure that a dated log book for the whole semester, apart from the laboratory manual is maintained by every student which s/he has to submit for assessment to the teacher in the next practical session.
2. There will be two sheets of blank pages after every practical for the student to report other matters (if any), which is not mentioned in the printed practicals.
3. For difficult practicals if required, teacher could provide the demonstration of the practical emphasizing of the skills which the student should achieve.
4. Teachers should give opportunity to students for hands-on after the demonstration.
5. Assess the skill achievement of the students and COs of each unit.
6. One or two questions ought to be added in each practical for different batches. For this teachers can maintain various practical related question bank for each course.
7. If some repetitive information like data sheet, use of software tools etc. has to be provided for effective attainment of practical outcomes, they can be incorporated in Appendix.
8. For effective implementation and attainment of practical outcomes, teacher ought to ensure that in the beginning itself of each practical, students must read through the complete write-up of that practical sheet.
9. During practical, ensure that each student gets chance and takes active part in taking observations/ readings and performing practical.
10. Teacher ought to assess the performance of students continuously according to the MSBTE guidelines

Instructions for Students

1. For incidental writing on the day of each practical session every student should maintain a dated log book for the whole semester, apart from this laboratory manual which s/he has to submit for assessment to the teacher in the next practical session.
2. For effective implementation and attainment of practical outcomes, in the beginning itself of each practical, students need to read through the complete write-up including the practical related questions and assessment scheme of that practical sheet.
3. Student ought to refer the data books, IS codes, Safety norms, Electricity act/rules, technical manuals, etc.
4. Student should not hesitate to ask any difficulties they face during the conduct of practicals.

Content Page

List of Practicals and Progressive Assessment Sheet

9.	Determine the strength of given Hydrochloric acid by pH meter. Part-I	46					
10.	Determine the strength of given Hydrochloric acid by pH meter. Part-II	51					
11.	Determine ammonia content in given sample of fertilizer of ammonium nitrate. Part - I	56					
12.	Determine ammonia content in given sample of fertilizer of ammonium nitrate. Part - II	62					
13.	Determine ammonia content in given sample of fertilizer of ammonium sulphate. Part - I	68					
14.	Determine ammonia content in given sample of fertilizer of ammonium sulphate. Part - II	74					
15.	Determine ammonia content in given sample of fertilizer of ammonium chloride. Part - I	80					
16.	Determine ammonia content in given sample of fertilizer of ammonium chloride. Part - II	86					
17.	Determine nitrogen content in given sample of ammonium fertilizer. Part - I	92					
18.	Determine nitrogen content in given sample of ammonium fertilizer. Part - II	98					
19.	Determine ammonia content in given sample of ammonium phosphate. Part - I	104					
20.	Determine ammonia content in given sample of ammonium phosphate. Part - II	110					

21.	Determine the percentage of CaO in given sample of lime stone. Part - I	116					
22.	Determine the percentage of CaO in given sample of lime stone. Part - II	120					
23.	Determined the percentage purity of given sample of caustic soda. Part - I	125					
24.	Determined the percentage purity of given sample of caustic soda. Part - II	131					
25.	Determined percentage purity of given sample of soda ash. Part - I	137					
26.	Determined percentage purity of given sample of soda ash. Part - II	143					
27.	Determine the calcium content in cement. Part - I	149					
28.	Determine the calcium content in cement . Part - II	155					
29.	Determine the insoluble ingredients in cement. Part - I	160					
30.	Determine the insoluble ingredients in cement. Part - II	165					
31.	Determine the carbon dioxide from given sample of water. Part - I	170					
32.	Determine the carbon dioxide from given sample of water. Part - II	174					
Total							

Note: To be transferred to Proforma of CIAAN-2017.

Practical No. 1: Determine percentage purity of commercial grade hydrochloric acid by physical & chemical method. Part-I

I Practical Significance

Purity, content of compound is the prime requirement in chemical industry. Such kind of test possible using measuring instruments like hydrometer, thermometer, and using appropriate chemicals.

II Relevant Program Outcomes (POs)

PO1 **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic engineering to solve the Chemical Engineering problems.

PO3 **- Experiments and practice:** Plan to perform experiments and practices to use the results to solve technical problems related to **Chemical Engineering**.

III Competency and Skills

- This practical is expected to develop the analytical skills for the industry
- **Apply basic concept of inorganic chemistry in chemical engineering applications.**

IV Relevant Course Outcome(s)

- Purity of commercial grade hydrochloric acid by physical & chemical method

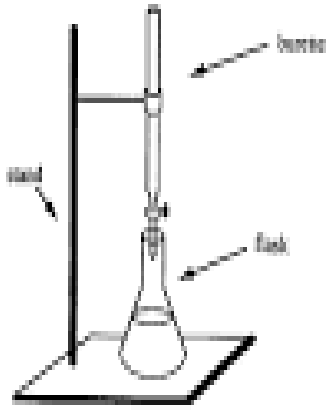
V Practical Outcome

- Determine percentage purity of commercial grade hydrochloric acid by physical & chemical method

VI Minimum Theoretical Background

It is the percentage presence of the substance in the mixture. In case of anhydrous acid and water. higher is the specific gravity, density and concentration, higher is the purity of acid.

VII Setup



VIII Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1.	Thermometer	0to110	1 No.
2.	Hydrometer	0.1to2	1 No.
3.	beaker	100ml	1 No.
4.	Volumetric flask	250ml	1 No.
5.	Pipette	10ml	1 No
6.	Burette	25ml	1 No
7.	Conical flask	250m	1 No

IX Precautions to be Followed

1. Use apron while doing practical's.
2. Don't touch concentrate chemicals.

X Procedure

1. Take accurate 1ml. of the given sample of HCL acid into conical flask
2. Make up to the 250ml mark with distilled water.
3. Mix thoroughly.
4. Pipette out 10ml. of the prepared diluted solution from volumetric flask into the conical flask.
5. Add 2 to 3 drops of phenolphthalein indicator to the conical flask.
6. Fill the burette with 0.1N NaOH solution to the zero mark
7. Titrate the solution from the conical flask against 0.1N NaOH solution from the burette
8. The end point of titration is from colorless to pink.
9. Record the volume of 0.1NaOH solution consumed from the burette.
10. Perform the titration until a constant burette reading is obtained.

XI Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1					
2					
3					

XII Actual Procedure Followed

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XIII Precautions Followed

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XIV Observations and Calculations

1 Specific gravity of the given sample of Hydrochloric acid ----------

2 Temperature of the given sample Hydrochloric acid .----------

3 In burette : 0.1N NaOH solution.

4 In conical flask: diluted HCl acid solution.

5 End point: colorless to pink.

6 Indicator used: Phenolphthalein.

Burette Reading

Reading	Burette reading in ml.			Constant burette Reading ml.
	I	II	III	
Initial				
Final				
Difference				

Sample calculations

1. Density of water at room temp. = 1 gm/cm^3, therefore, density of the given sample of Hydrochloric acid = specific gravity of Hydrochloric acid
   = specific gravity of Hydrochloric acid x Density of water .

2. Weight (mass) of the given = specific gravity of Hydrochloric acid sample transferred in to the 250ml. volumetric flask, in gms,.

   W = Density of the given of Hydrochloric acid sample x Volume of Hydrochloric acid sample taken.

   = Density of the given of Hydrochloric acid sample x 1ml. (already taken)

3. Normality of diluted Hydrochloric acid sample, by titration,

   Let,

   N_1 = Normality of diluted Hydrochloric acid sample.

   V_1 = Volume of diluted Hydrochloric acid sample taken in conical flask = 10 ml. (taken)

   N_2 = Normality of NaOH solution = 0.1N (taken)

   V_2 = Volume of 0.1N NaOH solution (from titration)

   Then,

   HCl V/S NaOH Solution

$N_1V_1 = N_2 V_2$

$N_1 = 0.1xV_2 / 10$

4. Actual amount of hydrochloric acid present in 250 ml. of diluted acid solution, W_1 gms.,

$$W_1 = \frac{N_1 \times 250 \times \text{Eq.wt. of HCl}}{1000}$$

$= N_1 \times 0.25 \times$ Eq Weight of HCl

$= N_1 \times 0.25 \times 36.5$

5. Percent purity of the given sample of Hydrochloric acid

$$= \frac{\text{Actual amount of HCl present in 250 ml of diluted acid solution} \times 100}{\text{Weight of the HCl sample taken}}$$

$= (W_1 / W) \times 100$ %

XV Results

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XVI Interpretation of Results

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XVII Conclusions

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XVIII Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. How to measure specific gravity of HCL by hydrometer
2. How to observe neutralization point during titration.

(Space for answers)

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XIX References

- www.creatingtechnology.org
- www.thechemicalengineer.com
- www.chemistry.harvard.edu

XX Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Handling of the chemicals & apparatus	20%
2	Determination of percentage purity	20%
Product Related (15 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. ……..
2. …….
3. ……

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	

Practical No.2: Determine percentage purity of commercial grade hydrochloric acid by physical & chemical method. Part-II

I Practical Significance

Purity, content of compound in the prime requirement in chemical industry. Such kind of test is possible using measuring instruments like hydrometer, thermometer, and using appropriate chemicals.

II Relevant Program Outcomes (POs)

PO1 **Basic knowledge :** Apply knowledge of basic mathematics, sciences and basic engineering to solve the **Chemical Engineering** problems

PO3 **- Experiments and practice:** Plan to perform experiments and practices to use the results to solve technical problems related to **Chemical Engineering**.

III Competency and Skills

- This practical is expected to develop the analytical skills for the industry
- Apply basic concept of inorganic chemistry in chemical engineering applications.

IV Relevant Course Outcome(s)

- Purity of commercial grade hydrochloric acid by physical & chemical method

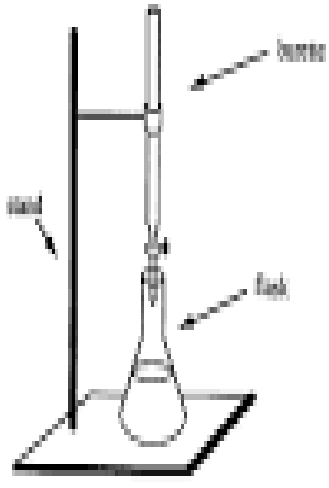
V Practical Outcome

- Determine percentage purity of commercial grade hydrochloric acid by physical & chemical method

VI Minimum Theoretical Background

It is the percentage presence of the a substance in the mixture. In case of anhydrous acid and water. higher is the specific gravity, density and concentration, higher is the purity of acid.

VII Setup



VIII Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Thermometer	0to110	1 No.
2	Hydrometer	0.1to2	1 No.
3	beaker	100ml	1 No.
4	Volumetric flask	250ml	1 No.
5	Pipette	10ml	1 No
6	Burette	25ml	1 No
7	Conical flask	250m	1 No

IX Precautions to be Followed

1. Use apron while doing practical's.
2. Don't touch concentrate chemicals.

X Procedure

1 Take accurate 2ml. of the given sample of HCL acid into conical flask
2 Make up to the 250ml mark with distilled water.
3 Mix thoroughly.
4 Pipette out 10ml. of the prepared diluted solution from volumetric flask into the conical flask.
5 Add 2 to 3 drops of phenolphthalein indicator to the conical flask.
6 Fill the burette with 0.1N NaOH solution to the zero mark
7 Titrate the solution from the conical flask against 0.1N NaOH solution from the burette
8 The end point of titration is from colorless to pink.
9 Record the volume of 0.1NaOH solution consumed from the burette.
10 Perform the titration until a constant burette reading is obtained.

XI Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		

XII Actual Procedure Followed

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XIII Precautions Followed

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XIV Observations and Calculations

1 Specific gravity of the given sample of Hydrochloric acid ----------

2 Temperature of the given sample Hydrochloric acid .----------

3 In burette : 0.1N NaOH solution.

4 In conical flask: diluted HCl acid solution.

5 End point: colorless to pink.

6 Indicator used: Phenolphthalein.

Burette Reading

Reading	Burette reading in ml.			Constant burette Reading ml.
	I	II	III	
Initial				
Final				
Difference				

Sample calculations

1. Density of water at room temp. = 1 gm/cm^3, therefore, density of the given sample of Hydrochloric acid = specific gravity of Hydrochloric acid
   = specific gravity of Hydrochloric acid x Density of water .

2. Weight (mass) of the given = specific gravity of Hydrochloric acid sample transferred in to the 250ml. volumetric flask, in gms,.

   W = Density of the given of Hydrochloric acid sample x Volume of Hydrochloric acid sample taken.

   = Density of the given of Hydrochloric acid sample x 2ml. (already taken)

3. Normality of diluted Hydrochloric acid sample, by titration,

   Let,

   N_1 = Normality of diluted Hydrochloric acid sample.

   V_1 = Volume of diluted Hydrochloric acid sample taken in conical flask = 10 ml. (taken)

   N_2 = Normality of NaOH solution = 0.1N (taken)

   V_2 = Volume of 0.1N NaOH solution (from titration)

Then,

HCl V/S NaOH Solution

$N_1V_1 = N_2 V_2$

$N_1 = 0.1xV_2 / 10$

4. Actual amount of hydrochloric acid present in 250 ml. of diluted acid solution, W_1 gms.,

$$W_1 = \frac{N_1 \times 250 \times \text{Eq.wt. of HCl}}{1000}$$

$= N_1x0.25x\text{Eq Weight of HCl}$

$= N_1x0.25x36.5$

5. Percent purity of the given sample of Hydrochloric acid

$$= \frac{\text{Actual amount of HCl present in 250 ml of diluted acid solution} \times 100}{\text{Weight of the HCl sample taken}}$$

$= (W_1 / W) \times 100\ \%$

XV Results

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XVI Interpretation of Results

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XVII Conclusions

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XVIII Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. How to measure specific gravity of HCL by hydrometer
2. How to observe neutralization point during titration.

(Space for answers)

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XIX References

- www.creatingtechnology.org
- www.thechemicalengineer.com
- www.chemistry.harvard.edu

XX Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Handling of the chemicals & apparatus	20%
2	Determination of percentage purity	20%
Product Related (15 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. ……..
2. ……..….
3. ……

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	

Practical No.3: Determine percentage purity of commercial grade sulfuric acid by physical & chemical method. part-I

I Practical Significance

Purity, content of compound is the prime requirement in chemical industry. Such kind of test is possible using measuring instruments like hydrometer, thermometer, and using appropriate chemicals.

II Relevant Program Outcomes (POs)

PO1 ***Basic knowledge :*** *Apply knowledge of basic mathematics, sciences and basic engineering to solve the* **Chemical Engineering** *problems.*

PO3 **- Experiments and practice:** *Plan to perform experiments and practices to use the results to solve technical problems related to* **Chemical Engineering**.

III Competency and Skills

- This practical is expected to develop the qualitative skills for the industry
- Apply basic concept of inorganic chemistry in chemical engineering applications.

IV Relevant Course Outcome(s)

- Purity of commercial grade sulfuric acid by physical & chemical method

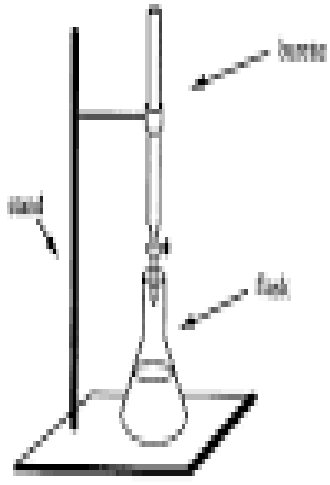
V Practical Outcome

- Determine percentage purity of commercial grade sulfuric acid by physical & chemical method

VI Minimum Theoretical Background

It is the percentage presence of the a substance in the mixture. In case of anhydrous acid and water. higher is the specific gravity, density and concentration, higher is the purity of acid.

VII Setup



VIII Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Thermometer	0to110	1 No.
2	Hydrometer	0.1to2	1 No.
3	beaker	100ml	1 No.
4	Volumetric flask	250ml	1 No.
5	Pipette	10ml	1 No
6	Burette	25ml	1 No
7	Conical flask	250m	1 No

IX Precautions to be Followed

1. Use apron while doing practical's.
2. Don't touch concentrate chemicals.

X Procedure

1. Stepwise Procedure:

1. Wash the cylindrical vessel.
2. Take sufficient quantity of sulphuric acid sample in the vessel.
3. Insert in the hydrometer and the Thermometer.
4. Record the specific gravity and the temperature of the given sulphuric acid sample.

2. Perform the titration:

1. Take accurately 1 ml. of the given sample of H_2SO_4 acid into a 250 ml. volumetric flask.
2. Make up to the 250 ml mark with distilled water.
3. Mix thoroughly.
4. Pipette out 10 ml. of the prepared diluted solution from the volumetric flask into the conical flask.
5. Add 2 to 3 drops of phenolphthalein indicator to the conical flask.
6. Fill in the burette with 0.1N NaOH solution to the zero mark.
7. Titrate the H_2SO_4 solution from the conical flask against 0.1N NaOH solution from the burette.
8. The end point of titration is from colorless to pink.
9. Record the volume of 0.1N NaOH solution consumed from the burette.
10. Perform the titration until a constant burette reading is obtained.

XI Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		

XII Actual Procedure Followed

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XIII Precautions Followed

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XIV Observations and Calculations

1. Specific gravity of the given sample of H_2SO_4
2. Temperature of the given sample H_2SO_4
3. In burette : 0.1N NaOH solution.
4. In conical flask: diluted H_2SO_4 acid solution.
5. End point: colorless to pink.
6. Indicator used: Phenolphthalein.

Burette Reading

Reading	Burette reading in ml.			Constant burette Reading ml.
	I	II	III	
Initial				
Final				
Difference				

Sample calculations

1. Density of water at room temp. = 1 gm/cm^3, therefore, density of the given sample of Sulphuric acid = specific gravity of Sulphuric acid x Density of water .

2. Weight (mass) of the given Sulphuric acid sample transferred in to the 250ml. volumetric flask, in gms,.

   W = Density of the given of Sulphuric acid sample x Volume of Sulphuric acid sample taken.

   = Density of the given of Sulphuric acid sample x 1ml. (already taken)

3 Normality of diluted Sulphuric acid sample, by titration,

   Let,

   N_1 = Normality of diluted Sulphuric acid sample.

   V_1 = Volume of diluted Sulphuric acid sample taken in conical flask = 10 ml. (taken)

   N_2 = Normality of NaOH solution = 0.1N (taken)

   V_2 = Volume of 0.1N NaOH solution (from titration)

   Then,

   $N_1V_1 = N_2 V_2$

   $N_1 = 0.1xV_2 / 10$

4. Actual amount of Sulphuric acid present in 250 ml. of diluted Sulphuric acid solution, W_1 gms.,

$$W_1 = \frac{N_1 \times 250 \times \text{Eq.wt. of } H_2So_4}{1000}$$

$$= N_1 \times 0.25 \times 64$$

5. Percent purity of the given sample of Sulphuric acid

$$= \frac{\text{Actual amount of } H_2SO_4 \text{ present in 250 ml of diluted acid solution} \times 100}{\text{Weight of the } H_2SO_4 \text{ sample taken}}$$

$$= (W_1 / W) \times 100\ \%$$

XV Results

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XVI Interpretation of Results

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XVII Conclusions

Actions to be taken based on the interpretations.

XVIII Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

How to measure specific gravity of H_2SO_4 by hydrometer.

How to observe neutralization point during titration.

(Space for answers)

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XIX References

- www.creatingtechnology.org
- www.thechemicalengineer.com
- www.chemistry.harvard.edu

XX Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Handling of the chemicals & apparatus	20%
2	Determination of percentage purity	20%
Product Related (15 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. ……..
2. …….
3. ……

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	

Practical No. 4: Determine percentage purity of commercial grade sulfuric acid by physical & chemical method. Part-II

I Practical Significance

Purity, content of compound is the prime requirement in chemical industry. Such kind of test is possible using measuring instruments like hydrometer, thermometer ,and using appropriate chemicals.

