






For Teachers

Assessing the Quality of Resources Used for Extraction of Calcium Carbonate

Module 1

Objective: Determining the Amount of Calcium Carbonate in Eggshells of Various Origins

Necessary Lab Supplies

Reactants	Formula		Quantity (g) or Concentration (M)
Eggshells	-	-	1.0 g
Hydrochloric acid	HCl		2 M
Ammonium buffer solution	NH ₄ Cl + NH ₃		-
Eriochrome Black T	C ₂₀ H ₁₂ N ₃ NaO ₇ S		0.5%
Water	H ₂ O	-	-
EDTA disodium salt (complexon III)	C ₁₀ H ₁₄ N ₂ Na ₂ O ₈		0.05M



List of lab equipment:

- balances (readability of at least 2 decimal places);
- stand with burette clamp;
- conical flask (250 mL);
- beaker (100 mL);
- Mohr pipette (20 mL, 10 mL);
- volumetric flask (100 mL);
- spoon;
- rubber pipette filler;
- burette (readability of at least 1 decimal place);
- funnel;
- graduated cylinder (at least 20 mL).

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Procedure

- Weigh 1.0 grams of eggshells and place them into a volumetric flask. Using a Mohr pipette add 10 mL 2M HCl to the eggshells. Allow the eggshells to dissolve in the hydrochloric acid solution for approx. 2 min.
- To the resulting solution add deionized water until it reaches the mark and mix.
- Using the Mohr pipette transfer 10 mL of the eggshell solution into a conical flask. Using a graduated cylinder measure 20 mL of ammonium buffer solution and add that along with 3-5 drops of an indicator – the Eriochrome Black T to the solution in the conical flask.
- Fill up a burette with the complexon III solution until it reaches the mark. Titrate the eggshell solution with the complexon III solution until the colour of the solution changes from red to blue. Wash the used conical flask and rinse it with deionised water. Repeat the titration at least two more times.

Additional Safety Notes



The ammonium buffer solution contains a large amount of concentrated ammonia, which is an irritating, highly volatile gas with a pungent smell. For this reason, it is better to conduct the experiment in a fume hood. In addition, the hydrochloric acid solution is quite concentrated and irritating to the skin and eyes, so it needs to be handled with caution.

Calculations

Further calculations depend on the amount of the complexon used. First, calculate the average volume used. Since the molar concentration of the solution is known, the amount of complex III would be:

$$n_{\text{kompl.III}} = c_{\text{kompl.III}} \cdot V_{\text{kompl.III}}$$

Since complex III is a polydentate complexing agent, the molar ratio of EDTA disodium salt and calcium ions can be considered equal:

$$n_{\text{kompl.III}} = n_{\text{Ca}^{2+}}$$

The equation of dissociation of calcium chloride shows that the amount of calcium ions is equal to the amount of calcium chloride, and the amount of calcium chloride is equal to the amount of calcium carbonate:

$$n_{\text{Ca}^{2+}} = n_{\text{CaCl}_2} = n_{\text{CaCO}_3}$$

Knowing the amount of calcium carbonate, it is possible to calculate the mass of calcium carbonate in 1.00 g of eggshell:

$$m_{\text{CaCO}_3} = n_{\text{CaCO}_3} \cdot M_{\text{CaCO}_3} \cdot 10$$

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Conclusions

Raw materials of different origins may have different qualitative and quantitative compositions – this applies even to such a trivial thing as an eggshell.

Eggshells are potentially an excellent source of calcium carbonate since the content of this substance in them is quite high.