Supelco®

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MQuant®

Alkalinity Test

Acid capacity to pH 8.2 and pH 4.3

1. Definitions

The **alkalinity** of a water is understood as its capacity to neutralize acids by the effect of dissolved bases (**acid-neutralizing capacity, ANC**). It is thus a measure for the buffering effect of the water in question. In order to obtain comparable results, the alkalinity is determined by titration with a strong acid until specified pH values are attained. Since the alkalinity of most waters is mainly due to dissolved carbonates (i. e. to the anions HCO_3^- and CO_3^{2-}), conventionally the pH values of the two equivalence points of the carbonic acid titration, at about 8.2 and 4.3, are used as the reference values. The corresponding consumption of acid, expressed in mmol/l H^+, is termed the **acid capacity to pH 8.2** ("**$K_{S8.2}$**") or, respectively, the **acid capacity to pH 4.3** ("**$K_{S4.3}$**") (**total alkalinity**). Under the precondition that buffering water constituents other than carbonic acid and its salts can be neglected - as is the case with most natural waters - the measurement values for the acid capacity can be used to approximately calculate the concentrations of the carbonic acid anions and also the **total inorganic carbon**, **TIC** (see card with brief instruction).

2. Method

Titrimetric determination with titration pipette

One sample (**sample A**) is titrated with hydrochloric acid against phenolphthalein until it becomes colorless (at pH 8.2), while a second sample (**sample B**) of the same water is titrated against a mixed indicator until its color changes to red (at pH 4.3). The values for $K_{S8.2}$ and $K_{S4.3}$ are determined from the corresponding consumption of titration solution.

3. Measuring range and number of determinations

Measuring range [1]	Graduation of the titration pipette	Number of determinations [2]
0.1 - 10 mmol/l H⁺	**0.1 mmol/l**	200 at 8.5 mmol/l

[1] with 1 full pipette
1 mmol/l H^+ ≙ 0.5 mmol/l $CaCO_3$ ≙ 50.04 mg/l $CaCO_3$ ≙ 61.02 mg/l HCO_3^-

[2] In the case of alkalinity values exceeding 8.5 mmol/l, the maximum number of determinations possible is fewer than 200 (see section 8).

4. Applications

The alkalinity (acid capacity) is an important parameter for the assessment of the surface-water quality and of the corrosive behavior of water as well as for water and wastewater treatment.

Sample material:
Groundwater and surface water, seawater
Drinking water and mineral water
Industrial water, prozess water, and wastewater
Boiler water
Aquarium water and waters from aquaculture
Swimming-pool water

5. Influence of foreign substances

The determination is interfered with when the water sample contains - in addition to carbonic acid and its salts - compounds that exert a buffering effect at pH 8.2 or 4.3 (e. g. humic acid salts, phosphates, polyphosphates, citrates, tartrates), or else when the water sample exhibits an intrinsic coloration or turbidity that makes it difficult to clearly discern any change in color.

6. Reagents and auxiliaries

Please note the warnings on the packaging materials!
The test reagents are stable up to the date stated on the pack when stored closed at +15 to +25 °C.

Package contents:
1 bottle of reagent R-1 (indicator solution)
1 bottle of reagent R-2 (indicator solution)
2 bottles of reagent R-3 (titration solution)
1 graduated 5-ml plastic syringe
1 test vessel
1 titration pipette
1 card with brief instruction

7. Procedure

It is advisable to check the pH (pH meter) before performing the actual test.
$K_{S8.2}$ can be determined only in waters with a pH above 8.2, $K_{S4.3}$ only in waters with a pH above 4.3.

7.1 Determination of $K_{S8.2}$

Rinse the test vessel several times with the water to be tested.		
Sample A (15 - 30 °C)	5 ml	Inject into the test vessel with the syringe.
Reagent R-1	2 drops [1]	Add and swirl. The solution must turn **pink to red** in color. If it remains **colorless**, its pH is lower than 8.2 and **only $K_{S4.3}$** can be determined.
Place the titration pipette **loosely** on the open reagent bottle R-3. **Slowly** withdraw the piston of the titration pipette from the lowest position until the **lower** edge of the black piston seal is level with the zero mark of the scale. (This fills **only the dropping tube** with titration solution.) Remove the titration pipette and briefly wipe the tip of the dropping tube. Then **slowly** add the titration solution dropwise to the sample **while swirling** until the sample becomes **entirely colorless**. Read off the result for $K_{S8.2}$ in mmol/l from the scale of the titration pipette at the **lower** edge of the black piston seal.		

[1] **Hold the bottle vertically while adding the reagent!**

7.2 Determination of $K_{S4.3}$

Rinse the test vessel several times with the water to be tested.		
Sample B (15 - 30 °C)	5 ml	Inject into the test vessel with the syringe.
Reagent R-2	2 drops [1]	Add and swirl. The solution must turn **blue** in color. If it changes to **red**, its pH is lower than 4.3. In this case there is **no alkalinity (acid capacity)** present.
Place the titration pipette **loosely** on the open reagent bottle R-3. **Slowly** withdraw the piston of the titration pipette from the lowest position until the **lower** edge of the black piston seal is level with the zero mark of the scale. (This fills **only the dropping tube** with titration solution.) Remove the titration pipette and briefly wipe the tip of the dropping tube. Then **slowly** add the titration solution dropwise to the sample **while swirling** until its color changes from **blue** via **grey** (shortly before the complete color change) to **red**. Shortly before the color changes, wait a few seconds after adding each drop. Read off the result for $K_{S4.3}$ in mmol/l from the scale of the titration pipette at the **lower** edge of the black piston seal.		

[1] **Hold the bottle vertically while adding the reagent!**

Samples with a pH between 4.3 and 8.2 (natural waters):
Only $K_{S4.3}$ can be determined. This capacity value corresponds approximately to the HCO_3^- concentration, which can be converted into the **carbonate hardness**, **CH**, as follows: $\mathbf{K_{S4.3}} \approx [HCO_3^-]$ [mmol/l] = 2 x CH [mmol/l Ca^{2+}] **= 0.285 x CH [°e]** or **CH [°e] ≈ 3.51 x $K_{S4.3}$**

Samples with a pH above 8.2:
Both $K_{S4.3}$ and $K_{S8.2}$ can be determined. The difference $K_{S4.3}$ - $K_{S8.2}$ corresponds approximately to the **total concentration of dissolved carbonic species**, **C_T** (dissolved inorganic carbon, DIC), in mmol/l.
This can be converted into the **TIC** in mg/l C (see card with brief instruction).

Notes on the measurement:

- While filling the titration pipette, it must **not** be screwed tightly on the reagent bottle!
- After the analysis inject any titration solution still remaining in the pipette back into the reagent bottle R-3 and **close the reagent bottle tightly using the pipette instead of the screw cap**.

8. Notes

- Reclose the reagent bottles immediately after use.
- Store the reagent bottle R-3 (titration solution) **with the titration pipette firmly attached** lying flat in the corresponding depression in the pack.
- Rinse the test vessel and the syringe **with distilled water only**.
- In titrimetric determinations the consumption of titration solution is dependent on the concentration of the substance to be determined (here: the bases). The quantities of indicator and titration solution contained in the reagent bottles have been calculated to suffice for 200 determinations each of 8.5 mmol/l. The following applies for other alkalinity values:

Alkalinity mmol/l	Number of determinations	Indicator solution	Titration solution
0.1 - 8.5	200	is used up completely	A remainder is left over.
>8.5	<200	A remainder is left over.	is not sufficient for 200 determinations

- **Information on disposal can be obtained at www.disposal-test-kits.com.**

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