II Relevant Program Outcomes (POs)

PO1 **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic engineering to solve the Chemical Engineering problems

PO3 **- Experiments and practice:** Plan to perform experiments and practices to use the results to solve technical problems related to Chemical Engineering.

III Competency and Skills

- This practical is expected to develop the qualitative skills for the industry
- Apply basic concept of inorganic chemistry in chemical engineering applications.

IV Relevant Course Outcome(s)

- Purity of commercial grade sulfuric acid by physical & chemical method

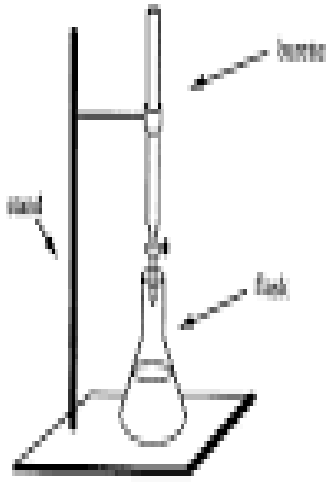
V Practical Outcome

- Determine percentage purity of commercial grade sulfuric acid by physical & chemical method

VI Minimum Theoretical Background

It is the percentage presence of the a substance in the mixture. In case of anhydrous acid and water. higher is the specific gravity, density and concentration, higher is the purity of acid.

VII Setup



VIII Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Thermometer	0to110	1 No.
2	Hydrometer	0.1to2	1 No.
3	beaker	100ml	1 No.
4	Volumetric flask	250ml	1 No.
5	Pipette	10ml	1 No
6	Burette	25ml	1 No
7	Conical flask	250m	1 No

IX Precautions to be Followed

Use apron while doing practical's.
Don't touch concentrate chemicals.

X Procedure

1. Stepwise Procedure:

1. Wash the cylindrical vessel.
2. Take sufficient quantity of sulphuric acid sample in the vessel.
3. Insert in the hydrometer and the Thermometer.
4. Record the specific gravity and the temperature of the given sulphuric acid sample.

2 Perform the titration:

1. Take accurately 1 ml. of the given sample of H_2SO_4 acid through a burette into a 250 ml. volumetric flask.
2. Make up to the 250 ml mark with distilled water.
3. Mix thoroughly.
4. Pipette out 10 ml. of the prepared diluted solution from the volumetric flask into the conical flask.
5. Add 2 to 3 drops of phenolphthalein indicator to the conical flask.
6. Fill in the burette with 0.1N NaOH solution to the zero mark.
7. Titrate the H_2SO_4 solution from the conical flask against 0.1N NaOH solution from the burette.
8. The end point of titration is from colorless to pink.
9. Record the volume of 0.1N NaOH solution consumed from the burette.
10. Perform the titration until a constant burette reading is obtained.

XI Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		

XII Actual Procedure Followed

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XIII Precautions Followed

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XIV Observations and Calculations

1 Specific gravity of the given sample of H_2SO_4

2 Temperature of the given sample H_2SO_4

3 In burette : 0.1N NaOH solution.

4 In conical flask: diluted H_2SO_4 acid solution.

5 End point: colorless to pink.

6 Indicator used: Phenolphthalein.

Burette Reading

Reading	Burette reading in ml.			Constant burette Reading ml.
	I	II	III	
Initial				
Final				
Difference				

Sample calculations

1. Density of water at room temp. = 1 gm/cm^3, therefore, density of the given sample of Sulphuric acid = specific gravity of Sulphuric acid x Density of water .

2. Weight (mass) of the given Sulphuric acid sample transferred in to the 250ml. volumetric flask, in gms,.

   W = Density of the given of Sulphuric acid sample x Volume of Sulphuric acid sample taken.

   = Density of the given of Sulphuric acid sample x 2ml. (already taken)

3. Normality of diluted Sulphuric acid sample, by titration,

   Let,

   N_1 = Normality of diluted Sulphuric acid sample.

   V_1 = Volume of diluted Sulphuric acid sample taken in conical flask = 10 ml. (taken)

   N_2 = Normality of NaOH solution = 0.1N (taken)

   V_2 = Volume of 0.1N NaOH solution (from titration)

   Then,

   $N_1V_1 = N_2 V_2$

   $N_1 = 0.1xV_2 / 10$

4. Actual amount of Sulphuric acid present in 250 ml. of diluted Sulphuric acid solution, W_1 gms.,

   $$W_1 = \frac{N_1 \times 250 \times \text{Eq.wt. of } H_2So_4}{1000}$$

   = N1x0.25x4g

5. Percent purity of the given sample of Sulphuric acid

   $$= \frac{\text{Actual amount of } H_2SO_4 \text{ present in 250 ml of diluted acid solution x 100}}{\text{Weight of the} H_2SO_4 \text{ sample taken}}$$

   = $(W_1 / W) \times 100$ %

XV Results

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XVI Interpretation of Results

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XVII Conclusions

Actions to be taken based on the interpretations.

XVIII Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

How to measure specific gravity of H_2SO_4 by hydrometer.

How to observe neutralization point during titration.

(Space for answers)

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XIX References

- www.creatingtechnology.org
- www.thechemicalengineer.com
- www.chemistry.harvard.edu

XX Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Handling of the chemicals & apparatus	20%
2	Determination of percentage purity	20%
Product Related (15 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. ……..
2. …….
3. ……

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	

Practical No. 5: Determine percentage purity of commercial grade Nitric acid by physical & chemical method. Part-I

I Practical Significance

Purity, content of compound is the prime requirement in chemical industry. Such kind of test is possible using measuring instruments like hydrometer, thermometer ,and using appropriate chemicals.

II Relevant Program Outcomes (POs)

PO1 **Basic knowledge :** Apply knowledge of basic mathematics, sciences and basic engineering to solve the Chemical Engineering problems

PO3 **- Experiments and practice:** Plan to perform experiments and practices to use the results to solve technical problems related to Chemical Engineering.

III Competency and Skills

- This practical is expected to develop the qualitative skills for the industry
- Apply basic concept of inorganic chemistry in chemical engineering applications.

IV Relevant Course Outcome(s)

- Purity of commercial grade nitric acid by physical & chemical method

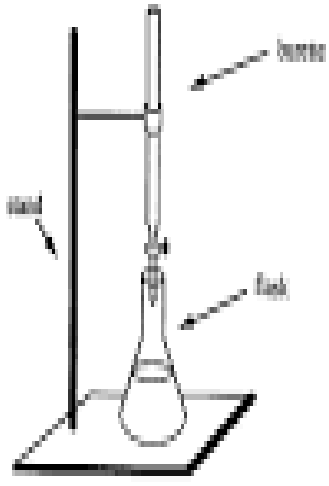
V Practical Outcome

- Determine percentage purity of commercial grade nitric acid by physical & chemical method

VI Minimum Theoretical Background

It is the percentage presence of the a substance in the mixture. In case of anhydrous acid and water. higher is the specific gravity, density and concentration, higher is the purity of acid.

VII Setup



VIII Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Thermometer	0to110	1 No.
2	Hydrometer	0.1to2	1 No.
3	beaker	100ml	1 No.
4	Volumetric flask	250ml	1 No.
5	Pipette	10ml	1 No
6	Burette	25ml	1 No
7	Conical flask	250m	1 No

IX Precautions to be Followed

Use apron while doing practicals.
Don't touch concentrate chemicals.

X Procedure

1 Determine specific gravity of Nitric acid sample:

1 Wash the cylindrical vessel with water and then rinse with the little quantity of sample to remove the dirt/ dust if any.

2 Take sufficient quantity of nitric acid sample in the vessel to dip the hydrometer.

3 Dip the hydrometer and the thermometer in the vessel.

4 Read the record the specific gravity and the temperature of the given nitric acid sample as indicated by the hydrometer and the thermometer respectively.

2 Perform the titration

1 Takes accurately 1 ml. of the given sample of nitric acid through a graduated pipette into a 250 ml. volumetric flask.

2 Make up to the 250 ml. mark with distilled water.

3 Mix thoroughly.

4 pipette out 10 ml. of the prepared diluted solution from the volumetric flask into the conical flask.

5 Add 2 to 3 drops of phenolphthalein indicator to the conical flask.

6 Fill in the burette with 0.1N NaOH solution to the zero mark.

7 Titrate the solution from the conical flask against 0.1N NaOH solution from the burette.

8 The end point of titration is from colorless to pink.

9 Record the volume of 0.1 NaOH solution consumed from the burette.

10 Perform the titration until a constant burette reading is obtained

XI Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		

XII Actual Procedure Followed

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XIII Precautions Followed

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XIV Observations and Calculation

1 Specific gravity of the given sample of HNO_3 :----------

2 Temperature of the given sample HNO_3 ----------

3 In burette: 0.1N NaOH solution.

4 In conical flask: diluted Nitric acid solution (10 ml).

5 End point: colorless to pink.

6 Indicator used: Phenolphthalein.

The reaction is,

$HNO_3 + NaOH = NaNO_3 + H_2O$

Burette Reading

Reading	Burette reading in ml.			Constant burette Reading Difference in ml.
	I	II	III	
Initial				
Final				
Difference				

Sample calculations:

1. Density of water at room temp. = 1.0gm/cm^3, therefore, density of the given sample of Nitric acid = specific gravity of Nitric acid x Density of water .

2. Weight (mass) of the given Nitric acid sample transferred in to the 250ml. volumetric flask, in gms,.

   W = Density of the given of Nitric acid sample x Volume of Nitric acid sample taken.

   = Density of the given of Nitric acid sample x 1ml. (already taken)

3 Normality of diluted Nitric acid sample, by titration,

   Let,

   N_1 = Normality of diluted Nitric acid sample.

   V1 = Volume of diluted Nitric acid sample taken in conical flask = 10 ml. (taken)

   N_2 = Normality of NaOH solution = 0.1N (taken)

   V_2 = Volume of 0.1N NaOH solution (from titration)

   Then,

   $N_1V_1 = N_2 V_2$

   $N_1 = 0.1xV_2 / 10$

4. Actual amount of Nitric acid present in 250 ml. of diluted Nitric acid solution, W_1 gms.,

   $$W_1 = \frac{N_1 \times 250 \times \text{Eq.wt. of Nitric acid}}{1000}$$

   = N1x0.25x63

5. Percent purity of the given sample of Nitric acid

   = $\frac{\text{Actual amount of Nitric acid present in 250 ml of diluted acid solution x 100}}{\text{Weight of the sample taken}}$

   = $\frac{W_1}{W} \times 100\%$

XV Results

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XVI Interpretation of Results

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XVII Conclusions

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XVIII Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

How to measure specific gravity of HCL by hydrometer

How to observe neutralization point during titration.

(Space for answers)

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XIX References

- www.creatingtechnology.org
- www.thechemicalengineer.com
- www.chemistry.harvard.edu

XX Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Handling of the chemicals & apparatus	20%
2	Determination of percentage purity	20%
Product Related (15 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. ……..
2. …….
3. ……

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	

Practical No. 6: Determine percentage purity of commercial grade Nitric acid by physical & chemical method. Part-II

I Practical Significance

Purity, content of compound is the prime requirement in chemical industry. Such kind of test is possible using measuring instruments like hydrometer, thermometer ,and using appropriate chemicals.

II Relevant Program Outcomes (POs)

PO1 **Basic knowledge** *: Apply knowledge of basic mathematics, sciences and basic engineering to solve the* **Chemical Engineering** *problems*

PO3 **- Experiments and practice:** *Plan to perform experiments and practices to use the results to solve technical problems related to* **Chemical Engineering**.

III Competency and Skills

- This practical is expected to develop the qualitative skills for the industry
- Apply basic concept of inorganic chemistry in chemical engineering applications.

IV Relevant Course Outcome(s)

- Purity of commercial grade nitric acid by physical & chemical method

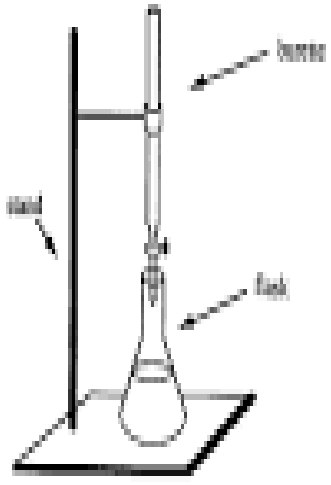
V Practical Outcome

- Determine percentage purity of commercial grade nitric acid by physical & chemical method

VI Minimum Theoretical Background

It is the percentage presence of the a substance in the mixture. In case of anhydrous acid and water. higher is the specific gravity, density and concentration, higher is the purity of acid.

VII Setup



VIII Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Thermometer	0to110	1 No.
2	Hydrometer	0.1to2	1 No.
3	beaker	100ml	1 No.
4	Volumetric flask	250ml	1 No.
5	Pipette	10ml	1 No
6	Burette	25ml	1 No
7	Conical flask	250m	1 No

IX Precautions to be Followed

Use apron while doing practical's.
Don't touch concentrate chemicals.

X Procedure

1 Determine specific gravity of Nitric acid sample:

1 Wash the cylindrical vessel with water and then rinse with the little quantity of sample to remove the dirt/ dust if any.

2 Take sufficient quantity of nitric acid sample in the vessel to dip the hydrometer.

3 Dip the hydrometer and the thermometer in the vessel.

4 Read the record the specific gravity and the temperature of the given nitric acid sample as indicated by the hydrometer and the thermometer respectively.

2 Perform the titration

1 Takes accurately 2 ml. of the given sample of nitric acid through a graduated pipette into a 250 ml. volumetric flask.

2 Make up to the 250 ml. mark with distilled water.

3 Mix thoroughly.

4 Pipette out 10 ml. of the prepared diluted solution from the volumetric flask into the conical flask.

5 Add 2 to 3 drops of phenolphthalein indicator to the conical flask.

6 Fill in the burette with 0.1N NaOH solution to the zero mark.

7 Titrate the solution from the conical flask against 0.1N NaOH solution from the burette.

8 The end point of titration is from colorless to pink.

9 Record the volume of 0.1 NaOH solution consumed from the burette.

10 Perform the titration until a constant burette reading is obtained

XI Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		

XII Actual Procedure Followed

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XIII Precautions Followed

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XIV Observations and Calculation

1 Specific gravity of the given sample of HNO_3 :----------

2 Temperature of the given sample HNO_3 ----------

3 In burette: 0.1N NaOH solution.

4 In conical flask: diluted Nitric acid solution (10 ml).

5 End point: colorless to pink.

6 Indicator used: Phenolphthalein.

The reaction is,

$HNO_3 + NaOH = NaNO_3 + H_2O$

Burette Reading

Reading	Burette reading in ml.			Constant burette Reading Difference in ml.
	I	II	III	
Initial				
Final				
Difference				

Sample calculations:

1. Density of water at room temp. = 1.0gm/cm3, therefore, density of the given sample of Nitric acid = specific gravity of Nitric acid x Density of water .

2. Weight (mass) of the given Nitric acid sample transferred in to the 250ml. volumetric flask, in gms,.

   W = Density of the given of Nitric acid sample x Volume of Nitric acid sample taken.

   = Density of the given of Nitric acid sample x 2ml. (already taken)

3. Normality of diluted Nitric acid sample, by titration,

   Let,

   N_1 = Normality of diluted Nitric acid sample.

   V1 = Volume of diluted Nitric acid sample taken in conical flask = 10 ml. (taken)

   N_2 = Normality of NaOH solution = 0.1N (taken)

   V_2 = Volume of 0.1N NaOH solution (from titration)

   Then,

   $N_1V_1 = N_2 V_2$

   $N_1 = 0.1xV_2 / 10$

4. Actual amount of Nitric acid present in 250 ml. of diluted Nitric acid solution, W_1 gms.,

   $$W_1 = \frac{N_1 \times 250 \times \text{Eq.wt. of Nitric acid}}{1000}$$

   = N1x0.25x63

5. Percent purity of the given sample of Nitric acid

   $$= \frac{\text{Actual amount of Nitric acid present in 250 ml of diluted acid solution x 100}}{\text{Weight of the sample taken}}$$

   $$= \frac{W_1 \times 100\%}{W}$$

XV Results

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XVI Interpretation of Results

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XVII Conclusions

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XVIII Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

How to measure specific gravity of HCL by hydrometer

How to observe neutralization point during titration.

(Space for answers)

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XIX References

- www.creatingtechnology.org
- www.thechemicalengineer.com
- www.chemistry.harvard.edu

XX Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Handling of the chemicals & apparatus	20%
2	Determination of percentage purity	20%
Product Related (15 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. ……..
2. …….
3. ……

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	

Practical No. 7: Determine the strength of given Nitric acid by pH meter. Part-I

I Practical Significance

Purity, content of compound is the prime requirement in chemical industry. Such kind of test is possible using measuring instruments like pH meter, thermometer ,and using appropriate chemicals.

II Relevant Program Outcomes (POs)

PO1 ***Basic knowledge :*** *Apply knowledge of basic mathematics, sciences and basic engineering to solve the* **Chemical Engineering** *problems*

PO3 **- Experiments and practice:** *Plan to perform experiments and practices to use the results to solve technical problems related to* **Chemical Engineering**.

III Competency and Skills

- This practical is expected to develop and understand the concept of pH. skills for the industry.

IV Relevant Course Outcome(s)

Manufacture the Inorganic acids in chemical process industries.

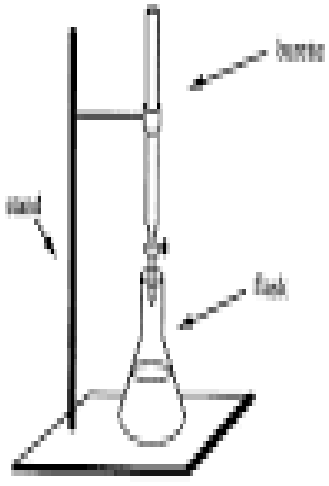
V Practical Outcome

Determine the strength of given nitric acid by pH meter

VI Minimum Theoretical Background

It is the percentage presence of the a substance in the mixture. In case of anhydrous acid and water. higher is the specific gravity, density and concentration, higher is the purity of acid.

VII Setup



VIII Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Thermometer	0to110	1 No.
2	pH meter	---	1 No.
3	beaker	100ml	1 No.
4	Volumetric flask	250ml	1 No.
5	Pipette	10ml	1 No
6	Burette	25ml	1 No
7	Conical flask	250m	1 No

IX Precautions to be Followed

Use apron while doing practical's.
Don't touch concentrate chemicals.

X Procedure

1. Calibrate the pH meter as per the instructions given in the instruction manual.
2. With the help of measuring cylinder take 5 ml of HNO_3 solution in 100 ml beaker. Add 45 ml of distilled water in it.
3. Put magnetic needle in the beaker and place it on magnetic stirrer.
4. Place the glass electrode in the solution and note down pH of pure acid solution.
5. Add 1ml 0.1NNaOH from burette in the acid solution. Stirr the contents and note down pH of the solution.
6. Continue adding 1 ml NaOH solution from burette every time note down the pH after each addition. Near the neutralization point the pH of solution changes rapidly.
7. Plot graph of pH (Y-axis) against volume of NaOH added (X-axis).

OBSERVATION AND OBSERVATION TABLE:

Observations :

Solution in Burette = 0.1 N NaOH

Solution in Beaker = 5 ml HNO_3 + 45 ml Distilled Water

Volume of 0.1 N NaOH added = 1 ml each time

End point = sharp change in pH value

Chemical Reaction : $HNO_3 + NaOH \rightarrow NaNO_3 + H_2O$

Observation Table :

Sr. No.	Volume of 0.1 NaOH added	pH - Value
1	0.0 ml	
2	1.0 ml	
3	2.0ml	
4	3.0ml	
5	4.0ml	
6	5.0ml	
7	6.0ml	
8	7.0ml	
9	8.0ml	
10	9.0ml	
11	10.0ml	

Nature of Graph :

CALCULATIONS:

a) To calculate normality of HNO_3 :

HNO_3 NaOH

$N_1V_1 = N_2V_2$

$N_1 \times 5 = 0.1 \times$ N.P(neutralization point)

$\therefore N_1 = \frac{0.1 \times N.P}{5.0}$

Normality HNO_3 = ……..N

b) To calculate strength of HNO_3 :

Strength of HNO_3 = Normality of HNO_3 Equivalent weight of HNO_3
(Equivalent weight of HNO_3 is 63)

Strength of H NO_3 = ……..X 63

Strength of H NO_3 = …….. g/l

XI Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		

XII Actual Procedure Followed

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XIII Precautions Followed

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XIV Results

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XV Interpretation of Results

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XVI Conclusions

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XVII Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

Define pH and give range of pH.

