

## 430 ALKALINITY

0.1 - 5 mmol/l CaCO<sub>3</sub> \ 75 Tests @ 1 mmol/l

## 440 CARBONATE HARDNESS (KH)

1 -30° KH \ 75 Tests @ 10°

*Acidimetric Titration to pH 4.3 for Total Alkalinity*

- Fill titration vessel with a fully extended (3.2ml) syringe of sample
- Add 1 drop of indicator **Alk-1** or **KH-1**
- Close titration vessel with dual-thread adapter
- Insert inverted bottle of titrant **Alk-2** (420) or **KH-2** (421) by screwing into the closed vessel to form a combined one-hand unit
- Titrate counting drops while mixing for a permanent green intermediate tint in the sequence blue → green → yellow
- Test **430**: 1 drop = 0.1mmol/l ≡ 0.2meq/l ≡ 10ppm CaCO<sub>3</sub>
- Test **440**: 1 drop = 1°KH (0.357meq/l ≡ 10 ppm CaO)

The alkalinity of water represents its acid binding capacity, with the titration differing from carbonate hardness in that the concentration of the dilute sulfuric acid titrant KH-2 is 1.79-times that of Alk- 2. Referring KH to CaO rather than CaCO<sub>3</sub> permits the values to be directly compared to Total Hardness GH (Test **450**). The capacity of water to bind acids normally depends on the dissolved Ca- und Mg-bicarbonates that separate out as carbonate scale on heating, causing this fraction to be referred to as *temporary hardness*. When this is deducted from total hardness, the remainder is taken to be *permanent*-, or *gypsum hardness*. The residual Ca- and Mg-sulfates are considered neutral salts without buffering capacity. Based on an acidimetric anion titration, KH can only represent the acid binding capacity of HCO<sub>3</sub><sup>-</sup> bound to Ca<sup>2+</sup> and Mg<sup>2+</sup>. The concentration of these metals determined by the GH titration therefore limits the maximum value KH can have. When the titrated KH exceeds GH its level has to be set to the GH value, assuming that the excess alkalinity must come from alkali metals or hydroxides. Restricting KH by definition solely to the carbonates of Ca and Mg makes alkalinity the *only relevant titration for total acid binding capacity*. The end point set at pH 4.3 marked the beginning of the colour change of *Methyl Orange* from pH 4.4 (yellow) to 3.1 (red). Today, *Bromocresol Green* (Alk-1, KH-1) is a more effective alternative, by a more favorable placement in the middle of the range between pH 3.8 (yellow) to 5.4 (blue) with a distinctive apple-green shade at pH 4.3. Nominally, this is the point at which all bicarbonate has been converted to carbon dioxide:-  $\text{Ca}(\text{HCO}_3)_2 + \text{H}_2\text{SO}_4 \rightarrow \text{CaSO}_4 + 2\text{CO}_2 + 2\text{H}_2\text{O}$ .

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