

INSTRUCTIONS:
**FIELD PROCEDURE FOR DETERMINING TOTAL
HARDNESS, CALCIUM AND MAGNESIUM IN FILTRATE**

EQUIPMENT:

1. Titration dish, 100 to 150-ml, preferably white
2. Three graduated pipets; one 1ml, one 5ml and one 10ml
3. Stirring rod
4. Porcelain spoon or spatula

REAGENTS:

1. Standard Versenate Solution
2. Strong Buffer Solution
3. Manver Indicator
4. Deionized Water
5. 8 N NaOH Solution
6. Calcon Indicator
7. Solution No. 1 Calcium Titration
8. Solution No. 2 Calcium Titration

PROCEDURE A: Total Hardness (Frequently and commonly referred to as calcium)

METHOD I: (Includes all metal which are titrated by Versenate solution)

1. Add approximately 20 ml of deionized water to titration vessel.
2. Add 1 or 2 ml of the water or filtrate to be tested. NOTE: The endpoint is occasionally difficult to see in the dark colored filtrates. Reduce the sample size to $\frac{1}{2}$ ml if the endpoint cannot be seen with a 1 ml sample or follow procedure listed under determination of total hardness, calcium and magnesium in dark filtrates.
3. Add 1 ml of Strong Buffer solution.
4. Add 3 drops of Manver Indicator and mix with a stirring rod. A wine red color will develop if hardness is present.
5. Using a pipet, titrate with Standard Versenate Solution, stirring continuously, until the sample turns to blue (or green for dark color filtrates) with no under tint of red remaining. Record the number of ml of Standard Versenate Solution used.

CALCULATIONS:

$$\text{Total Hardness as calcium, mg/liter} = \frac{\text{Ml of Standard Versenate} \times 400}{\text{Ml of sample}}$$

$$\text{Total Hardness as CaCO}_3, \text{ mg/liter} = \text{Ca, mg/liter} \times 2.5$$

METHOD II: (Includes calcium and magnesium combined only)

1. Add approximately 20 ml of deionized water to titration vessel.
2. Add 1 or 2 ml of the water or filtrate to be tested. NOTE: The endpoint is occasionally difficult to see in dark colored filtrates. Reduce the sample size to $\frac{1}{2}$ ml if the endpoint cannot be seen with a 1 ml sample or follow procedure for dark filtrate.
3. Add 1 ml of Strong Buffer Solution.
4. Add 1 ml of Solution No. 1 and stir.
5. Add 1 ml of Solution No. 2 and stir. NOTE: Solution No. 2 is extremely poisonous. Do not pipet with your mouth. Never mix Solution No. 2 with an acid.
6. Add 3 drops of Manver Indicator and mix with a stirring rod. A wine red color will develop if calcium and/or magnesium are present.
7. Using a pipet, titrate with Standart Versenate Solution, stirring continuously, until the sample turns to a blue (or green for dark colored filtrates) with no under tint of red remaining. Record the number of ml of Standart Versenate Solution used. (If magnesium is to be determined as in Procedure B, this is Value A.)

CALCULATIONS:

$$\text{Total Hardness as calcium, mg/liter} = \frac{\text{Ml of Standard Versenate} \times 400}{\text{Ml of sample}}$$

$$\text{Total Hardness as CaCO}_3, \text{ mg/liter} = \\ \text{Ca, mg/liter} \times 2.5$$

PROCEDURE B: CALCIUM AND MAGNESIUM SEPERATELY

NOTE: Solutions 1 and 2 must be used in this procedure to mask out other metals as in Method II above or results could be invalid.

1. Add approximately 20 ml of deionized water to the titration vessel.
2. Add the same amount of filtrate to be tested as used in the Total Hardness test.
3. Add 1 ml of 8 N NaOH.
4. Add 1 ml of Solution No. 1 and stir.
5. Add 1 ml of Solution No. 2 and stir.
6. Add ¼ spoonful of Calcon Indicator and mix with a stirring rod.
7. Titrate with Standard Versenate Solution until the indicator turns from wine red to blue with no under tint of red remaining. Record the number of ml of Standard Versenate required. This is Value B.

CALCULATIONS:

$$\text{Calcium, mg/liter} = \frac{\text{B} \times 400}{\text{Ml of sample}}$$

$$\text{Magnesium, mg/liter} = \frac{(\text{A}-\text{B}) \times 243}{\text{Ml of sample}}$$

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