Al-Mustansiriyah University

College of Science/Department of Chemistry

Analytical Chemistry Lab.

Second Year

Five Lecture Exp.3 /II Semester

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Experiment (3)

Water turbidity Determination by Cation Exchanger

The theoretical part

In the beginning we need to know what water turbidity, it is formed in the water by the presence of the calcium and magnesium salts dissolved in water and sometimes in the presence of the iron salts in water.

Two kinds of the water turbidity can be distinguished depending on the nature of the dissolved salts in water:

1- Temporary turbidity

It is formed in the water as a result of the containing this water on $Ca(HCO_3)_2$, $Mg(HCO_3)_2$ or both of them, these salts are decomposed

- **heating the water turbidity to the boiling point so it cause to form $CaCO_3$ and $MgCO_3$, At a result of that the temporary turbidity will be gone that known as a carbonate turbidity as in the equations.**

$$Ca(HCO_3)_2 \leftrightarrow CaCO_3 \downarrow + H_2O + CO_2$$

$$Mg(HCO_3)_2 \leftrightarrow MgCO_3 \downarrow + H_2O + CO_2$$

- **add sodium carbonate to water turbidity Where the calcium and magnesium bicarbonate dissolved in water are converted into insoluble carbonates and deposited in the solution as in the equations**

$$Ca(HCO_3)_2 + Na_2CO_3 \rightarrow CaCO_3 \downarrow + 2NaHCO_3$$

$$Mg(HCO_3)_2 + Na_2CO_3 \rightarrow MgCO_3 \downarrow + 2NaHCO_3$$

- **Ion exchange**

- **Evaporation and condensation of water**

2- Permanent turbidity

This is produced by the presence of the sulfate and chloride calcium or sulfate and chloride magnesium, dissolved in water. This turbidity cannot be removed by boiling. When the water (for example, tap water) is passed on a cation exchanger as a (H^+ - Form), the dissolved cations in the water turbidity that containing (calcium and magnesium ions) will be exchange with the hydrogen ions in the exchanger. The solution will be acids of the anions dissolved in the water .The amount of the exchange hydrogen ions can be calculated by titration the acid with a standard solution of NaOH using the methyl orange indicator.

طرق معالجة العسرة الدائمية

١- اضافة كاربونات الصوديوم والتي تتفاعل مع الاملاح المسببه للعسرة الدائمية فتحولها الى كاربونات غير ذائبة تترسب في المحلول

$$CaCl_2 + Na_2CO_3 \rightarrow CaCO_3 \downarrow + 2NaCL$$

$$MgCl_2 + Na_2CO_3 \rightarrow Mg\,CO_3 \downarrow + 2NaCL$$

٢- التبادل الايوني

Industrial Applications (deionized water)

- **The ion exchange columns are widely used in the industry for the purpose of obtaining deionized water. The method is to passes the ordinary water in a strong cation column**

(H^+ - Form), the water exited from this column is free from cations but it contains anions and hydrogen ion (acid). Then, acidic water should be passes through another separated strong anionic column as a (OH^- - Form). When water passes in this column, an exchange between the anions and the hydroxyl group (OH) will occur. The anions remain on the column resin and the hydroxyl group goes to the water, Water now contains hydrogen ion and hydroxyl ion and is free of cations and anions. as in the equations

$$R - H + CaCO_3 \rightarrow R - Ca + H_2CO_3$$ acidic water

$$R - OH + H_2CO_3 \rightarrow R - CO_3 + 2H_2O$$ deionized water: free of cations and anions.