How the pH meter cailibrated?

(Space for answers)

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XVIII References

- www.creatingtechnology.org
- www.thechemicalengineer.com
  - www.chemistry.harvard.edu

XIX Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Handling of the chemicals & apparatus	20%
2	Determination of percentage purity	20%
Product Related (15 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. ……..
2. …….
3. ……

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	

Practical No. 8: Determine the strength of given Nitric acid by pH meter. Part-II

I Practical Significance

Purity, content of compound prime requirement in chemical industry. Such kind of test possible using measuring instruments like pH meter, thermometer, and using appropriate chemicals.

II Relevant Program Outcomes (POs)

PO1 **Basic knowledge :** Apply knowledge of basic mathematics, sciences and basic engineering to solve the **Chemical Engineering** problems

PO3 **- Experiments and practice:** Plan to perform experiments and practices to use the results to solve technical problems related to **Chemical Engineering**.

III Competency and Skills

- This practical is expected to develop and understand the concept of pH. skills for the industry.

IV Relevant Course Outcome(s)

Manufacture the Inorganic acids in chemical process industries.

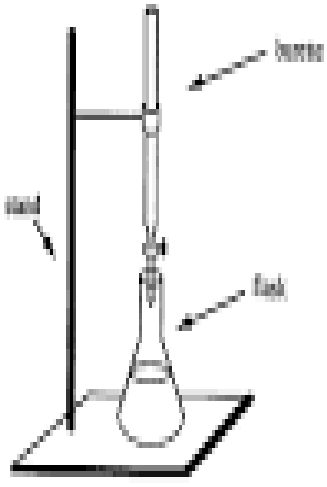
V Practical Outcome

Determine the strength of given Nitric acid by pH meter

VI Minimum Theoretical Background

It is the percentage presence of the a substance in the mixture. In case of anhydrous acid and water. higher is the specific gravity, density and concentration, higher is the purity of acid.

VII Setup



VIII Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Thermometer	0to110	1 No.
2	pH meter	---	1 No.
3	beaker	100ml	1 No.
4	Volumetric flask	250ml	1 No.
5	Pipette	10ml	1 No
6	Burette	25ml	1 No
7	Conical flask	250m	1 No

IX Precautions to be Followed

Use apron while doing practical's.
Don't touch concentrate chemicals.

X Procedure

1 Calibrate the pH meter as per the instructions given in the instruction manual.
2 With the help of measuring cylinder take 10 ml of HNO_3 solution in 100 ml beaker. Add 45 ml of distilled water in it.
3 Put magnetic needle in the beaker and place it on magnetic stirrer.
4 Place the glass electrode in the solution and note down pH of pure acid solution.
5 Add 1ml 0.1N NaOH from burette in the acid solution. Stirr the contents and note down pH of the solution.
6 Continue adding 1 ml NaOH solution from burette every time note down the pH after each addition. Near the neutralization point the pH of solution changes rapidly.
7 Plot graph of pH (Y-axis) against volume of NaOH added (X-axis).

OBSERVATION AND OBSERVATION TABLE:

Observations :

Solution in Burette = 0.1 N NaOH

Solution in Beaker = 5 ml HNO_3 + 45 ml Distilled Water

Volume of 0.1 N NaOH added = 1 ml each time

End point = sharp change in pH value

Chemical Reaction : $HNO_3 + NaOH \rightarrow Na\ NO_3 + H_2O$

Observation Table:

Sr. No.	Volume of 0.1 NaOH added	pH - Value
1	0.0 ml	
2	1.0 ml	
3	2.0ml	
4	3.0ml	
5	4.0ml	
6	5.0ml	
7	6.0ml	
8	7.0ml	
9	8.0ml	
10	9.0ml	
11	10.0ml	

Nature of Graph :

CALCULATIONS:

a) **To calculate normality of HNO_3 :**

$H NO_3$ NaOH

$N_1V_1 = N_2V_2$

$N_1 \times 10 = 0.1 \times N.P$(neutralization point)

$$\therefore N_1 = \frac{0.1 \times N.P}{10}$$

Normality $H NO_3$ = ……..N

b) **To calculate strength of HNO_3 :**

Strength of $H NO_3$ = Normality of $H NO_3$ Equivalent weight of $H NO_3$

(Equivalent weight of $H NO_3$ is 36.5)

Strength of $H NO_3$ = …….. X 63

Strength of $H NO_3$ = …….. g/l

XI Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		

XII Actual Procedure Followed

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XIII Precautions Followed

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XIV Results

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XV Interpretation of Results

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XVI Conclusions

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XVII Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

Define pH and give range of pH**.**

How the pH meter cailibrated?

(**Space for answers**)

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XVIII References

- www.creatingtechnology.org
- www.thechemicalengineer.com
- www.chemistry.harvard.edu

XIX Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Handling of the chemicals & apparatus	20%
2	Determination of percentage purity	20%
Product Related (15 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. ……..
2. …….
3. ……

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	

Practical No.9: Determine the strength of given hydrochloric acid by pH meter. Part-I

I Practical Significance

Purity, content of compound is the prime requirement in chemical industry. Such kind of test is possible using measuring instruments like pH meter, thermometer ,and using appropriate chemicals.

II Relevant Program Outcomes (POs)

PO1 ***Basic knowledge :*** *Apply knowledge of basic mathematics, sciences and basic engineering to solve the* **Chemical Engineering** *problems*

PO3 **- Experiments and practice:** *Plan to perform experiments and practices to use the results to solve technical problems related to* **Chemical Engineering**.

III Competency and Skills

- This practical is expected to develop and understand the concept of pH. skills for the industry.

IV Relevant Course Outcome(s)

Manufacture the Inorganic acids in chemical process industries.

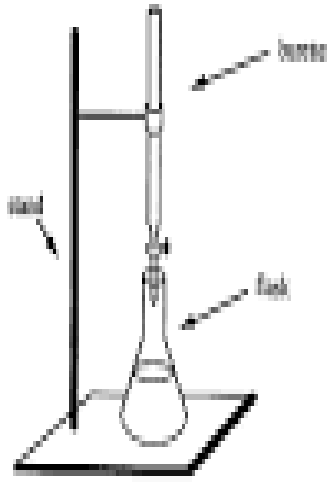
V Practical Outcome

Determine the strength of given hydrochloric acid by pH meter

VI Minimum Theoretical Background

It is the percentage presence of the a substance in the mixture. In case of anhydrous acid and water. higher is the specific gravity, density and concentration, higher is the purity of acid.

VII Setup



VIII Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Thermometer	0to110	1 No.
2	pH meter	---	1 No.
3	beaker	100ml	1 No.
4	Volumetric flask	250ml	1 No.
5	Pipette	10ml	1 No
6	Burette	25ml	1 No
7	Conical flask	250m	1 No

IX Precautions to be Followed

Use apron while doing practical's.
Don't touch concentrate chemicals.

X Procedure

1 Calibrate the pH meter as per the instructions given in the instruction manual.
2 With the help of measuring cylinder take 5 ml of HCI solution in 100 ml beaker. Add 45 ml of distilled water in it.
3 Put magnetic needle in the beaker and place it on magnetic stirrer.
4 Place the glass electrode in the solution and note down pH of pure acid solution.
5 Add 1ml 0.1NNaOH from burette in the acid solution. Stirr the contents and note down pH of the solution.
6 Continue adding 1 ml NaOH solution from burette every time note down the pH after each addition. Near the neutralization point the pH of solution changes rapidly.
7 Plot graph of pH (Y-axis) against volume of NaOH added (X-axis).

OBSERVATION AND OBSERVATION TABLE:

Observations :

Solution in Burette = 0.1 N NaOH

Solution in Beaker = 5 ml HCI + 45 ml Distilled Water

Volume of 0.1 N NaOH added = 1 ml each time

End point = sharp change in pH value

Chemical Reaction : $HCI + NaOH \rightarrow NaCL + H_2O$

Observation Table:

Sr. No.	Volume of 0.1 NaOH added	pH - Value
1	0.0 ml	
2	1.0 ml	
3	2.0ml	
4	3.0ml	
5	4.0ml	
6	5.0ml	
7	6.0ml	
8	7.0ml	
9	8.0ml	
10	9.0ml	
11	10.0ml	

Nature of Graph :

CALCULATIONS:

a) To calculate normality of HCl :

HCl NaOH

$N_1V_1 = N_2V_2$

$N_1 \times 5 = 0.1 \times N.P$(neutralization point)

$\therefore N_1 = \frac{0.1 \times N.P}{5.0}$

Normality HCl = ……..N

b) To calculate strength of HCI :

Strength of HCI = Normality of HCI Equivalent weight of HCl

(Equivalent weight of HCI is 36.5)

Strength of HCI = ……..X 36.5

Strength of HCI = …….. g/l

XI Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		

XII Actual Procedure Followed

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XIII Precautions Followed

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XIV Results

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XV Interpretation of Results

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XVI Conclusions

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XVII Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

Define pH and give range of pH.

How the pH meter cailibrated?

(Space for answers)

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XVIII References

- www.creatingtechnology.org
- www.thechemicalengineer.com
- www.chemistry.harvard.edu

XIX Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Handling of the chemicals & apparatus	20%
2	Determination of percentage purity	20%
Product Related (15 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. ……..
2. …….
3. ……

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	

Practical No.10: Determine the strength of given hydrochloric acid by pH meter. Part-II

I Practical Significance

Purity, content of compound is the prime requirement in chemical industry. Such kind of test is possible using measuring instruments like pH meter, thermometer, and using appropriate chemicals.

II Relevant Program Outcomes (POs)

PO1 ***Basic knowledge :*** *Apply knowledge of basic mathematics, sciences and basic engineering to solve the* **Chemical Engineering** *problems*

PO3 **- Experiments and practice:** *Plan to perform experiments and practices to use the results to solve technical problems related to* **Chemical Engineering**.

III Competency and Skills

- This practical is expected to develop and understand the concept of pH. skills for the industry.

IV Relevant Course Outcome(s)

Manufacture the Inorganic acids in chemical process industries.

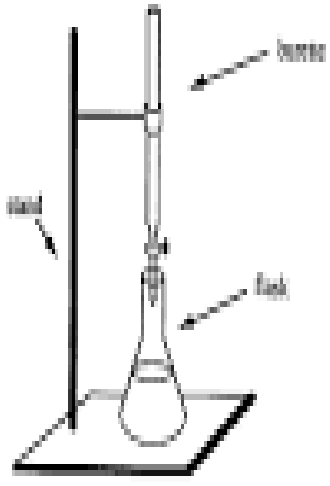
V Practical Outcome

Determine the strength of given hydrochloric acid by pH meter

VI Minimum Theoretical Background

It is the percentage presence of the a substance in the mixture. In case of anhydrous acid and water higher is the specific gravity, density and concentration, higher is the purity of acid.

VII Setup



VIII Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Thermometer	0to110	1 No.
2	pH meter	---	1 No.
3	beaker	100ml	1 No.
4	Volumetric flask	250ml	1 No.
5	Pipette	10ml	1 No
6	Burette	25ml	1 No
7	Conical flask	250m	1 No

IX Precautions to be Followed

Use apron while doing practical's.
Don't touch concentrate chemicals.

X Procedure

1 Calibrate the pH meter as per the instructions given in the instruction manual.
2 With the help of measuring cylinder take 10 ml of HCI solution in 100 ml beaker. Add 45 ml of distilled water in it.
3 Put magnetic needle in the beaker and place it on magnetic stirrer.
4 Place the glass electrode in the solution and note down pH of pure acid solution.
5 Add 1ml 0.1NNaOH from burette in the acid solution. Stirr the contents and note down pH of the solution.
6 Continue adding 1 ml NaOH solution from burette every time note down the pH after each addition. Near the neutralization point the pH of solution changes rapidly.
7 Plot graph of pH (Y-axis) against volume of NaOH added (X-axis).

OBSERVATION AND OBSERVATION TABLE:

Observations :

Solution in Burette = 0.1 N NaOH

Solution in Beaker = 5 ml HCI + 45 ml Distilled Water

Volume of 0.1 N NaOH added = 10 ml each time

End point = sharp change in pH value

Chemical Reaction : $HCI + NaOH \rightarrow NaCL + H_2O$

Observation Table:

Sr. No.	Volume of 0.1 NaOH added	pH - Value
1	0.0 ml	
2	1.0 ml	
3	2.0ml	
4	3.0ml	
5	4.0ml	
6	5.0ml	
7	6.0ml	
8	7.0ml	
9	8.0ml	
10	9.0ml	
11	10.0ml	

Nature of Graph:

CALCULATIONS:

c) To calculate normality of HCI :

HCl NaOH

$N_1V_1 = N_2V_2$

$N_1 \times 10 = 0.1 \times N.P$(neutralization point)

$$\therefore N_1 = \frac{0.1 \times N.P}{10}$$

Normality HCI = ……..N

d) To calculate strength of HCI :

Strength of HCI = Normality of HCI Equivalent weight of HCI

(Equivalent weight of HCI is 36.5)

Strength of HCI = ……..X 36.5

Strength of HCI = …….. g/l

XI Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		

XII Actual Procedure Followed

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XIII Precautions Followed

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XIV Results

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XV Interpretation of Results

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XVI Conclusions

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XVII Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

Define pH and give range of pH.

How the pH meter cailibrated?

(Space for answers)

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XVIII References

- www.creatingtechnology.org
- www.thechemicalengineer.com
- www.chemistry.harvard.edu

XIX Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Handling of the chemicals & apparatus	20%
2	Determination of percentage purity	20%
Product Related (15 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. ……..
2. …….
3. ……

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	

Practical No. 11: Determine ammonia content in given sample of fertilizer of ammonium nitrate. Part_I

I Practical Significance

Purity, content of compound is prime requirement in chemical industry. Such kind of test possible using measuring instruments like hydrometer, thermometer ,and using appropriate chemicals.

II Relevant Program Outcomes (POs)

PO1 ***Basic knowledge :*** *Apply knowledge of basic mathematics, sciences and basic engineering to solve the* **Chemical Engineering** *problems*

PO3 **- Experiments and practice:** *Plan to perform experiments and practices to use the results to solve technical problems related to* **Chemical Engineering**.

III Competency and Skills

- **This practical is expected to develop the qualitative skills for the industry**
- **Apply basic concept of inorganic chemistry in chemical engineering applications.**

IV Relevant Course Outcome(s)

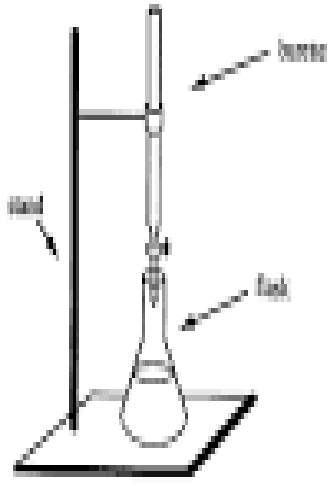
- For identification of proper fertilizer.

V Practical Outcome Determine ammonia content in given sample of fertilizer of ammonium nitrate.

VI Minimum Theoretical Background

It is the amount of available elemental nitrogen present in ammonium fertilizer.

VII Setup



VIII Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Thermometer	0to110	1 No.
2	Hydrometer	0.1to2	1 No.
3	beaker	100ml	1 No.
4	Volumetric flask	250ml	1 No.
5	Pipette	10ml	1 No
6	Burette	25ml	1 No
7	Conical flask	250m	1 No

IX Precautions to be Followed

Use apron while doing practical's.
Don't touch concentrate chemicals.

X Procedure

Stepwise Procedure:

1. Wash the glassware with water and rinse with respective solution to be handled.
2. Weight accurately 0.2 gms . of ammonium nitrate fertilizer sample.
3. Dissolve it in a 100ml. of 0.1N NaOH solution in a conical flask.
4. Keep funnel on the flask to avoid evaporation losses.
5. Heat the reaction mixture so that ammonium nitrate hydrolyses with evolution of ammonia gas.
6. Confirm total removal of ammonia by change in the color of yellow turmeric paper.
7. Carry out blank titration between 0.1N HCl solution and 0.1N NaOH solution.
8. Cool the reaction mixture initially prepared and titrate it against 0.1N HCl solution. This Known as back titration.
9. Perform the titration until a constant burette reading is obtained.

XI Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		

Actual Procedure Followed

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XII Precautions Followed

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XIII Observations and Calculations

For blank titration,

1. In burette – 0.1N HCl solution.
2. In conical flask -- 10ml. of 0.1N NaOH solution.
3. Indicator – Phenolphthalein.
4. End point pink to colorless.

For back titration,

1. In burette 0.1N HCl solution.
2. In conical flask -- 100 ml. of prepared reaction mixture.
3. Indicator – Phenolphthalein.
4. End point -- colorless to pink.

The reaction are,

$HCl + NaOH = NaCl + H_2O$

Chemical reaction

$NH_4NO_3 + NaOH \rightarrow NH_3 + NaNO_3 + H_2O$

Burette Reading

For blank titration

Reading	Burette reading in ml.			Constant burette Reading ml.
	I	II	III	X ml.
Initial				
Final				
Difference				

For back titration

Reading	Burette reading in ml.			Constant burette Reading ml.
	I	II	III	X_2 ml.
Initial				
Final				
Difference				

Sample calculations

1. Constant burette reading for blank titration = X ml.

   This is valume of 0.1N HCl solution consumed for 10ml. of 0.1N NaOH solution

   Therefore,

   For 100ml of 0.1N NaOH solution,

   = X x 10 ml = X_1 ml of 0.1N HCl solution

2. Amount of 0.1N NaOH solution consumed,

   A = ($X_1 - X_2$) ml.

   Now

   1ml of 0.1N NaOH solution

   = 0.0017 gm of ammonia (for ammonium nitrate).

Therefore,

A ml of 0.1N NaOH solution

= (0.0017 x A) gm of ammonia in 0.2 gm ammonium nitrate .

= B gms.

Therefore,

Ammonia content in given fertilizer sample,

= (Amount of Ammonia / Amount of fertilizer sample) x 100

= (B/0.2) x 100 %

XIV Results

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XV Interpretation of Results

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XVI Conclusions

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XVII Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

What is nitrogenous fertilizer.

What is the percentage of nitrogen in ammonium fertilizer.

(Space for answers)

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XVIII References

- www.creatingtechnology.org
- www.thechemicalengineer.com
- www.chemistry.harvard.edu

XIX Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Handling of the chemicals & apparatus	20%
2	Determination of percentage purity	20%
Product Related (15 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. ……..
2. …….
2. ……

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	

Practical No. 12: Determine ammonia content in given sample of fertilizer of ammonium nitrate. Part_II

I Practical Significance Purity, content of compound is prime requirement in chemical industry. Such kind of test is possible using measuring instruments like hydrometer, thermometer, and using appropriate chemicals.

II **Relevant Program Outcomes (POs)**
PO1 ***Basic knowledge :*** *Apply knowledge of basic mathematics, sciences and basic engineering to solve the* **Chemical Engineering** *problems*
PO3 **- Experiments and practice:** *Plan to perform experiments and practices to use the results to solve technical problems related to* **Chemical Engineering**.

