

450 TOTAL HARDNESS (GH)

1 -30° DH \ 75 Tests @ 10°

451 RESIDUAL HARDNESS (GH)

0.1 -3° DH \ 75 Tests @ 1°

454 CALCIUM HARDNESS (CaH)

1 -30° DH(Ca) \ 75 Tests @ 10°

Chelatometric Drop-Count Titration with EDTA

- Fill titration vessel with a fully extended syringe (3.2ml) of sample
- Add 1 drop of **GH-1**(450), **RH-1** (451) or 1 spoon of **CaH-1** (454)
- Close titration-vessel with dual-thread adaptor
- Insert inverted bottle of titrant **GH-2** (450), **RH-2** (451) or **CaH-2** (454) by screwing into the closed vessel for one-hand use
- Titrate while counting drops for colour change *violet® blue* (450 / 451) or *pink® violet* (454) while mixing
- Test **450**: 1 drop = 1°DH \equiv 10 ppm CaO oder 7.19 ppm MgO
- Test **451**: 1 drop = 0.1°DH \equiv 1 ppm CaO oder 0.72 ppm MgO
- Test **454**: 1 drop = 1°DH(Ca) \equiv 10 ppm CaO

The essentially insoluble Ca- and Mg-carbonates of sedimentary rocks are converted to their soluble bicarbonates by ground water acidified with carbon dioxide. When such water is used for washing, Ca+Mg replace the Na+K cations in the fatty-acid compounds that make up the major part of soap. The resultant alkaline-earth "soaps" are insoluble coagulates. They consume detergency without any cleansing action and become deposited as curds on bathroom ceramics and laundry. The latter feels "hard", as does water when failing to develop a soapy character during washing. For the determination of this "Hardness", in reality a collective measurement of CaO+MgO converted on a molecular basis to CaO, it was customary to titrate with a standardized soap solution to an end-point that gave a permanent lather. At this stage, all Ca+Mg had been neutralized. In an attempt to immobilize Ca+Mg of hard water, *Münz* in 1935 found Ethylenediamine-tetra-acetic acid (EDTA) to be an ideal complex-former. Ten years later, *Schwarzenbach et al.* recognized the value of EDTA as a titrant, combining this with *Murexide* (CaH-1) or indicators selected from the available chelate-forming dihydroxyazo dyes (GH-1, RH-1). In the alkaline range of the titration these range from blue to violet with their Mg- and Ca- complexes being violet to pink. After the start of the titration, they are in the reddish metalized form. When the EDTA titrant (GH-2, RH-2, CaH-2) has bound all Ca and Mg as colourless EDTA-complexes, the colour changes to the bluish metal-free dye.

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