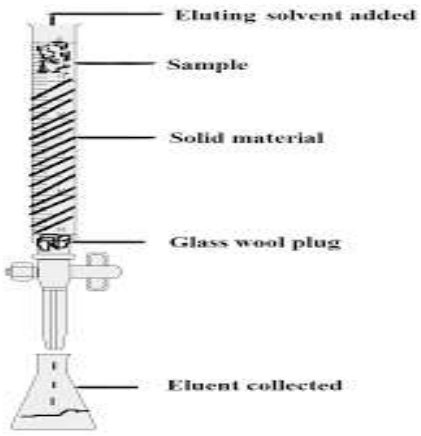
The amount of cations and anions in the prepared water in this method (deionized water) is much less than the amount of ions contained in the water prepared by water evaporation and condensation (Distilled water) using regular fumigants. The resin which used in this method can be reused after activated in the normal method.

Materials

1- HCl (3M)
2- AgNO3 (0.1 M)
3- Sample turbidity water (25ml)
4- Methyl orange (M.O) Indicator
5- Standard base NaOH (0.1N) in burette

Procedure

1. Activate the cationic column by hydrochloric acid (3M HCl), as we Know



2. Take (25ml) from the turbidity water measured by the pipette in a clean beaker, then transfer it to the cationic exchanger
3. Collect the solution from the bottom of the column (eluent solution) in the conical flask 1 and then wash the beaker with a little distilled water and transfer it to the ion exchang column.
4. Collect the first amount in conical flask1 of washing water from the column and check it by adding of the M.O indicator. when a pink color appear, transfer to conical flask2 Add another amount of the distilled water to the column and we take eluent solution it in the conical flask1, then also check it by use the M.O indicator and repeat this process until the pink color disappearance and it changes yellow color
5. Titrate the solution that collected pink color in the conical flask 2 with the sodium hydroxide NaOH (0.1N)

Calculation

نفرض الحجم النازل من السحاحة(القاعدة القياسية) والمكافئ لحجم الحامض هو 5ml

1- number of m.eq of salt

No. meq. of cation ($CaCO_3$) = No. meq. of NaOH

No. of meq.of NaOH = No. of meq. $CaCO_3$

2- wight of calcium carbonate in turbidity water?

$$\frac{N_{NaOH} \times V_{NaOH}}{1000} = \frac{Wt_{CaCO3}}{Eq.Wt_{CaCO3}}$$

3- ppm $CaCO_3$?

$$ppm = \frac{wt\ mg}{V_{L\ Sample=25ml}} \times 10^6$$

4- concentration molar [M] of $CaCO_3$?

$$ppm = M \times M.wt \times 1000$$

5- PH?

❖ ان العمود المستخدم هو كاتيوني لذلك المحلول النازل من العمود هو محلول حامضي

نقيس حجمه ونفرض 50ml (eluent solution)

No. meq. of H^+ = No. meq. of NaOH

No. meq. of H^+ = N × V = 0.1 ×5

$$[H^+] = \frac{\text{No. meq. of H +}}{V_{ml\ (eluent\ solution)}}$$

$$PH = -Log\ [H^+]$$

6- Percentage CO_3% ?

ان حجم $CaCO_3$ هو حجم النموذج اي حجم الماء العسر=25ml

نستخرج وزن $CaCO_3$ ونعتبره الراسب كما في الخطوه 2

نستخرج وزن CO_3 من العامل الوزني كما في الكورس الاول

ثم نجد النسبة المئوية لكاربونات في النموذج

Discussion questions

1- **What is water turbidity?**

2- **What is the reason of presence of the turbidity in water and what are the types of it?**

3- **Define the permanent turbidity and how we can treatment it?**

4- **What are methods to remove the temporary turbidity?**

5- **How to obtain deionized water? What is the type of the exchanger used? Write the equations?**

6- **What is the difference between deionized water, and distilled water**

7- **(60 ml) is the volume of the potassium chloride that was passed through the cationic column weight (0.5 gm) ,This column was washed by D.W then (50 ml) of the eluent solution was collected , IF the capacity was (9 mmole/g) ,Calculated :**

1- Write the equation for this question?

2- The initial weight of potassium chloride that was added?

3- The PH of the eluent solution?

If you know the atomic weight of K= 39 , Cl = 35.5