III **Competency and Skills**
- This practical is expected to develop the qualitative skills for the industry
- Apply basic concept of inorganic chemistry in chemical engineering applications**.**

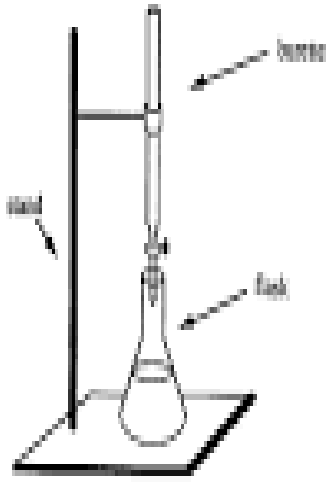
IV **Relevant Course Outcome(s)**

- For identification of proper fertilizer.

V **Practical Outcome** Determine ammonia content in given sample of fertilizer of ammonium nitrate.

VI **Minimum Theoretical Background**
It is the amount of available elemental nitrogen present in ammonium fertilizer.

VII **Setup**



VIII Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Thermometer	0to110	1 No.
2	Hydrometer	0.1to2	1 No.
3	beaker	100ml	1 No.
4	Volumetric flask	250ml	1 No.
5	Pipette	10ml	1 No
6	Burette	25ml	1 No
7	Conical flask	250m	1 No

IX Precautions to be Followed

Use apron while doing practical's.
Don't touch concentrate chemicals.

X Procedure

Stepwise Procedure:

1. Wash the glassware with water and rinse with respective solution to be handled.
2. Weight accurately 0.5 gms . of ammonium nitrate fertilizer sample.
3. Dissolve it in a 100ml. of 0.1N NaOH solution in a conical flask.
4. Keep funnel on the flask to avoid evaporation losses.
5. Heat the reaction mixer so that ammonium nitrate hydrolyses with evolution of ammonia gas.
6. Confirm total removal of ammonia by change in the color of yellow turmeric paper.
7. Carry out blank titration between 0.1N HCl solution and 0.1N NaOH solution.
8. Cool the reaction mixer initially prepared and titrate it against 0.1N HCl solution. This Known as back titration.
9. Perform the titration until a constant burette reading is obtained.

XI Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		

XII Actual Procedure Followed

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XIII Precautions Followed

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XIV Observations and Calculations

For blank titration,

1. In burette – 0.1N HCl solution.
2. In conical flask -- 10ml. of 0.1N NaOH solution.
3. Indicator – Phenolphthalein.
4. End point pink to colorless.

For back titration,

1. In burette 0.1N HCl solution.
2. In conical flask -- 100 ml. of prepared reaction mixture.
3. Indicator – Phenolphthalein.
4. End point -- colorless to pink.

The reaction are,

$HCl + NaOH = Nacl + H_2O$

$NH_4 NO_3 + = NH_3 + NaNO_3 + H_2O$

Burette Reading

For blank titration

Reading	Burette reading in ml.			Constant burette Reading ml.
	I	II	III	X ml.
Initial				
Final				
Difference				

For back titration

Reading	Burette reading in ml.			Constant burette Reading ml.
	I	II	III	X_2 ml.
Initial				
Final				
Difference				

Sample calculations

1. Constant burette reading for blank titration = X ml.

   This is valume of 0.1N HCl solution consumed for 10ml. of 0.1N NaOH solution

   Therefore,

   For 100ml of 0.1N NaOH solution,

   = X x 10 ml = X_1 ml of 0.1N HCl solution

2. Amount of 0.1N NaOH solution consumed,

   A = ($X_1 - X_2$) ml.

   Now

   1ml of 0.1N NaOH solution

   = 0.0017 gm of ammonia (for ammonium nitrate).

Therefore,

A ml of 0.1N NaOH solution

= (0.0017 x A) gm of ammonia in 0.5 gm ammonium nitrate .

= B gms.

Therefore,

Ammonia content in given fertilizer sample,

= (Amount of Ammonia / Amount of fertilizer sample) x 100

= (B/0.5) x 100 %

XV Results

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XVI Interpretation of Results

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XVII Conclusions

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XVIII Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

What is nitrogenous fertilizer.

What is the percentage of nitrogen in ammonium fertilizer.

(Space for answers)

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XIX References

- www.creatingtechnology.org
- www.thechemicalengineer.com
- www.chemistry.harvard.edu

XX Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Handling of the chemicals & apparatus	20%
2	Determination of percentage purity	20%
Product Related (15 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. ……..
2. …….
3. ……

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	

Practical No.13: Determine ammonia content in given sample of fertilizer of ammonium sulphate. Part_I

I Practical Significance

The nitrogen content indicates the available nitrogen in the ammonium sulphate fertilizer.

II Relevant Program Outcomes (POs)

PO1 **Basic knowledge :** Apply knowledge of basic mathematics, sciences and basic engineering to solve the **Chemical Engineering** problems

PO3 **- Experiments and practice:** Plan to perform experiments and practices to use the results to solve technical problems related to **Chemical Engineering**.

III Competency and Skills

- This practical is expected to develop the ability to perform the experiment effectively to achieve the result.

IV Relevant Course Outcome(s)

- Prepare Ammonia based fertilizers in chemical process industries

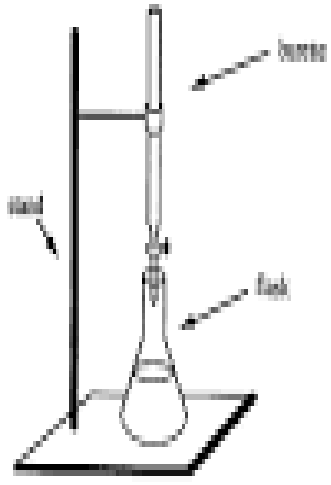
V Practical Outcome

- Determine ammonia content in given sample of fertilizer of ammonium sulphate

VI Minimum Theoretical Background

Ammonium sulphate is well-known fertilizer which will be used by farmer to increase the fertility of soil.

VII Setup



VIII Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Thermometer	0to110	1 No.
2	Weighing balance	0.1to200grms	1 No.
3	beaker	100ml	1 No.
4	Volumetric flask	250ml	1 No.
5	Pipette	10ml	1 No
6	Burette	25ml	1 No
7	Conical flask	250m	1 No

IX Precautions to be Followed

Use apron while doing practicals.
Don't touch concentrate chemicals.

X Procedure

1. Wash the glassware with water.
2. Weight accurately 0.2 gms . of ammonium sulphate fertilizer sample
3. Dissolve it in a 100ml. of 0.1N NaOH solution in a conical flask.
4. Keep funnel on the flask to avoid evaporation losses.
5. Heat the reaction mixture so that ammonium sulphate hydrolyses with evolution of ammonia gas.
6. Confirm total removal of ammonia by change in the color of yellow turmeric paper.
7. Carry out blank titration between 0.1N HCl solution and 0.1N NaOH solution.
8. Cool the reaction mixture initially prepared and titrate it against 0.1N HCl solution. Known as back titration.
9. Perform the titration until a constant burette reading is obtained.

XI Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		

XII Actual Procedure Followed

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XIII Precautions Followed

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XIV Observations and Calculations

For blank titration:-

1. In burette – 0.1N HCl solution.
2. In conical flask -- 10ml. of 0.1N NaOH solution.
3. Indicator – Phenolphthalein.
4. End point- pink to colourless.

For back titration:-

1. In burette 0.1N HCl solution.
2. In conical flask -- 100 ml. of prepared reaction mixture.
3. Indicator – Phenolphthalein.
4. End point -- colourless to pink.

The reaction are,

$HCl + NaOH = NaCl + H_2O$

$(NH_4)_2SO_4 + 2NaOH = 2NH_3 + Na_2SO_4 + H_2O$

Burette Reading

For blank titration

Reading	Burette reading in ml.			Constant burette Reading ml.
	I	II	III	X ml.
Initial				
Final				
Difference				

For back titration

Reading	Burette reading in ml.			Constant burette Reading ml.
	I	II	III	X_2 ml.
Initial				
Final				
Difference				

Sample calculations

1. Constant burette reading for blank titration = X ml.

   This is valume of 0.1N HCl solution consumed for 10ml. of 0.1N NaOH solution

   Therefore,

   For 100ml of 0.1N NaOH solution,

   = X x 10 ml = X_1 ml of 0.1N HCl solution

2. Amount of 0.1N NaOH solution consumed,

   A = ($X_1 - X_2$) ml.

   Now

   1ml of 0.1N NaOH solution

   = 0.0034 gm of ammonia (for ammonium sulphate).

Therefore,

A ml of 0.1N NaOH solution

= (0.0034 x A) gm of ammonia in 0.2 gm ammonium sulphate.

= B gms.

Therefore,

Ammonia content in given fertilizer sample,

= (Amount of Ammonia / Amount of fertilizer sample) x 100

= $\frac{B}{0.2}$ x 100 %

XV Results

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XVI Interpretation of Results

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XVII Conclusions

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XVIII Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

What are the uses of ammonium sulphate?

What is mixed fertilizer?

(Space for answers)

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XIX References

- www.creatingtechnology.org
- www.thechemicalengineer.com
- www.chemistry.harvard.edu

XX Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Handling of the chemicals & apparatus	20%
2	Determination of percentage purity	20%
Product Related (15 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. ……..
2. …….
3. ……

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	

Practical No.14: Determine ammonia content in given sample of fertilizer of ammonium sulphate. Part_II

I Practical Significance

The nitrogen content indicates the available nitrogen in the ammonium sulphate fertilizer.

II Relevant Program Outcomes (POs)

PO1 ***Basic knowledge :*** *Apply knowledge of basic mathematics, sciences and basic engineering to solve the* **Chemical Engineering** *problems*

PO3 **- Experiments and practice:** *Plan to perform experiments and practices to use the results to solve technical problems related to* **Chemical Engineering**.

III Competency and Skills

- This practical is expected to develop the ability to perform the experiment effectively to achieve the result.

IV Relevant Course Outcome(s)

- Prepare Ammonia based fertilizers in chemical process industries

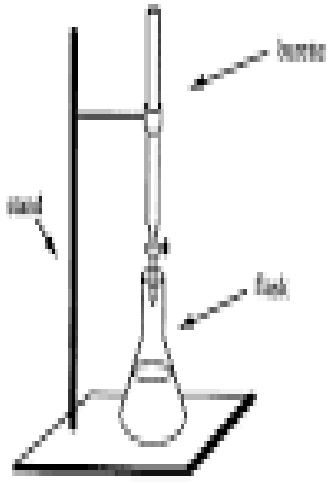
V Practical Outcome

- Determine ammonia content in given sample of fertilizer of ammonium sulphate

VI Minimum Theoretical Background

Ammonium sulphate is well-known fertilizer which will be used by farmer to increase the fertility of soil.

VII Setup



VIII Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Thermometer	0to110	1 No.
2	Weighing balance	0.1to200grms	1 No.
3	beaker	100ml	1 No.
4	Volumetric flask	250ml	1 No.
5	Pipette	10ml	1 No
6	Burette	25ml	1 No
7	Conical flask	250m	1 No

IX Precautions to be Followed

Use apron while doing practicals.
Don't touch concentrate chemicals.

X Procedure

1. Wash the glassware with water.
2. Weight accurately 0.5 gms . of ammonium sulphate fertilizer sample
3. Dissolve it in a 100ml. of 0.1N NaOH solution in a conical flask.
4. Keep funnel on the flask to avoid evaporation losses.
5. Heat the reaction mixer so that ammonium sulphate hydrolyses with evolution of ammonia gas.
6. Confirm total removal of ammonia by change in the color of yellow turmeric paper.
7. Carry out blank titration between 0.1N HCl solution and 0.1N NaOH solution.
8. Cool the reaction mixer initially prepared and titrate it against 0.1N HCl solution. Known as back titration.
9. Perform the titration until a constant burette reading is obtained.

XI Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		

XII Actual Procedure Followed

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XIII Precautions Followed

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XIV Observations and Calculations

For blank titration:

1. In burette – 0.1N HCl solution.
2. In conical flask -- 10ml. of 0.1N NaOH solution.
3. Indicator – Phenolphthalein.
4. End point- pink to colourless.

For back titration:-

1. In burette 0.1N HCl solution.
2. In conical flask -- 100 ml. of prepared reaction mixture.
3. Indicator – Phenolphthalein.
4. End point -- colorless to pink.

The reaction are,

$HCl + NaOH = NaCl + H_2O$

$(NH_4)_2SO_4 + 2NaOH = 2NH_3 + Na_2SO_4 + H_2O$

Burette Reading

For blank titration

Reading	**Burette reading in ml.**			**Constant burette Reading ml.**
	I	**II**	**III**	**X ml.**
Initial				
Final				
Difference				

For back titration

Reading	**Burette reading in ml.**			**Constant burette Reading ml.**
	I	**II**	**III**	**X_2 ml.**
Initial				
Final				
Difference				

Sample calculations

1. Constant burette reading for blank titration = X ml.

   This is volume of 0.1N HCl solution consumed for 10ml. of 0.1N NaOH solution

   Therefore,

For 100ml of 0.1N NaOH solution,

$= X \times 10$ ml $= X_1$ ml of 0.1N HCl solution

2. Amount of 0.1N NaOH solution consumed,

   $A = (X_1 - X_2)$ ml.

Now

1ml of 0.1N NaOH solution

= 0.0034 gm of ammonia (for ammonium sulphate).

Therefore,

A ml of 0.1N NaOH solution

= (0.0034 x A) gm of ammonia in 0.5 gm ammonium sulphate.

= B gms.

Therefore,

Nitrogen content in given fertilizer sample,

= (Amount of Ammonia / Amount of fertilizer sample) x 100

$= \frac{B}{0.5} \times 100\ \%$

XV Results

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XVI Interpretation of Results

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XVII Conclusions

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XVIII Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

What are the uses of ammonium sulphate?

What is mixed fertilizer?

(Space for answers)

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XIX References

- www.creatingtechnology.org
- www.thechemicalengineer.com
- www.chemistry.harvard.edu

XX Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Handling of the chemicals & apparatus	20%
2	Determination of percentage purity	20%
Product Related (15 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. ……..
2. …….
3. ……

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	

Practical No. 15: Determine ammonia content in given sample of fertilizer of ammonium chloride. Part-I

I Practical Significance

The ammonia content of the fertilizer is important to ascertain its quality for use in agriculture and soil analysis.

II Relevant Program Outcomes (POs)

PO1 ***Basic knowledge :*** *Apply knowledge of basic mathematics, sciences and basic engineering to solve the* Chemical Engineering *problems*

PO3 **- Experiments and practice:** *Plan to perform experiments and practices to use the results to solve technical problems related to* **Chemical Engineering**.

III Competency and Skills

- This practical is expected to understand the presence and importance of ammonia in ammonium chloride.

IV Relevant Course Outcome(s)

- Prepare Ammonia based fertilizers in chemical process industries

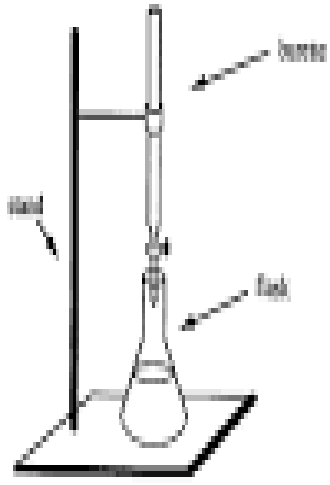
V Practical Outcome

Determine ammonia content in given sample of fertilizer of ammonium chloride

VI Minimum Theoretical Background

The determination of ammonia contents of the fertilizer is important to know the available ammonia in the fertilizer as a requirement by the consumers.

VII Setup



VIII Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Thermometer	0to110	1 No.
2	Weighing balance	0.1to200grms	1 No.
3	beaker	100ml	1 No.
4	Volumetric flask	250ml	1 No.
5	Pipette	10ml	1 No
6	Burette	25ml	1 No
7	Conical flask	250m	1 No

IX Precautions to be Followed

Use apron while doing practical's.
Don't touch concentrate chemicals.

X Procedure

1. Wash the glassware with water.
2. Weight accurately 0.2 gms . of ammonium chloride fertilizer sample
3. Dissolve it in a 100ml. of 0.1N NaOH solution in a conical flask.
4. Keep funnel on the flask to avoid evaporation losses.
5. Heat the reaction mixture so that ammonium chloride hydrolyses with evolution of ammonia gas.
6. Confirm total removal of ammonia by change in the color of yellow turmeric paper.
7. Carry out blank titration between 0.1N HCl solution and 0.1N NaOH solution.
8. Cool the reaction mixture initially prepared and titrate it against 0.1N HCl solution. Known as back titration.
9. Perform the titration until a constant burette reading is obtained.

XI Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1					
2					
3					

XII Actual Procedure Followed

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XIII Precautions Followed

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XIV Observations and Calculations

For blank titration:

1. In burette – 0.1N HCl solution.
2. In conical flask -- 10ml. of 0.1N NaOH solution.
3. Indicator – Phenolphthalein.
4. End point- pink to colourless.

For back titration:

1. In burette 0.1N HCl solution.
2. In conical flask -- 100 ml. of prepared reaction mixture.
3. Indicator – Phenolphthalein.
4. End point -- colourless to pink.

The reaction are,

$HCl + NaOH = NaCl + H_2O$

$NH4Cl + 2NaOH = 2NH_3 + NaCl + H_2O$

Burette Reading

For blank titration

Reading	**Burette reading in ml.**			**Constant burette Reading ml.**
	I	**II**	**III**	**X ml.**
Initial				
Final				
Difference				

For back titration

Reading	**Burette reading in ml.**			**Constant burette Reading ml.**
	I	**II**	**III**	**X_2 ml.**
Initial				
Final				
Difference				

Sample calculations

1. Constant burette reading for blank titration = X ml.

   This is valume of 0.1N HCl solution consumed for 10ml. of 0.1N NaOH solution

   Therefore,

For 100ml of 0.1N NaOH solution,

$= X \times 10$ ml $= X_1$ ml of 0.1N HCl solution

2. Amount of 0.1N NaOH solution consumed,

   $A = (X_1 - X_2)$ ml.

Now

1ml of 0.1N NaOH solution

= 0.0034 gm of ammonia (for ammonium chloride).

Therefore,

A ml of 0.1N NaOH solution

= (0.0034 x A) gm of ammonia in 0.2 gm ammonium chloride.

= B gms.

Therefore,

Ammonia content in given fertilizer sample,

= (Amount of Ammonia / Amount of fertilizer sample) x 100

$= \frac{B}{0.2} \times 100\ \%$

XV Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1					
2					
3					

XVI Actual Procedure Followed

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XVII Precautions Followed

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XVIII Results

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XIX Interpretation of Results

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XX Conclusions

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XXI Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

Give importance of ammonium chloride as a fertilizer

How the grades of fertilizer is decided.

(Space for answers)

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XXII References

- www.creatingtechnology.org
- www.thechemicalengineer.com
- www.chemistry.harvard.edu

XXIII Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Handling of the chemicals & apparatus	20%
2	Determination of percentage purity	20%
Product Related (15 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. ……..
2. …….
3. ……

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	

Practical No. 16: Determine ammonia content in given sample of fertilizer of ammonium chloride. Part-II

I Practical Significance

The ammonia content of the fertilizer is important to ascertain its quality for use in agriculture and soil analysis.

II Relevant Program Outcomes (POs)

PO1 ***Basic knowledge :*** *Apply knowledge of basic mathematics, sciences and basic engineering to solve the* Chemical Engineering *problems*

PO3 **- Experiments and practice:** *Plan to perform experiments and practices to use the results to solve technical problems related to* **Chemical Engineering**.

III Competency and Skills

- This practical is expected to understand the presence and importance of ammonia in ammonium chloride.

IV Relevant Course Outcome(s)

- Prepare Ammonia based fertilizers in chemical process industries

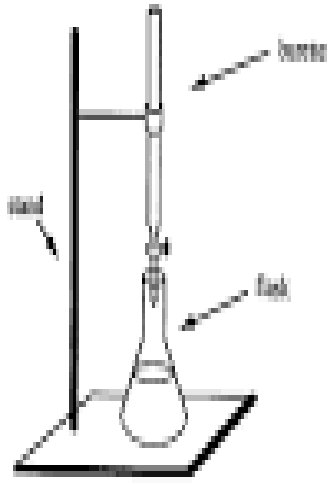
V Practical Outcome

Determine ammonia content in given sample of fertilizer of ammonium chloride

VI Minimum Theoretical Background

The determination of ammonia contents of the fertilizer is important to know the available ammonia in the fertilizer as a requirement by the consumers.

VII Setup



VIII Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Thermometer	0to110	1 No.
2	Weighing balance	0.1to200grms	1 No.
3	beaker	100ml	1 No.
4	Volumetric flask	250ml	1 No.
5	Pipette	10ml	1 No
6	Burette	25ml	1 No
7	Conical flask	250m	1 No

IX Precautions to be Followed

Use apron while doing practical's.
Don't touch concentrate chemicals.

X Procedure

1. Wash the glassware with water.
2. Weight accurately 0.5 gms . of ammonium chloride fertilizer sample
3. Dissolve it in a 100ml. of 0.1N NaOH solution in a conical flask.
4. Keep funnel on the flask to avoid evaporation losses.
5. Heat the reaction mixture so that ammonium chloride hydrolyses with evolution of ammonia gas.
6. Confirm total removal of ammonia by change in the color of yellow turmeric paper.
7. Carry out blank titration between 0.1N HCl solution and 0.1N NaOH solution.
8. Cool the reaction mixture initially prepared and titrate it against 0.1N HCl solution. Known as back titration.
9. Perform the titration until a constant burette reading is obtained.

XI Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1					
2					
3					

XII Actual Procedure Followed

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XIII Precautions Followed

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XIV Observations and Calculations

For blank titration:

1. In burette – 0.1N HCl solution.
2. In conical flask -- 10ml. of 0.1N NaOH solution.
3. Indicator – Phenolphthalein.
4. End point- pink to colourless.

For back titration:

1. In burette 0.1N HCl solution.
2. In conical flask -- 100 ml. of prepared reaction mixture.
3. Indicator – Phenolphthalein.
4. End point -- colourless to pink.

The reaction are,

$HCl + NaOH = NaCl + H_2O$

$NH4Cl + 2NaOH = 2NH_3 + NaCl + H_2O$

Burette Reading

For blank titration

Reading	Burette reading in ml.			Constant burette Reading ml.
	I	II	III	X ml.
Initial				
Final				
Difference				

For back titration

Reading	Burette reading in ml.			Constant burette Reading ml.
	I	II	III	X_2 ml.
Initial				
Final				
Difference				

Sample calculations

1. Constant burette reading for blank titration = X ml.

   This is valume of 0.1N HCl solution consumed for 10ml. of 0.1N NaOH solution

   Therefore,

For 100ml of 0.1N NaOH solution,

$= X \times 10$ ml $= X_1$ ml of 0.1N HCl solution

2. Amount of 0.1N NaOH solution consumed,

   $A = (X_1 - X_2)$ ml.

Now

1ml of 0.1N NaOH solution

= 0.0034 gm of ammonia (for ammonium chloride).

Therefore,

A ml of 0.1N NaOH solution

= (0.0034 x A) gm of ammonia in 0.5 gm ammonium chloride.

= B gms.

Therefore,

Ammonia content in given fertilizer sample,

= (Amount of ammonia / Amount of fertilizer sample) x 100

$= \frac{B}{0.5} \times 100\ \%$

XV Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1					
2					
3					

XVI Actual Procedure Followed

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XVII Precautions Followed

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XVIII Results

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XIX Interpretation of Results

Giving meaning to the results

XX Conclusions

Actions to be taken based on the interpretations.

XXI Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

Give importance of ammonium chloride as a fertilizer

How the grades of fertilizer is decided.

(Space for answers)

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XXII References

- www.creatingtechnology.org
- www.thechemicalengineer.com
- www.chemistry.harvard.edu

XXIII Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Handling of the chemicals & apparatus	20%
2	Determination of percentage purity	20%
Product Related (15 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. …. ……..

2 . …….

3. ……

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	

Practical No.17: Determine nitrogen content in given sample of ammonium fertilizer. Part-I

I Practical Significance

The nitrogen content indicates the available nitrogen in ammonium fertilizer. Such kind of test possible using measuring instruments like glassware, thermometer, and using appropriate chemicals.

II Relevant Program Outcomes (POs)

PO1 ***Basic knowledge :*** *Apply knowledge of basic mathematics, sciences and basic engineering to solve the* **Chemical Engineering** *problems*

PO3 **- Experiments and practice:** *Plan to perform experiments and practices to use the results to solve technical problems related to* **Chemical Engineering**.

III Competency and Skills

This practical is expected to develop the analytical skills for the industry .

IV Relevant Course Outcome(s)

Prepare Ammonia based fertilizers in chemical process industries

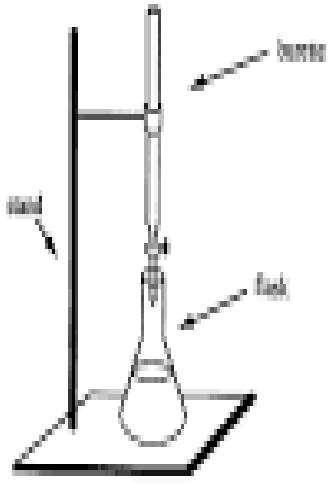
V Practical Outcome

Determine nitrogen content in given sample of ammonium fertilizer

VI Minimum Theoretical Background

The fertilizer in which the nitrogenous present is called nitrogenous fertilizer. It is very essential to know the nitrogen which will help for selection of fertilizer.

VII Setup



VIII Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Thermometer	0to110	1 No.
2	Weighing balance	0.1to200grms	1 No.
3	beaker	100ml	1 No.
4	Volumetric flask	250ml	1 No.
5	Pipette	10ml	1 No
6	Burette	25ml	1 No
7	Conical flask	250m	1 No

IX Precautions to be Followed

Use apron while doing practical's.
Don't touch concentrate chemicals.

X Procedure

1. Wash the glassware with water.
2. Weight accurately 0.2 gms . of ammonium fertilizer sample
3. Dissolve it in a 100ml. of 0.1N NaOH solution in a conical flask.
4. Keep funnel on the flask to avoid evaporation losses.
5. Heat the reaction mixer so that ammonium hydrolyses with evolution of ammonia gas.
6. Confirm total removal of ammonia by change in the color of yellow turmeric paper.
7. Carry out blank titration between 0.1N HCl solution and 0.1N NaOH solution.
8. Cool the reaction mixer initially prepared and titrate it against 0.1N HCl solution. Known as back titration.
9. Perform the titration until a constant burette reading is obtained.

XI Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1					
2					
3					

XII Actual Procedure Followed

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XIII Precautions Followed

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XIV Observations and Calculations

For blank titration,

1. In burette – 0.1N HCl solution.
2. In conical flask -- 10ml. of 0.1N NaOH solution.
3. Indicator – Phenolphthalein.
4. End point pink to colorless.

For back titration,

1. In burette 0.1N HCl solution.
2. In conical flask -- 100 ml. of prepared reaction mixture.
3. Indicator – Phenolphthalein.
4. End point -- colorless to pink.

The reaction are,

$HCl + NaOH = Nacl + H_2O$

$(NH_4)_2SO_4 + 2NaOH = 2NH_3 + Na_2SO_4 + H_2O$

Burette Reading

For blank titration

Reading	Burette reading in ml.			Constant burette Reading ml.
	I	II	III	X ml.
Initial				
Final				
Difference				

For back titration

Reading	Burette reading in ml.			Constant burette Reading ml.
	I	II	III	X_2 ml.
Initial				
Final				
Difference				

Sample calculations

1. Constant burette reading for blank titration = X ml.

   This is valume of 0.1N HCl solution consumed for 10ml. of 0.1N NaOH solution

   Therefore,

For 100ml of 0.1N NaOH solution,

= X x 10 ml = X_1 ml of 0.1N HCl solution

2. Amount of 0.1N NaOH solution consumed,

   A = ($X_1 - X_2$) ml.

Now

1ml of 0.1N NaOH solution

= 0.0034 gm of ammonia (for ammonium sulphate).

Therefore,

A ml of 0.1N NaOH solution

= (0.0034 x A) gm of ammonia in 0.2 gm ammonium sulphate.

= B gms.

Therefore,

Nitrogen content in given fertilizer sample,

= (Amount of nitrogen / Amount of fertilizer sample) x 100

$$= \frac{Bx\ (14/17)\ x\ 100\ \%}{0.2}$$

$$= \frac{B \times 14}{0.2 \times 17} \times 100\ \%$$

XV Results

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XVI Interpretation of Results

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XVII Conclusions

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XVIII Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

How to you detect evolution of ammonia during practical.

How to observe neutralization point during titration.

(Space for answers)

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XIX References

- www.creatingtechnology.org
- www.thechemicalengineer.com
- www.chemistry.harvard.edu

XX Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Handling of the chemicals & apparatus	20%
2	Determination of percentage purity	20%
Product Related (15 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. ……..
2. …….
3. ……

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	

Practical No.18: Determine nitrogen content in given sample of ammonium fertilizer. Part-II

I Practical Significance

The nitrogen content indicates the available nitrogen in ammonium fertilizer. Such kind of test possible using measuring instruments like glassware, thermometer, and using appropriate chemicals.

II Relevant Program Outcomes (POs)

PO1 ***Basic knowledge :*** *Apply knowledge of basic mathematics, sciences and basic engineering to solve the* **Chemical Engineering** *problems*

PO3 **- Experiments and practice:** *Plan to perform experiments and practices to use the results to solve technical problems related to* **Chemical Engineering**.

III Competency and Skills

This practical is expected to develop the analytical skills for the industry .

IV Relevant Course Outcome(s)

Prepare Ammonia based fertilizers in chemical process industries

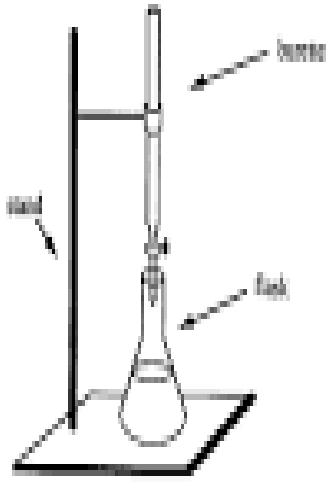
V Practical Outcome

Determine nitrogen content in given sample of ammonium fertilizer

VI Minimum Theoretical Background

The fertilizer in which the nitrogenous present is called nitrogenous fertilizer. It is very essential to know the nitrogen which will help for selection of fertilizer.

VII Setup



VIII Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Thermometer	0to110	1 No.
2	Weighing balance	0.1to200grms	1 No.
3	beaker	100ml	1 No.
4	Volumetric flask	250ml	1 No.
5	Pipette	10ml	1 No
6	Burette	25ml	1 No
7	Conical flask	250m	1 No

IX Precautions to be Followed

Use apron while doing practical's.
Don't touch concentrate chemicals.

X Procedure

1. Wash the glassware with water.
2. Weight accurately 0.5 gms . of ammonium fertilizer sample
3. Dissolve it in a 100ml. of 0.1N NaOH solution in a conical flask.
4. Keep funnel on the flask to avoid evaporation losses.
5. Heat the reaction mixer so that ammonium hydrolyses with evolution of ammonia gas.
6. Confirm total removal of ammonia by change in the color of yellow turmeric paper.
7. Carry out blank titration between 0.1N HCl solution and 0.1N NaOH solution.
8. Cool the reaction mixer initially prepared and titrate it against 0.1N HCl solution. Known as back titration.
9. Perform the titration until a constant burette reading is obtained.

XI Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1					
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XII Actual Procedure Followed

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XIII Precautions Followed

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XIV Observations and Calculations

For blank titration,

1. In burette – 0.1N HCl solution.
2. In conical flask -- 10ml. of 0.1N NaOH solution.
3. Indicator – Phenolphthalein.
4. End point pink to colorless.

For back titration,

1. In burette 0.1N HCl solution.
2. In conical flask -- 100 ml. of prepared reaction mixture.
3. Indicator – Phenolphthalein.
4. End point -- colorless to pink.

The reaction are,

$HCl + NaOH = Nacl + H_2O$

$(NH_4)_2SO_4 + 2NaOH = 2NH_3 + Na_2SO_4 + H_2O$

Burette Reading

For blank titration

Reading	Burette reading in ml.			Constant burette Reading ml.
	I	II	III	X ml.
Initial				
Final				
Difference				

For back titration

Reading	Burette reading in ml.			Constant burette Reading ml.
	I	II	III	X_2 ml.
Initial				
Final				
Difference				

Sample calculations

1. Constant burette reading for blank titration = X ml.

   This is valume of 0.1N HCl solution consumed for 10ml. of 0.1N NaOH solution

   Therefore,

For 100ml of 0.1N NaOH solution,

$= X \times 10$ ml $= X_1$ ml of 0.1N HCl solution

2. Amount of 0.1N NaOH solution consumed,

   $A = (X_1 - X_2)$ ml.

Now

1ml of 0.1N NaOH solution

= 0.0034 gm of ammonia (for ammonium sulphate).

Therefore,

A ml of 0.1N NaOH solution

= (0.0034 x A) gm of ammonia in 0.2 gm ammonium sulphate.

= B gms.

Therefore,

Nitrogen content in given fertilizer sample,

= (Amount of nitrogen / Amount of fertilizer sample) x 100

$$= \frac{B \times (14/17) \times 100\ \%}{0.5}$$

$$= \frac{B \times 14}{0.5 \times 17} \times 100\ \%$$

XV Results

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XVI Interpretation of Results

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XVII Conclusions.

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XVIII Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

How to you detect evolution of ammonia during practical.

How to observe neutralization point during titration.

(Space for answers)

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XIX References

- www.creatingtechnology.org
- www.thechemicalengineer.com
- www.chemistry.harvard.edu

XX Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Handling of the chemicals & apparatus	20%
2	Determination of percentage purity	20%
Product Related (15 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. ……..
2. …….
3. ……

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	

Practical No. 19: Determine ammonia content in given sample of ammonium phosphate. Part-I

I Practical Significance

Purity, content of compound is prime requirement in chemical industry. Such kind of test is possible using measuring instruments and using appropriate chemicals.

II Relevant Program Outcomes (POs)

PO1 ***Basic knowledge :*** *Apply knowledge of basic mathematics, sciences and basic engineering to solve the* **Chemical Engineering** *problems*

PO3 **- Experiments and practice:** *Plan to perform experiments and practices to use the results to solve technical problems related to* **Chemical Engineering**.

III Competency and Skills

- This practical is expected to develop the analytical skills for the industry

IV Relevant Course Outcome(s)

- Select the raw material for Phosphate based fertilizer manufacturing

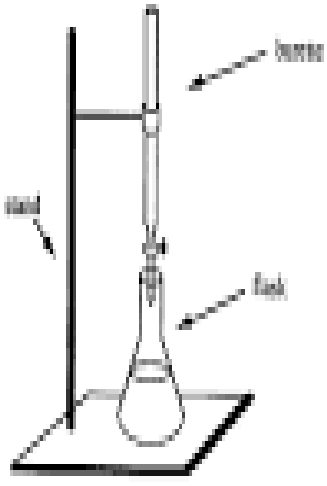
V Practical Outcome

Determine ammonia content in given sample of ammonium phosphate

VI Minimum Theoretical Background

It is the percentage presence of the a ammonia in the ammonium phosphate.

VII Setup



VIII Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Thermometer	0to110	1 No.
2	Weighing balance	0.1to200grms	1 No.
3	beaker	100ml	1 No.
4	Volumetric flask	250ml	1 No.
5	Pipette	10ml	1 No
6	Burette	25ml	1 No
7	Conical flask	250m	1 No

IX Precautions to be Followed

Use apron while doing practical's.
Don't touch concentrate chemicals.

X Procedure

1. Wash the glassware with water.
2. Weight accurately 0.2 gms . of ammonium phosphate fertilizer sample
3. Dissolve it in a 100ml. of 0.1N NaOH solution in a conical flask.
4. Keep funnel on the flask to avoid evaporation losses.
5. Heat the reaction mixer so that ammonium phoslphate hydrolyses with evolution of ammonia gas.
6. Confirm total removal of ammonia by change in the color of yellow turmeric paper.
7. Carry out blank titration between 0.1N HCl solution and 0.1N NaOH solution.
8. Cool the reaction mixer initially prepared and titrate it against 0.1N HCl solution. Known as back titration.
9. Perform the titration until a constant burette reading is obtained.

XI Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1					
2					
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XII Actual Procedure Followed

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XIII Precautions Followed

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XIV Observations and Calculations

For blank titration:

1. In burette – 0.1N HCl solution.
2. In conical flask -- 10ml. of 0.1N NaOH solution.
3. Indicator – Phenolphthalein.
4. End point- pink to colourless.

For back titration:

1. In burette 0.1N HCl solution.
2. In conical flask -- 100 ml. of prepared reaction mixture.
3. Indicator – Phenolphthalein.
4. End point -- colourless to pink.

The reaction are,

$HCl + NaOH = NaCl + H_2O$

$(NH_4)_3PO_4 + 2NaOH \rightarrow 2NH_3 + Na_2PO_4 + 3H_2O$

Burette Reading

For blank titration

Reading	**Burette reading in ml.**			**Constant burette Reading ml.**
	I	**II**	**III**	**X ml.**
Initial				
Final				
Difference				

For back titration

Reading	**Burette reading in ml.**			**Constant burette Reading ml.**
	I	**II**	**III**	**X_2 ml.**
Initial				
Final				
Difference				

Sample calculations

1. Constant burette reading for blank titration = X ml.

   This is volume of 0.1N HCl solution consumed for 10ml. of 0.1N NaOH solution

   Therefore,

For 100ml of 0.1N NaOH solution,

= X x 10 ml = X_1 ml of 0.1N HCl solution

2. Amount of 0.1N NaOH solution consumed,

   A = ($X_1 - X_2$) ml.

   Now

   1ml of 0.1N NaOH solution

   = 0.0034 gm of ammonia (for ammonium phosphate).

Therefore,

A ml of 0.1N NaOH solution

= (0.0034 x A) gm of ammonia in 0.2 gm ammonium phosphate.

= B gms.

Therefore,

Nitrogen content in given fertilizer sample,

= (Amount of nitrogen / Amount of fertilizer sample) x 100

XV Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1					
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3					

XVI Actual Procedure Followed

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XVII Precautions Followed

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XVIII Results

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XIX Interpretation of Results

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XX Conclusions

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XXI Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

Give importance of phosphatic fertilizer.

How to observe neutralization point during titration.

(Space for answers)

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XXII References

- www.creatingtechnology.org
- www.thechemicalengineer.com
- www.chemistry.harvard.edu

XXIII Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Handling of the chemicals & apparatus	20%
2	Determination of percentage purity	20%
Product Related (15 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. ……..
2. …….
3. ……

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	

Practical No. 20: Determine ammonia content in given sample of ammonium phosphate. Part-II

I Practical Significance

Purity, content of compound prime requirement in chemical industry. Such kind of test possible using measuring instruments and using appropriate chemicals.

II Relevant Program Outcomes (POs)

PO1 ***Basic knowledge :*** *Apply knowledge of basic mathematics, sciences and basic engineering to solve the* **Chemical Engineering** *problems*

PO3 **- Experiments and practice:** *Plan to perform experiments and practices to use the results to solve technical problems related to* **Chemical Engineering**.

III Competency and Skills

- This practical is expected to develop the analytical skills for the industry

IV Relevant Course Outcome(s)

- Select the raw material for Phosphate based fertilizer manufacturing

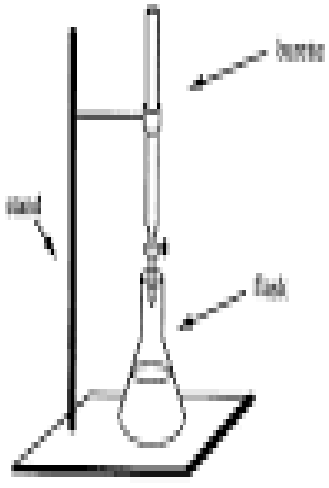
V Practical Outcome

Determine ammonia content in given sample of ammonium phosphate

VI Minimum Theoretical Background

It is the percentage presence of the a ammonia in the ammonium phosphate.

VII Setup



VIII Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Thermometer	0to110	1 No.
2	Weighing balance	0.1to200grms	1 No.
3	beaker	100ml	1 No.
4	Volumetric flask	250ml	1 No.
5	Pipette	10ml	1 No
6	Burette	25ml	1 No
7	Conical flask	250m	1 No

IX Precautions to be Followed

Use apron while doing practical's.
Don't touch concentrate chemicals.

X Procedure

1. Wash the glassware with water.
2. Weight accurately 0.2 gms . of ammonium phosphate fertilizer sample
3. Dissolve it in a 100ml. of 0.1N NaOH solution in a conical flask.
4. Keep funnel on the flask to avoid evaporation losses.
5. Heat the reaction mixer so that ammonium phoslphate hydrolyses with evolution of ammonia gas.
6. Confirm total removal of ammonia by change in the color of yellow turmeric paper.
7. Carry out blank titration between 0.1N HCl solution and 0.1N NaOH solution.
8. Cool the reaction mixer initially prepared and titrate it against 0.1N HCl solution. Known as back titration.
9. Perform the titration until a constant burette reading is obtained.

XI Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1					
2					
3					

XII Actual Procedure Followed

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XIII Precautions Followed

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XIV Observations and Calculations

For blank titration:

1. In burette – 0.1N HCl solution.
2. In conical flask -- 10ml. of 0.1N NaOH solution.
3. Indicator – Phenolphthalein.
4. End point- pink to colourless.

For back titration:

1. In burette 0.1N HCl solution.
2. In conical flask -- 100 ml. of prepared reaction mixture.
3. Indicator – Phenolphthalein.
4. End point -- colourless to pink.

The reaction are,

$HCl + NaOH = NaCl + H_2O$

$(NH_4)_2SO_4 + 2NaOH = 2NH_3 + Na_2SO_4 + H_2O$

Burette Reading

For blank titration

Reading	Burette reading in ml.			Constant burette Reading ml.
	I	II	III	X ml.
Initial				
Final				
Difference				

For back titration

Reading	Burette reading in ml.			Constant burette Reading ml.
	I	II	III	X_2 ml.
Initial				
Final				
Difference				

Sample calculations:

1. Constant burette reading for blank titration = X ml.

   This is valume of 0.1N HCl solution consumed for 10ml. of 0.1N NaOH solution

   Therefore,

   For 100ml of 0.1N NaOH solution,

   = X x 10 ml = X_1 ml of 0.1N HCl solution

2. Amount of 0.1N NaOH solution consumed,

   A = ($X_1 - X_2$) ml.

   Now

   1ml of 0.1N NaOH solution

   = 0.0034 gm of ammonia (for ammonium phosphate).

Therefore,

A ml of 0.1N NaOH solution

= (0.0034 x A) gm of ammonia in 0.2 gm ammonium phosphate.

= B gms.

Therefore,

Nitrogen content in given fertilizer sample,

= (Amount of nitrogen / Amount of fertilizer sample) x 100

$$= \frac{Bx\ (14/17)\ x\ 100\ \%}{0.2}$$

$$= \frac{B \times 14 \times 100\ \%}{0.2 \times 17}$$

XV Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1					
2					
3					

XVI Actual Procedure Followed

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XVII Precautions Followed

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XVIII Results

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XIX Interpretation of Results

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XX Conclusions

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XXI Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

Give importance of phosphatic fertilizer.

How to observe neutralization point during titration.

(Space for answers)

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XXII References

- www.creatingtechnology.org
- www.thechemicalengineer.com
- www.chemistry.harvard.edu

XXIII Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Handling of the chemicals & apparatus	20%
2	Determination of percentage purity	20%
Product Related (15 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. ……..
2. …….
3. ……

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	

Practical No.21: Determine the percentage of C_aO in given sample of lime stone. Part-I

I Practical Significance

Purity, content of compound is prime requirement in chemical industry. Such kind of test is possible using measuring instruments and using appropriate chemicals.

II Relevant Program Outcomes (POs)

PO1 ***Basic knowledge :*** *Apply knowledge of basic mathematics, sciences and basic engineering to solve the* **Chemical Engineering** *problems*

PO3 **- Experiments and practice:** *Plan to perform experiments and practices to use the results to solve technical problems related to* **Chemical Engineering**.

III Competency and Skills

- This practical is expected to develop the qualitative skills for the industry .

IV Relevant Course Outcome(s)

- Synthesis the Cement of known composition

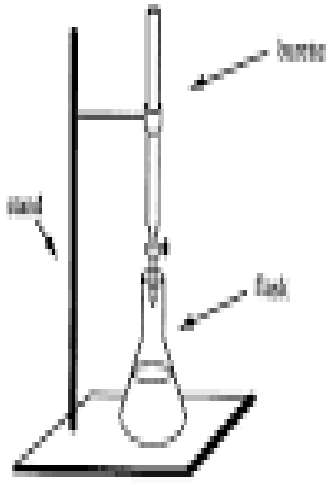
V Practical Outcome

Determine the percentage of C_aO in given sample of lime stone

VI Minimum Theoretical Background

There is a need for quality control to make sure the life of building.

VII Setup



VIII Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Thermometer	0to110	1 No.
2	Weighing balance	0.1to200grms	1 No.
3	beaker	100ml	1 No.
4	Volumetric flask	250ml	1 No.

5	Pipette	10ml	1 No
6	Burette	25ml	1 No
7	Conical flask	250m	1 No

IX Precautions to be Followed

Use apron while doing practical's.
Don't touch concentrate chemicals.

X Procedure

A mixture of exactly 10g of each sample and 1.0g of ammonium chloride was dissolved in 10ml of conc.HCl : the solution was gently heated for 20min.Boiled water was carefully poured down to the solution: subsequently the solution was filtered into a 500ml volumetric flask and the residue was washed several times with hot water, the filtrate was made up to the mark with distilled water and allowed to cool.50ml of the cooled solution above was pipette into a 250ml. beaker,10ml of 50% triethanomine and 20ml of 50 % ammonia solution were added. The resulting solution was titrated against 0.025M disodium ethylene diamine terta acetic solution. Methythmol blue is used as indicator. The procedure is repeated for MgO. Hence, 20% potassium hydroxide is used instead of 50% ammonia solution and calcein powder is used as indicator.

Calculation

% of CaO = axbx100/W.
Where a --- CaO Titre value.
b — CaO Factor (1.4287)
W — Wt. of the sample.

%MgO = cxb/W
Where c — MgO Titre –CaO Titre value
b — MgO Factor(2.951)
W—Wt. of sample.

XI Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1					
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XII Actual Procedure Followed

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XIII Precautions Followed

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XIV Results

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XV Interpretation of Results

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XVI Conclusions

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XVII Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

Write type of cement?

How to observe neutralization point during titration.

(Space for answers)

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XVIII References

- www.creatingtechnology.org
- www.thechemicalengineer.com
- www.chemistry.harvard.edu

XIX Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Handling of the chemicals & apparatus	20%
2	Determination of percentage purity	20%
Product Related (15 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. ……..
2. …….
3. ……

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	

Practical No.22: Determine the percentage of CaO in given sample of lime stone. Part-II

I Practical Significance

Purity, content of compound is prime requirement in chemical industry. Such kind of test is possible using measuring instruments and using appropriate chemicals.

II Relevant Program Outcomes (POs)

PO1 ***Basic knowledge :*** *Apply knowledge of basic mathematics, sciences and basic engineering to solve the* **Chemical Engineering** *problems*

PO3 **- Experiments and practice:** *Plan to perform experiments and practices to use the results to solve technical problems related to* **Chemical Engineering**.

III Competency and Skills

- This practical is expected to develop the qualitative skills for the industry .

IV Relevant Course Outcome(s)

- Synthesis the Cement of known composition

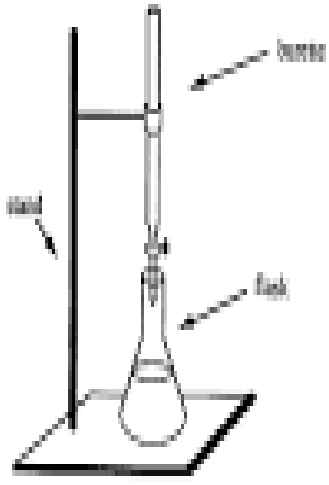
V Practical Outcome

Determine the percentage of CaO in given sample of lime stone

VI Minimum Theoretical Background

There is a need for quality control to make sure the life of building.

VII Setup



VIII Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Thermometer	0to110	1 No.
2	Weighing balance	0.1to200grms	1 No.
3	beaker	100ml	1 No.
4	Volumetric flask	250ml	1 No.
5	Pipette	10ml	1 No
6	Burette	25ml	1 No
7	Conical flask	250m	1 No

IX Precautions to be Followed

Use apron while doing practical's.
Don't touch concentrate chemicals.

X Procedure

A mixture of exactly 10g of each sample and 1.0g of ammonium chloride was dissolved in 10ml of conc.HCl : the solution was gently heated for 20min.Boiled water was carefully poured down to the solution: subsequently the solution was filtered into a 500ml volumetric flask and the residue was washed several times with hot water,the filtrate was made up to the mark with distilled water and allowed to cool.50ml of the cooled solution above was pipette into a 250ml. beaker,10ml of 50% triethanomine and 20ml of 50 % ammonia solution were added. The resulting solution was titrated against 0.025M disodium ethylene diamine terta acetic solution. Methythmol blue is used as indicator. The procedure is repeated for MgO. Hence, 20% potassium hydroxide is used instead of 50% ammonia solution and calcein powder is used as indicator.

Calculation

% of CaO = axbx100/W.
Where a--- CaO Titre value.
b—CaO Factor (1.4287)
W—Wt. of the sample.

%MgO =cxb/W
Where c — MgO Titre –CaO Titre value
b — MgO Factor(2.951)
W — Wt. of sample.

XI Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1					
2					
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XII Actual Procedure Followed

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XIII Precautions Followed

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XIV Results

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XV Interpretation of Results

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XVI Conclusions

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XVII Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

Write type of cement?

How to observe neutralization point during titration.

(Space for answers)

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XVIII References

- www.creatingtechnology.org
- www.thechemicalengineer.com
- www.chemistry.harvard.edu

XIX Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Handling of the chemicals & apparatus	20%
2	Determination of percentage purity	20%
Product Related (15 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. ……..
2. …….
3. ……

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	

Practical No. 23: Determined the percentage purity of given sample of caustic soda. Part-I

I Practical Significance

Purity, content of compound is prime requirement in chemical industry. Such kind of test is possible using qualitative analysis.

II Relevant Program Outcomes (POs)

PO1 ***Basic knowledge :*** *Apply knowledge of basic mathematics, sciences and basic engineering to solve the* **Chemical Engineering** *problems*

PO3 **- Experiments and practice:** *Plan to perform experiments and practices to use the results to solve technical problems related to* **Chemical Engineering**.

III Competency and Skills

- This practical is expected to develop the qualitative skills for the industry .

IV Relevant Course Outcome(s)

Prepare Caustic soda in chemical process industries

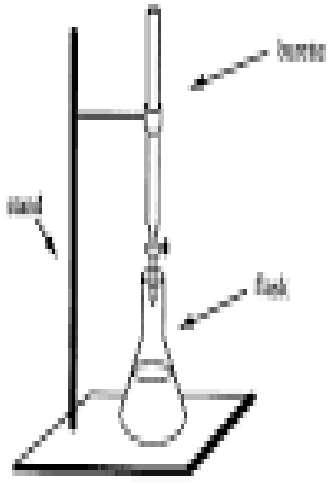
V Practical Outcome

Determined the percentage purity of given sample of caustic soda.

VI Minimum Theoretical Background

Higher is the proportion of sodium hydroxide and lower is the proportion of sodium carbonate in the sample, higher s the purity & quality of given sample of caustic soda.

VII Setup



VIII Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Thermometer	0to110	1 No.
2	Weighing balance	0.1to200grms.	1 No.
3	beaker	100ml	1 No.
4	Volumetric flask	250ml	1 No.
5	Pipette	10ml	1 No
6	Burette	25ml	1 No
7	Conical flask	250m	1 No

IX Precautions to be Followed

Use apron while doing practical's.
Don't touch concentrate chemicals.

X Procedure

1. Wash the 100 ml. volumetric flask.
2. Weight accurately 2.0gms of the given caustic soda sample on a Petri dish.
3. Dissolve the weighted sample in 30 to 50 ml. of distilled water, allow the solution to cool and then transfer the solution to 100 ml. volumetric flask to be diluted to 100 ml. mark with distilled water.

Perform the titration:

1. Pipette out 10 ml. of the prepared alkaline solution of caustic soda in a conical flask.
2. Add 10 ml. 10 % Barium chloride solution to the conical flask.
3. Allow the formed Barium carbonate precipitate to settle.
4. Fill in the burette with 0.1N HCl solution to the mark.
5. Add 2 to 3 drops of phenolphthalein indicator to the conical flask.
6. Titrate the alkaline solution from the conical flask against 0.1N HCl solution from the burette.
7. The end point of titration is from colorless to pink.
8. Record the volume of 0.1N HCl solution consumed from the burette.
9. Perform the titration until a constant burette reading is obtained.

XI Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1					
2					
3					

XII Actual Procedure Followed

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XIII Precautions Followed

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XIV Observations and Calculations

1 Weight of caustic soda sample taken on a petri dish 2.0gms.

2 Volume of diluted alkaline sodium of caustic soda prepared :100 ml.

3 In burette : 0.1N HCl solution.

4 In conical flask: 10 ml. of alkaline sodium to which 10 ml of 10 % $BaCl_2$ solution is added.

5. Indictor used: Phenolphthalein.

6. End point: colorless to pink.

* Reaction Occurring:

1. $NaOH + HCl \rightarrow NaCl + H_2O$

2. $Na_2CO_3 + BaCl_2 \rightarrow BaCO_3 + 2NaCl$

Burette Reading

Reading	Burette reading in ml.			Constant burette Reading ml.
	I	II	III	
Initial				
Final				
Difference				

Sample calculations

We have,

1ml of 0.1 N HCl = 0.004gm of NaOH

Therefore,

‘ X ’ml of 0.1N HCl = ‘ X ‘x 0.004gm of NaOH

‘ A ‘ gm of NaOH

Now

‘ A ‘ gm of NaOH is present in 10ml of dilute alkaline solution of caustic soda sample.

Therefore,

100 ml of dilute alkaline solution contains,

10X ‘A’ gm of NaOH

And this is present in 2.0 gm of caustic soda sample.

Percantage of NaOH present,

$$NaOH = \frac{10 \times A}{2} \times 100$$

XV Results

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XVI Interpretation of Results

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XVII Conclusions

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XVIII Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

What are the impurities in commercial grade caustic soda.

How to observe neutralization point during titration.

(Space for answers)

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XIX References

- www.creatingtechnology.org
- www.thechemicalengineer.com
- www.chemistry.harvard.edu

XX Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Handling of the chemicals & apparatus	20%
2	Determination of percentage purity	20%
Product Related (15 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. ……..
2. …….
3. ……

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	

Practical No. 24: Determined the percentage purity of given sample of caustic soda. Part-II

I Practical Significance

Purity, content of compound is prime requirement in chemical industry. Such kind of test is possible using qualitative analysis.

II Relevant Program Outcomes (POs)

PO1 ***Basic knowledge :*** *Apply knowledge of basic mathematics, sciences and basic engineering to solve the* **Chemical Engineering** *problems*

PO3 **- Experiments and practice:** *Plan to perform experiments and practices to use the results to solve technical problems related to* **Chemical Engineering**.

III Competency and Skills

- This practical is expected to develop the qualitative skills for the industry .

IV Relevant Course Outcome(s)

Prepare Caustic soda in chemical process industries

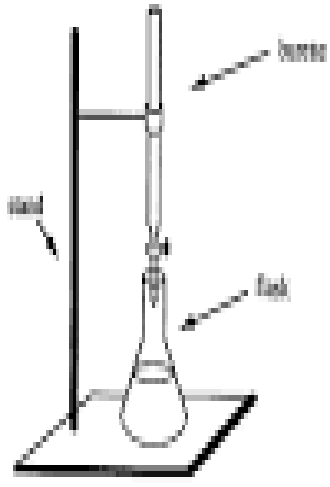
V Practical Outcome

Determined the percentage purity of given sample of caustic soda.

VI Minimum Theoretical Background

Higher is the proportion of sodium hydroxide and lower is the proportion of sodium carbonate in the sample, higher s the purity & quality of given sample of caustic soda.

VII Setup



VIII Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Thermometer	0to110	1 No.
2	Weighing balance	0.1to200grms.	1 No.
3	beaker	100ml	1 No.
4	Volumetric flask	250ml	1 No.
5	Pipette	10ml	1 No
6	Burette	25ml	1 No
7	Conical flask	250m	1 No

IX Precautions to be Followed

Use apron while doing practical's.
Don't touch concentrate chemicals.

X Procedure

1. Wash the 100 ml. volumetric flask .
2. Weight accurately 5.0gms of the given caustic soda sample on a Petri dish.
3. Dissolve the weighted sample in 30 to 50 ml. of distilled water, allow the solution to cool and then transfer the solution to 100 ml. volumetric flask to be diluted to 100 ml. mark with distilled water.

Perform the titration:

1. Pipette out 10 ml. of the prepared alkaline solution of caustic soda in a conical flask.
2. Add 10 ml. 10 % Barium chloride solution to the conical flask.
3. Allow the formed Barium carbonate precipitate to settle.
4. Fill in the burette with 0.1N HCl solution to the mark.
5 Add 2 to 3 drops of phenolphthalein indicator to the conical flask.
6. Titrate the alkaline solution from the conical flask against 0.1N HCl solution from the burette.
7. The end point of titration is from colorless to pink.
8. Record the volume of 0.1N HCl solution consumed from the burette.
9. Perform the titration until a constant burette reading is obtained.

XI Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
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2					
3					

XII Actual Procedure Followed

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XIII Precautions Followed

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XIV Observations and Calculations

1 Weight of caustic soda sample taken on a petri dish 5.0gms.

2 Volume of diluted alkaline sodium of caustic soda prepared :100 ml.

3 In burette : 0.1N HCl solution.

4 In conical flask: 10 ml. of alkaline sodium to which 10 ml of 10 % $BaCl_2$ solution is added.

5. Indictor used: Phenolphthalein.

6. End point: colorless to pink.

* Reaction Occurring:

1. $NaOH + HCl \rightarrow NaCl + H_2O$

2. $Na_2Co_3 + BaCl_2 \rightarrow BaCO_3 + 2NaCl$

Burette Reading

Reading	Burette reading in ml.			Constant burette Reading ml.
	I	II	III	
Initial				
Final				
Difference				

Sample calculations

We have,

1ml of 0.1 N HCl = 0.004gm of NaOH

Therefore,

‘ X ’ml of 0.1N HCl = ‘ X ‘x 0.004gm of NaOH

‘ A ‘ gm of NaOH

Now

‘ A ‘ gm of NaOH is present in 10ml of dilute alkaline solution of caustic soda sample.

Therefore,

100 ml of dilute alkaline solution contains,

10X ‘A’ gm of NaOH

And this is present in 5.0 gm of caustic soda sample.

Percantage of NaOH present,

$$NaOH = \frac{10 \times A}{5} \times 100$$

XV Results

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XVI Interpretation of Results

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XVII Conclusions

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XVIII Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

What are the impurities in commercial grade caustic soda.

How to observe neutralization point during titration.

(Space for answers)

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XIX References

- www.creatingtechnology.org
- www.thechemicalengineer.com
- www.chemistry.harvard.edu

XX Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Handling of the chemicals & apparatus	20%
2	Determination of percentage purity	20%
Product Related (15 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. ……..
2. …….
3. ……

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	

Practical No. 25: Determined percentage purity of given sample of soda ash. Part-I

I Practical Significance

Purity, content of compound is prime requirement in chemical industry. Such kind of test is possible using measuring instruments ,and using appropriate chemicals.

II Relevant Program Outcomes (POs)

PO1 ***Basic knowledge :*** *Apply knowledge of basic mathematics, sciences and basic engineering to solve the* **Chemical Engineering** *problems*

PO3 **- Experiments and practice:** *Plan to perform experiments and practices to use the results to solve technical problems related to* **Chemical Engineering**.

III Competency and Skills

- This practical is expected to develop the analytical skills for the industry

IV Relevant Course Outcome(s)

- Prepare soda ash in chemical process industries

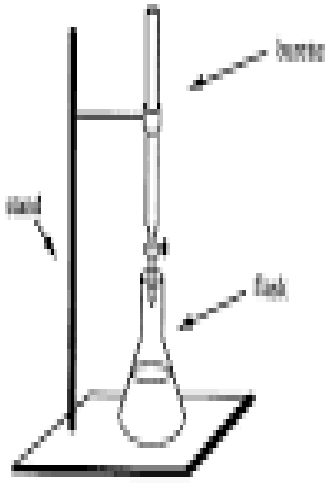
V Practical Outcome

Determined percentage purity of given sample of soda ash

VI Minimum Theoretical Background

It is the percentage presence of total sodium carbonate in the given soda ash sample, the impurity being mainly the presence of sodium chloride and other sodium salts along with.

VII Setup



VIII Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Thermometer	0to110	1 No.
2	Petri dish	Small size	1 No.
3	beaker	100ml	1 No.
4	Volumetric flask	250ml	1 No.
5	Pipette	10ml	1 No
6	Burette	25ml	1 No
7	Conical flask	250m	1 No

IX Precautions to be Followed

Use apron while doing practical's.
Don't touch concentrate chemicals.

X Procedure

1. Wash the 100 ml. volumetric flask .
2. Weight accurately 2. 0 gms of the given soda ash sample on a petri dish.
3. Dissolve the weighted sample in 30 to 50 ml. of distilled water, allow the solution to cool and then transfer the solution to 100 ml. volumetric flask to be diluted to 100 ml. mark with distilled water.

Perform the titration

1. Pipette out 10 ml. of the prepared solution of soda ash in a conical flask.
2. Add 2 to 3 drops of Methyl orange indicator to the conical flask.
3. Fill in the burette with 0.1N HCl solution to the mark.
4. Titrate the solution from the conical flask against 0.1N HCl solution from the burette.
5. The end point of titration is from yellow to red.
6. Record the volume of 0.1N HCl solution consumed from the burette.
7. Perform the titration until a constant burette reading is obtained.

XI Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1					
2					
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XII Actual Procedure Followed

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XIII Precautions Followed

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XIV Observations and Calculations

1. Weight of soda ash sample taken on a petri dish 2.0gms.
2. Volume of diluted soda ash prepared :100 ml.
3. In burette : 0.1N HCl solution.
4. In conical flask: 10 ml. of soda ash sample.
5. Indictor used: Methyl orange .
6. End point: yellow to red.

* Reaction Occurring:

1. $Na_2CO_3 + 2HCl$ ---- $CO_2 + H_2O + 2NaCl$

Burette Reading

Reading	Burette reading in ml.			Constant burette Reading Difference in ml.
	I	II	III	
Initial				
Final				
Difference				

Mean Burette reading ‘ x’ ml

Sample calculations :

We have,

1ml of 0.1 N HCl = 0.0053 gm of Na_2CO_3

Therefore,

‘ X ’ml of 0.1N HCl = ‘ X ‘x 0.0053 gm of Na_2CO_3

‘ A ‘ gm of Na_2CO_3

Now

‘ A ‘ gm of Na_2CO_3 is present in 10ml of dilute alkaline solution of soda ash sample.

Therefore,

100 ml of dilute alkaline solution contains,

10X ‘A’ gm of Na_2CO_3

And this is present in 2.0 gm of soda ash sample.

Percent total of Na_2CO_3 present

$$\% Na_2CO_3 = \frac{Na_2CO_3 \text{ present in gm}}{\text{Gm of soda ash sample}} \times 100$$

$$\% \text{ of } Na_2CO_3 = \frac{10 \times A}{2} \times 100$$

XV Results

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XVI Interpretation of Results

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XVII Conclusions

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XVIII Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1 Why the purity of soda ash is to be determined?

2 What are the impurities in commercial grade soda ash

(Space for answers)

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XIX References

- www.creatingtechnology.org
- www.thechemicalengineer.com
- www.chemistry.harvard.edu

XX Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Handling of the chemicals & apparatus	20%
2	Determination of percentage purity	20%
Product Related (15 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. ……..
2. …….
3. ……

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	

Practical No. 26: Determined percentage purity of given sample of soda ash. Part-II

I Practical Significance

Purity, content of compound is prime requirement in chemical industry. Such kind of test is possible using measuring instruments ,and using appropriate chemicals.

II Relevant Program Outcomes (POs)

PO1 ***Basic knowledge :*** *Apply knowledge of basic mathematics, sciences and basic engineering to solve the* **Chemical Engineering** *problems*

PO3 **- Experiments and practice:** *Plan to perform experiments and practices to use the results to solve technical problems related to* **Chemical Engineering**.

III Competency and Skills

- This practical is expected to develop the analytical skills for the industry

IV Relevant Course Outcome(s)

- Prepare soda ash in chemical process industries

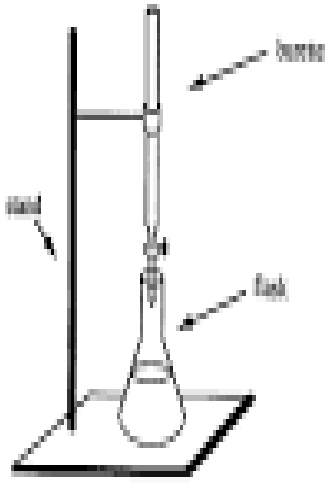
V Practical Outcome

Determined percentage purity of given sample of soda ash

VI Minimum Theoretical Background

It is the percentage presence of total sodium carbonate in the given soda ash sample, the impurity being mainly the presence of sodium chloride and other sodium salts along with.

VII Setup



VIII Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Thermometer	0to110	1 No.
2	Petri dish	Small size	1 No.
3	beaker	100ml	1 No.
4	Volumetric flask	250ml	1 No.
5	Pipette	10ml	1 No
6	Burette	25ml	1 No
7	Conical flask	250m	1 No

IX Precautions to be Followed

Use apron while doing practical's.
Don't touch concentrate chemicals.

X Procedure

1. Wash the 100 ml. volumetric flask .
2. Weight accurately 5 gms of the given soda ash sample on a petri dish.
3. Dissolve the weighted sample in 30 to 50 ml. of distilled water, allow the solution to cool and then transfer the solution to 100 ml. volumetric flask to be diluted to 100 ml. mark with distilled water.

Perform the titration

1. Pipette out 10 ml. of the prepared solution of soda ash in a conical flask.
2. Add 2 to 3 drops of Methyl orange indicator to the conical flask.
3. Fill in the burette with 0.1N HCl solution to the mark.
4. Titrate the solution from the conical flask against 0.1N HCl solution from the burette.
5. The end point of titration is from yellow to red.
6. Record the volume of 0.1N HCl solution consumed from the burette.
7. Perform the titration until a constant burette reading is obtained.

XI Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1					
2					
3					

XII Actual Procedure Followed

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XIII Precautions Followed

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XIV Observations and Calculations

1. Weight of soda ash sample taken on a petri dish 5 gms.
2. Volume of diluted soda ash prepared :100 ml.
3. In burette : 0.1N HCl solution.
4. In conical flask: 10 ml. of soda ash sample.
5. Indictor used: Methyl orange .
6. End point: yellow to red.

* Reaction Occurring:

1. $Na_2Co_3 + 2HCL$ ---- $CO_2 + H_2O + 2NaCl$

Burette Reading

Reading	Burette reading in ml.			Constant burette Reading Difference in ml.
	I	II	III	
Initial				
Final				
Difference				

Mean Burette reading ‘ x’ ml

Sample calculations

We have,

1ml of 0.1 N HCl = 0.0053 gm of Na_2CO_3

Therefore,

‘ X ’ml of 0.1N HCl = ‘ X ‘x 0.0053 gm of Na_2CO_3

‘ A ‘ gm of Na_2CO_3

Now

‘ A ‘ gm of Na_2CO_3 is present in 10ml of dilute alkaline solution of soda ash sample.

Therefore,

100 ml of dilute alkaline solution contains,

10X ‘A’ gm of Na_2CO_3

And this is present in 5 gm of soda ash sample.

Percent total of Na_2CO_3 present

$$\% Na_2CO_3 = \frac{Na_2CO_3 \text{ present in gm}}{\text{Gm of soda ash sample}} \times 100$$

$$\% Na_2CO_3 = \frac{10 \times a}{5} \times 100$$

XV Results

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XVI Interpretation of Results

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XVII Conclusions

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XVIII Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1 Why the purity of soda ash is to be determined?

2 What are the impurities in commercial grade soda ash?

(Space for answers)

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XIX References

- www.creatingtechnology.org
- www.thechemicalengineer.com
- www.chemistry.harvard.edu

XX Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Handling of the chemicals & apparatus	20%
2	Determination of percentage purity	20%
Product Related (15 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. ……..…..

2. …….

3. ……

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	

Practical No. 27: Determine the calcium content in cement. Part-I

I Practical Significance

Purity, content of compound is prime requirement in chemical industry. Such kind of test is possible using measuring instruments and using appropriate chemicals.

II Relevant Program Outcomes (POs)

PO1 ***Basic knowledge :*** *Apply knowledge of basic mathematics, sciences and basic engineering to solve the* **Chemical Engineering** *problems*

PO3 **- Experiments and practice:** *Plan to perform experiments and practices to use the results to solve technical problems related to* **Chemical Engineering**.

III Competency and Skills

- This practical is expected to develop the qualitative skills for the industry .

IV Relevant Course Outcome(s)

- Synthesis the Cement of known composition

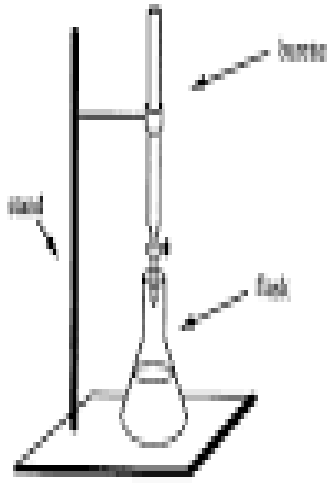
V Practical Outcome

Determine the calcium content in cement.

VI Minimum Theoretical Background

Cement is the mixture of calcium silicates and aluminates which has property of setting and hardening in presence of water.

VII Setup



VIII Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Thermometer	0to110	1 No.
2	Weighing balance	0.1to200grms.	1 No.
3	beaker	100ml	1 No.
4	Volumetric flask	250ml	1 No.
5	Pipette	10ml	1 No
6	Burette	25ml	1 No
7	Conical flask	250m	1 No

IX Precautions to be Followed

1. Use apron while doing practical's.
2. Don't touch concentrate chemicals.

X Procedure

Dissolution of cement sample

1. Weight about 1 g of cement using watch glass transfer it to 250 ml beaker.
2. Add to 10 ml of concentrated HCl and 2 ml water.
3. Heat the content on wire gauze using low flame with stirring till it dissolve.
4. Cool it to get clean solution and filter it using ordinary filter paper.
5. Collect the filtrate in 250 ml volumetric flask and dilute it up to 250 ml using distilled water. This is stock solution.
6. Pipette out 50 ml of stock solution in a beaker.
7. Add 1 ml concentrated HNO_3 and boil the solution. Then add about 1 g of NH_4Cl and one test tube of 1:1 ammonia with constant stirring.
8. Aluminum and iron will precipitate in the from of their hydroxide, filter the solution to remove ppt.
9. Collect filtrate in 250 ml volumetric flask and dilute it to 250 ml shake the solution to make it homogenous (Solution A).

Estimation of Calcium Volumetrically:

1. Pipette out 25 ml of solution A in conical flask.
2. Add 5 ml of buffer solution (pH 10) and 5 drops of EBT s an indicator.
3. Fill the burette with 0.01 M EDTA solution adjust zero mark.
4. Titrate it against standard EDTA solution till wine red colour changes to sky blue.
5. Note down the reading as pilot reading.
6. Take three more readings find out constant burette reading. Let this be 'X'.
7. Reading corresponds to both Ca and Mg, but percentage of Mg is very small so using this reading calculate percentage of Ca.

XI Observation and Calculation Table:-

OBSERVATION:-

1. Solution burette : 0.01 M EDTA solution
2. Solution in conical flask : 25 ml solution A
3. Indicator : Eriochrome Black T
4. End Point : Wine Red to sky blue

OBSERVATION TABLE:-

Burette Level	Pilot Reading	Burette Reading in ml			Constant Burette Reading in ml (X)
		I	II	III	
Initial					x=_____ml
Final					
Difference					

CALCULATIONS:-

Step-I: quantity of Ca in 25 ml of solution A:

1000 ml of 1 M EDTA = 40g of Ca

1 ml of 1 M EDTA = $\frac{40}{1000}$ g of Ca

1 ml of 0.01 M EDTA= $\frac{40 \times 0.01}{1000} \times X$ g of Ca

X ml of 0.01 M EDTA = $\frac{40 \times 0.01 \times X}{1000}$ g of Ca

X ml of 0.01 M EDTA = 4.0×10^{-4} x g of Ca

X ml of 0.01 M EDTA = 4.0×10^{-4} x_____ g of Ca

X ml of 0.01 M EDTA = _____ (y) g of Ca / 25 ml of solution A

Step-II:

Quantity of Ca in 250 ml of stock solution(or in 1 g cement)

Since, 25 ml of solution A contains = (y) g of Ca

250 ml of solution A contains = $\frac{y \times 250}{25}$ g of Ca

250 ml of solution A contains = y x 10 g of Ca

250 ml of solution A contains = _____ x 10 g of Ca

250 ml of solution A contains = _____(y) x gm of Ca

But 250 ml of solution A is prepared by dilution of 50 ml stock solution.

50 ml of stock solution contains = (z) g of Ca

250 ml of stock solution (1 g cement) contains = $\frac{z \times 250}{50}$ g of Ca

250 ml of stock solution (1 g cement) contains = $\frac{\_\_\_\_ \times 250}{50}$ g of Ca

250 ml of stock solution (1 g cement) contains = (w)g of Ca

Step-III:

Percentage of Ca in cement

Since, 1 g of cement contains = w g of Ca

100 g of cement contains = $\frac{w \times 100}{1}$

100 g of cement contains = $\frac{\_\_\_\_\_ \times 100}{1}$

100 g of cement contains = _____ % of Ca

XII Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1					
2					
3					

XIII Actual Procedure Followed

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XIV Precautions Followed

Don't touch concentrate chemicals……

Wear apron while doing practical…….

XV Results

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XVI Interpretation of Results

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XVII Conclusions

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XVIII Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

Which acid is used foe dissolving cement.

What is cement.

(Space for answers)

XIX References

- www.creatingtechnology.org
- www.thechemicalengineer.com
- www.chemistry.harvard.edu

XX Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Handling of the chemicals & apparatus	20%
2	Determination of percentage purity	20%
Product Related (15 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. ……..
2. …….
3. ……

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	

Practical No. 28: Determine the calcium content in cement. Part-II

I Practical Significance

Purity, content of compound is prime requirement in chemical industry. Such kind of test is possible using measuring instruments and using appropriate chemicals.

II Relevant Program Outcomes (POs)

PO1 ***Basic knowledge :*** *Apply knowledge of basic mathematics, sciences and basic engineering to solve the* **Chemical Engineering** *problems*

PO3 **- Experiments and practice:** *Plan to perform experiments and practices to use the results to solve technical problems related to* **Chemical Engineering**.

III Competency and Skills

- This practical is expected to develop the qualitative skills for the industry .

IV Relevant Course Outcome(s)

- Synthesis the Cement of known composition

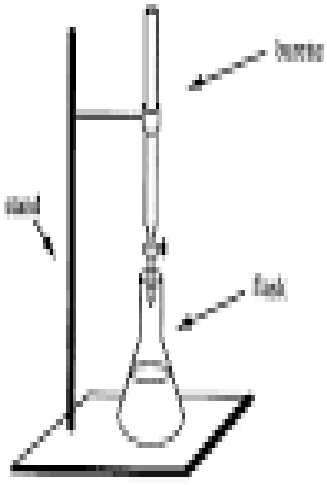
V Practical Outcome

Determine the calcium content in cement.

VI Minimum Theoretical Background

Cement is the mixture of calcium silicates and aluminates which has property of setting and hardening in presence of water.

VII Setup



VIII Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Thermometer	0to110	1 No.
2	Weighing balance	0.1to200grms.	1 No.
3	beaker	100ml	1 No.
4	Volumetric flask	250ml	1 No.
5	Pipette	10ml	1 No
6	Burette	25ml	1 No
7	Conical flask	250m	1 No

IX Precautions to be Followed

Use apron while doing practical's.
Don't touch concentrate chemicals.

X Procedure

Dissolution of cement sample

1 Weight about 2 g of cement using watch glass transfer it to 250 ml beaker.
2 Add to 10 ml of concentrated HCL and 2 ml water.
3 Heat the content on wire gauze using low flame with stirring till it dissolve.
4 Cool it to get clean solution and filter it using ordinary filter paper.
5. Collect the filtrate in 250 ml volumetric flask and dilute it up to 250 ml using distilled water. This is stock solution.
6 Pipette out 50 ml of stock solution in a beaker.
7 Add 1 ml concentrated HNO_3 and boil the solution. Then add about 1 g of NH_4Cl and one test tube of 1:1 ammonia with constant stirring.
8 Aluminum and iron will precipitate in the from of their hydroxide, filter the solution to remove ppt.
9 Collect filtrate in 250 ml volumetric flask and dilute it to 250 ml shake the solution to make it homogenous (Solution A).

Estimation of Calcium Volumetrically:

1 Pipette out 25 ml of solution A in conical flask.
2 Add 5 ml of buffer solution (pH 10) and 5 drops of EBT s an indicator.
3 Fill the burette with 0.01 M EDTA solution adjust zero mark.
4 Titrate it against standard EDTA solution till wine red colour changes to sky blue.
5 Note down the reading as pilot reading.
6 Take three more readings find out constant burette reading. Let this be 'X'.
7 Reading corresponds to both Ca and Mg, but percentage of Mg is very small so using this reading calculate percentage of Ca.

XI OBSERVATION AND CALCULATION TABLE

OBSERVATION

1. Solution burette : 0.01 M EDTA solution
2. Solution in conical flask : 25 ml solution A
3. Indicator : Eriochrome Black T

4. End Point : Wine Red to sky blue

OBSERVATION TABLE

Burette Level	Pilot Reading	Burette Reading in ml			Constant Burette Reading in ml (X)
		I	II	III	
Initial					x=_____ml
Final					
Difference					

CALCULATIONS:

Step-I: quantity of Ca in 25 ml of solution A:

1000 ml of 1 M EDTA = 40g of Ca

1 ml of 1 M EDTA = $\frac{40}{1000}$ g of Ca

1 ml of 0.01 M EDTA = $\frac{40 \times 0.01}{1000}$ g of Ca

X ml of 0.01 M EDTA = $\frac{40 \times 0.0}{1000}$ g of Ca

X ml of 0.01 M EDTA = 4.0×10^{-4} x g of Ca

X ml of 0.01 M EDTA = 4.0×10^{-4} x_____ g of Ca

X ml of 0.01 M EDTA = _____ (y) g of Ca / 25 ml of solution A

Step-II:

Quantity of Ca in 250 ml of stock solution(or in 1 g cement)

Since, 25 ml of solution A contains = (y) g of Ca

250 ml of solution A contains = $\frac{y \times 250}{25}$ g of Ca

250 ml of solution A contains = y x 10 g of Ca

250 ml of solution A contains = _____ x 10 g of Ca

250 ml of solution A contains = _____(y) x gm of Ca

But 250 ml of solution A is prepared by dilution of 50 ml stock solution.

50 ml of stock solution contains = (z) g of Ca

250 ml of stock solution (1 g cement) contains = $\frac{z \times 250}{50}$ g of Ca

250 ml of stock solution (1 g cement) contains = $\frac{\_\_\_\_ \times 250}{50}$ g of Ca

250 ml of stock solution (1 g cement) contains = (w)g of Ca

Step-III:

Percentage of Ca in cement

Since, 1 g of cement contains = w g of Ca

100 g of cement contains = $\frac{w \times 100}{1}$

100 g of cement contains = $\frac{\_\_\_\_\_ \times 100}{2}$

100 g of cement contains = _____ % of Ca

XII Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		

XIII Actual Procedure Followed

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XIV Precautions Followed

1 Don't touch concentrate chemicals……

2 Wear apron while doing practical.…….

XV Results

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XVI Interpretation of Results

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XVII Conclusions

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XVIII Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1 Which acid is used foe dissolving cement.

2 What is cement.

(Space for answers)

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XIX References

- www.creatingtechnology.org
- www.thechemicalengineer.com
- www.chemistry.harvard.edu

XX Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Handling of the chemicals & apparatus	20%
2	Determination of percentage purity	20%
Product Related (15 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. ……..
2. …….
3. ……

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	

Practical No. 29: Determine the insoluble ingredients in cement. Part-I

I Practical Significance

Purity, content of compound is prime requirement in chemical industry. Such kind of test is possible using measuring instruments and using appropriate chemicals.

II Relevant Program Outcomes (POs)

PO1 ***Basic knowledge :*** *Apply knowledge of basic mathematics, sciences and basic engineering to solve the* **Chemical Engineering** *problems.*

OP5 The engineer and society: *Assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to practice in field of* **Chemical Engineering**.

III Competency and Skills

- This practical is expected to understand the presence of soluble matter in cement.

IV Relevant Course Outcome(s)

Synthesis the Cement of known composition

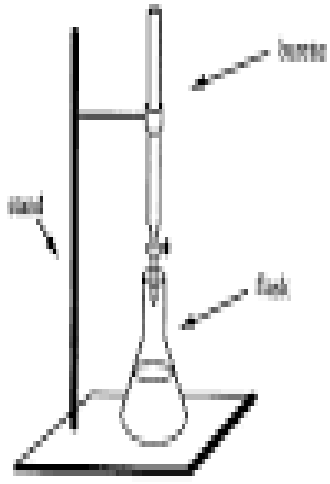
V Practical Outcome

Determine the insoluble ingredients in cement.

VI Minimum Theoretical Background

Determination of insoluble matter in cement is necessary to ascertain its quality for the use in construction industry.

VII Setup



VIII Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Thermometer	0to110	1 No.
2	Crucible	Small size	1 No.
3	beaker	100ml	1 No.
4	Volumetric flask	250ml	1 No.
5	Pipette	10ml	1 No
6	Burette	25ml	1 No
7	Conical flask	250m	1 No

IX Precautions to be Followed

Use apron while doing practical.
Don't touch concentrate chemicals.

X Procedure

1. Weigh 1.0 gm of the cement sample and transfer it to a beaker.
2. Add 25 ml. of cold water and 5 ml. of concentrated HCl to it.
3. Heat the solution and grind the contents of the beaker with glass rod.
4. Dilute the solution in the beaker to 100 ml. With water.
5. Digest the solution on steam bath for 15 minutes.
6. Cool down and filter the solid residue by using a filter paper.
7. Wash the residue on the filter paper with hot water 6 times.
8. Digest the filter paper along with the solid residue in about 30 ml. of 5 % sodium carbonate solution at a temperature just below the boiling point for 15 minutes.
9. Filter the residue again on a filter paper and wash twice with hot water.
10. Add few drops of dilute HCl (1: 9).
11. Wash the residue 8-10 times with hot water.
12. Heat the residue in a crucible to remove moisture and weigh as insoluble matter.

XI Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		

XII Actual Procedure Followed

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XIII Precautions Followed

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XIV Observations and Calculations

1. Weight of empty crucible = W_1 gms.
2. Weight of crucible + residue = W2gms.

Therefore,

Weight of insoluble matter = (W2 – W1) = W gms.

Therefore,

Percentage of insoluble matter in cement sample,

= (Weight of insoluble matter/ Weight of sample) x 100 %

= (W / 1.0) x 100 %

XV Results

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XVI Interpretation of Results

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XVII Conclusions

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XVIII Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1 What is cement?

2 What are the chemical composition of cement.

(Space for Answer)

XIX References

- www.creatingtechnology.org
- www.thechemicalengineer.com
- www.chemistry.harvard.edu

XX Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Handling of the chemicals & apparatus	20%
2	Determination of percentage purity	20%
Product Related (15 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. ……..

2. …….

3. ……

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	

Practical No. 30: Determine the insoluble ingredients in cement. Part-II

I Practical Significance

Purity, content of compound is prime requirement in chemical industry. Such kind of test is possible using measuring instruments and using appropriate chemicals.

II Relevant Program Outcomes (POs)

PO1 ***Basic knowledge :*** *Apply knowledge of basic mathematics, sciences and basic engineering to solve the* **Chemical Engineering** *problems*.

PO5 ***The engineer and society:*** *Assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to practice in field of* **Chemical Engineering**.

III Competency and Skills

- This practical is expected to understand the presence of soluble matter in cement.

IV Relevant Course Outcome(s)

Synthesis the Cement of known composition

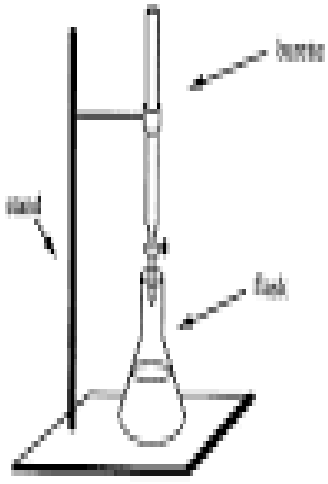
V Practical Outcome

Determine the insoluble ingredients in cement.

VI Minimum Theoretical Background

Determination of insoluble matter in cement is necessary to ascertain its quality for the use in construction industry.

VII Setup



VIII Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Thermometer	0to110	1 No.
2	Crucible	Small size	1 No.
3	beaker	100ml	1 No.
4	Volumetric flask	250ml	1 No.
5	Pipette	10ml	1 No
6	Burette	25ml	1 No
7	Conical flask	250m	1 No

IX Precautions to be Followed

Use apron while doing practical.
Don't touch concentrate chemicals.

X Procedure

1. Weigh 2.0 gm of the cement sample and transfer it to a beaker.
2. Add 25 ml. of cold water and 5 ml. of concentrated HCl to it.
3. Heat the solution and grind the contents of the beaker with glass rod.
4. Dilute the solution in the beaker to 100 ml. With water.
5. Digest the solution on steam bath for 15 minutes.
6. Cool down and filter the solid residue by using a filter paper.
7. Wash the residue on the filter paper with hot water 6 times.
8. Digest the filter paper along with the solid residue in about 30 ml. of 5 % sodium carbonate solution at a temperature just below the boiling point for 15 minutes.
9. Filter the residue again on a filter paper and wash twice with hot water.
10. Add few drops of dilute HCl (1: 9).
11. Wash the residue 8-10 times with hot water.
12. Heat the residue in a crucible to remove moisture and weigh as insoluble matter.

XI Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		

XII Actual Procedure Followed

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XIII Precautions Followed

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XIV Observations and Calculations

1. Weight of empty crucible = W_1 gms.
2. Weight of crucible + residue = W2gms.

Therefore,

Weight of insoluble matter = (W2 – W1) = W gms.

Therefore,

Percentage of insoluble matter in cement sample,

= (Weight of insoluble matter/ Weight of sample) x 100 %

= (W / 2.0) x 100 %

XV Results

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XVI Interpretation of Results

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XVII Conclusions

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XVIII Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. What is cement?

2. What are the chemical composition of cement.

(Space for answers)

XIX References

- www.creatingtechnology.org
- www.thechemicalengineer.com
- www.chemistry.harvard.edu

XX Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Handling of the chemicals & apparatus	20%
2	Determination of percentage purity	20%
Product Related (15 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. ……..
2. …….
3. ……

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	

Practical No. 31: Determine the carbon Dioxide from given sample of water. Par-I

I Practical Significance

Purity, content of compound is prime requirement in chemical industry. Such kind of test is possible using measuring instruments like , thermometer ,and using appropriate chemicals.

II Relevant Program Outcomes (POs)

PO1 ***Basic knowledge :*** *Apply knowledge of basic mathematics, sciences and basic engineering to solve the* **Chemical Engineering** *problems*

PO3 **- Experiments and practice:** *Plan to perform experiments and practices to use the results to solve technical problems related to* **Chemical Engineering**.

III Competency and Skills

- This practical is expected to develop the qualitative skills for the industry.

IV Relevant Course Outcome(s)

Manufacture industrially important gases.

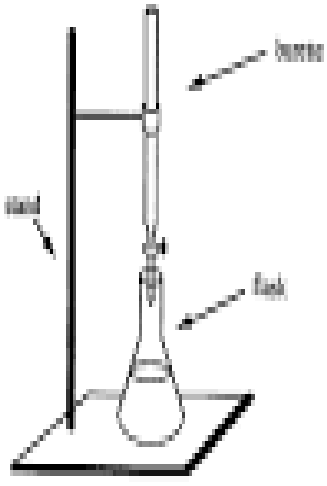
V Practical Outcome

Determine the carbon Dioxide from given sample of water

VI Minimum Theoretical Background

To know the dissolved carbon dioxide in water

VII Setup



VIII Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Thermometer	0to110	1 No.
2	Hach Kit	Model-ca-23	1 No.
3	beaker	100ml	1 No.
4	Volumetric flask	250ml	1 No.
5	Pipette	10ml	1 No
6	Burette	25ml	1 No
7	Conical flask	250m	1 No

IX Precautions to be Followed

Use apron while doing practical's.
Don't touch concentrate chemicals.

X Procedure

1. Fill the mixing bottle to the 23ml mark with the water sample
2. Add one drop of the phenolphthalein indicator solution to the sample.
3. Add the sodium hydroxide solution drop by drop to the sample. Count each drop as it is added. Swirl the bottle to mix after each drop is added. Continue adding drops until a light pink colour forms ,and persists for 30 seconds.
4. Each drop of sodium hydroxide solution used equals 1.25mg/l carbon dioxide.

OBSERVATION AND OBSERVATION TABLE

Mixing bottle-----23ml water sample
Indicator-------Phenolphthalein.
Burette-------- 1 N sodium hydroxide.

CALCULATIONS :

Each drop of sodium hydroxide solution used = 1.25mg/l carbon dioxide

XI Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		

XII Actual Procedure Followed

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XIII Precautions Followed

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XIV Results

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XV Interpretation of Results

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XVI Conclusions

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XVII Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

What is the source of CO2 in water.

How to observe neutralization point during titration.

(Space for answers)

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XVIII References

- www.creatingtechnology.org
- www.thechemicalengineer.com
- www.chemistry.harvard.edu

XIX Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Handling of the chemicals & apparatus	20%
2	Determination of percentage purity	20%
Product Related (15 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. ……..

2. ……..…….

3. ……

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	

Practical No. 32: Determine the carbon Dioxide from given sample of water. Part-II

I Practical Significance

Purity, content of compound is prime requirement in chemical industry. Such kind of test is possible using measuring instruments like , thermometer ,and using appropriate chemicals.

II Relevant Program Outcomes (POs)

PO1 ***Basic knowledge :*** *Apply knowledge of basic mathematics, sciences and basic engineering to solve the* **Chemical Engineering** *problems*

PO3 **- Experiments and practice:** *Plan to perform experiments and practices to use the results to solve technical problems related to* **Chemical Engineering**.

III Competency and Skills

- This practical is expected to develop the qualitative skills for the industry.

IV Relevant Course Outcome(s)

Manufacture industrially important gases.

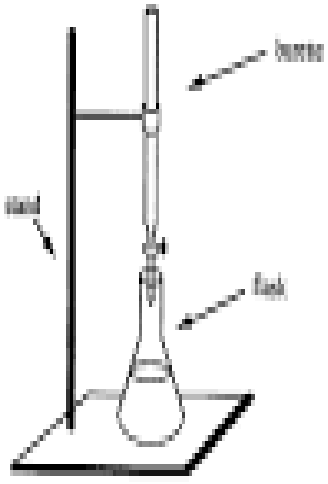
V Practical Outcome

Determine the carbon Dioxide from given sample of water

VI Minimum Theoretical Background

To know the dissolved carbon dioxide in water

VII Setup



VIII Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Thermometer	0to110	1 No.
2	Hach Kit	Model-ca-23	1 No.
3	beaker	100ml	1 No.
4	Volumetric flask	250ml	1 No.
5	Pipette	10ml	1 No
6	Burette	25ml	1 No
7	Conical flask	250m	1 No

IX Precautions to be Followed

Use apron while doing practical's.
Don't touch concentrate chemicals.

X Procedure

1 Fill the mixing bottle to the 23ml mark with the water sample
2 Add one drop of the phenolphthalein indicator solution to the sample.
3 Add the sodium hydroxide solution drop by drop to the sample. Count each drop as it is added. Swirl the bottle to mix after each drop is added. Continue adding drops until a light pink colour forms ,and persists for 30 seconds.
4 Each drop of sodium hydroxide solution used equals 1.25mg/l carbon dioxide.

OBSERVATION AND OBSERVATION TABLE

Mixing bottle-----23ml water sample
Indicator-------Phenolphthalein.
Burette-------- 1 N sodium hydroxide.

CALCULATIONS :

Each drop of sodium hydroxide solution used = 1.25mg/l carbon dioxide

XI Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		

XII Actual Procedure Followed

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XIII Precautions Followed

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XIV Results

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XV Interpretation of Results

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XVI Conclusions

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XVII Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

What is the source of CO2 in water.

How to observe neutralization point during titration.

(Space for answers)

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XVIII References

- www.creatingtechnology.org
- www.thechemicalengineer.com
- www.chemistry.harvard.edu

XIX Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Handling of the chemicals & apparatus	20%
2	Determination of percentage purity	20%
Product Related (15 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
Total (25 Marks)		**100 %**

Names of Student Team Members

1. ……..
2. …….
3. ……

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	

List Of Laboratory Manuals Developed by MSBTE

First Semester:

1	Fundamentals of ICT	22001
2	English	22101
3	English Work Book	22101
4	Basic Science (Chemistry)	22102
5	Basic Science (Physics)	22102

Second Semester:

1	Bussiness Communication Using Computers	22009
2	Computer Peripherals & Hardware Maintenace	22013
3	Web Page Design with HTML	22014
4	Applied Science (Chemistry)	22202
5	Applied Science (Physics)	22202
6	Applied Machines	22203
7	Basic Surveying	22205
8	Applied Science (Chemistry)	22211
9	Applied Science (Physics)	22211
10	Fundamental of Electrical Engineering	22212
11	Elements of Electronics	22213
12	Elements of Electrical Engineering	22215
13	Basic Electronics	22216
14	'C' programming Language	22218
15	Basic Electronics	22225
16	Programming in "C"	22226
17	Fundamentals of Chemical Engineering	22231

Third Semester:

1	Applied Multimedia Techniques	22024
2	Advanced Serveying	22301
3	Highway Engineering	22302
4	Mechanics of Structures	22303
5	Building Construction	22304
6	Concrete Technology	22305
7	Strength Of Materials	22306
8	Automobile Engines	22308
9	Automobile Transmission System	22309
10	Mechanical Operations	22313
11	Technology Of Inorganic Chemicals	22314
12	Object Oriented Programming Using C++	22316
13	Data Structure Using 'C'	22317
14	Computer Graphics	22318
15	Database Management System	22319
16	Digital Techniques	22320
17	Principles Of Database	22321
18	Digital Techniques & Microprocessor	22323
19	Electrical Circuits	22324
20	Electrical & Electronic Measurment	22325
21	Fundamental Of Power Electronics	22326
22	Electrical Materials & Wiring Practice	22328
23	Applied Electronics	22329
24	Electrical Circuits & Networks	22330
25	Electronic Measurments & Instrumentation	22333
26	Principles Of Electronics Communication	22334
27	Thermal Engineering	22337
28	Engineering Matrology	22342
29	Mechanical Engineering Materials	22343
30	Theory Of Machines	22344

Fourth Semester:

1	Hydraulics	22401
2	Geo Technical Engineering	22404
3	Chemical Process Instrumentation & Control	22407
4	Fluid Flow Operation	22409
5	Technology Of Organic Chemicals	22410
6	Java Programming	22412
7	GUI Application Development Using VB.net	22034
8	Microprocessor	22415
9	Database Managment	22416
10	Electric Motors And Transformers	22418
11	Industrial Measurements	22420
12	Digital Electronics And Microcontroller Applications	22421
13	Linear Integrated Circuits	22423
14	Microcontroller & Applications	22426
15	Basic Power Electronics	22427
16	Digital Communication Systems	22428
17	Mechanical Engineering Measurments	22443
18	Fluid Mechanics and Machinery	22445
19	Fundamentals Of Mechatronics	22048

Fifth Semester:

1	Design of Steel and RCC Structures	22502
2	Public Health Engineering	22504
3	Heat Transfer Operation	22510
4	Environmental Technology	22511
5	Operating Systems	22516
6	Advanced Java Programming	22517
7	Software Testing	22518
8	Control Systems and PLC's	22531
9	Embedded Systems	22532
10	Mobile and Wireless Communication	22533
11	Industrial Machines	22523
12	Switchgear and Protection	22524
13	Energy Conservation and Audit	22525
14	Power Engineering and Refrigeration	22562
15	Solid Modeling and Additive Manufacturing	22053
16	Guidelines & Assessment Manual for Micro Projects & Industrial Training	22057

Sixth Semester:

1	Solid Modeling	17063
2	Highway Engineering	17602
3	Contracts & Accounts	17603
4	Design of R.C.C. Structures	17604
5	Industrial Fluid Power	17608
6	Design of Machine Elements	17610
7	Automotive Electrical and Electronic Systems	17617
8	Vehicle Systems Maintenance	17618
9	Software Testing	17624
10	Advanced Java Programming	17625
11	Mobile Computing	17632
12	System Programing	17634
13	Testing & Maintenance of Electrical Equipments	17637
14	Power Electronics	17638
15	Illumination Engineering	17639
16	Power System Operation & Control	17643
17	Environmental Technology	17646
18	Mass Transfer Operation	17648
19	Advanced Communication System	17656
20	Mobile Communication	17657
21	Embedded System	17658
22	Process Control System	17663
23	Industrial Automation	17664
24	Industrial Drives	17667
25	Video Engineering	17668
26	Optical Fiber & Mobile Communication	17669
27	Therapeutic Equipment	17671
28	Intensive Care Equipment	17672
29	Medical Imaging Equipment	17673

Pharmacy Lab Manual

First Year:

1	Pharmaceutics - I	0805
2	Pharmaceutical Chemistry - I	0806
3	Pharmacognosy	0807
4	Biochemistry and Clinical Pathology	0808
5	Human Anatomy and Physiology	0809

Second Year:

1	Pharmaceutics - II	0811
2	Pharmaceutical Chemistry - II	0812
3	Pharmacology & Toxicology	0813
4	Hospital and Clinical Pharmacy	0816

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