3-5.2 CHEMICAL ANALYSIS OF WATER

A general chemical analysis of water has to be carried out by a well equipped laboratory (e.g. of a hospital or a high school).

For general analysis a sample of at least 2 litres is required. It should be collected in a chemically clean bottle made of good quality (neutral) glass, practically colourless and fitted with a ground-glass stopper.

In the collection of samples from mineralized sources, the bottle should be completely filled and the stopper securely fastened.

Samples should be transported to the laboratory with as little delay as possible and should be kept cool during transport. Chemical analysis should be started as soon as practicable after the collection of the samples and in any case should not be delayed for more than 72 hours.

Fig. 21 shows the result of such a chemical partial analysis of different CD/SATA-Helvetas water supplies.

If a general chemical analysis is not possible, the design engineer has to analyse the water by a field test. Additionally the engineer has to find out from the local population whether the water is potable or not.

Chemical field test (Hach)

With the portable water analysis kit (model CA-24WR) of Hach, which is available with CD-SATA-Helvetas, the following chemical values can be measured:

- Content of carbon dioxide (CO_2) in mg/l (see 2-3.3)
- Content of dissolved oxygen in mg/l
- Hardness in grain $CaCO_3$/gallon (see 2-3.4)
- PH-value (see 2-3.2)

The test procedure is described in Fig. 22.

Fig. 22 Test procedure with the portable laboratory Hach

HACH MODEL CA-24WR

Carbon Dioxide Test

1. Fill the plastic measuring tube level full with the water to be tested and transfer to the mixing bottle by placing the mixing bottle over the tube and turning the bottle right-side-up.
2. Add one drop of Phenolphthalein Indicator Solution.
3. Add Sodium Hydroxide Solution dropwise, counting the drops and gently swirling the bottle to mix after each drop is added until the solution becomes light pink. Each drop equals 5 milligrams per liter (mg/l) carbon dioxide (CO_2).

Dissolved Oxygen Test

HIGH RANGE (1 drop=1 mg/l DO)

1. Fill the glass-stoppered DO bottle with the water to be tested by allowing the water to overflow the bottle for 2 or 3 minutes. Be certain there are no air bubbles present in the bottle.
2. Add the contents of one pillow each of Dissolved Oxygen 1 Reagent Powder and Dissolved Oxygen 2 Reagent Powder. Stopper firmly and carefully so that no air is trapped in the bottle. *See Note A.* Grip the bottle and shake vigorously to mix. *See Note B.* A flocculant precipitate will form. If oxygen is present the precipitate will be brownish-orange in color.
3. Allow the sample to stand until the floc has settled halfway and leaves the upper half of the bottle clear. Then again shake the bottle and again let it stand until the upper half of the bottle is clear. *See Note D.*
4. Remove the stopper and add the contents of one pillow of Dissolved Oxygen 3 Reagent Powder. Carefully re-stopper and shake to mix. The floc will dissolve and a yellow color will develop if oxygen is present. This is the prepared sample.
5. Fill the plastic measuring tube level full with prepared sample and pour it into the mixing bottle.
6. While swirling the sample to mix, add PAO Titrant dropwise, counting each drop, until the sample changes from yellow to colorless. The dropper must be held in a vertical manner. Each drop is equal to 1 mg/l dissolved oxygen (DO). *See Note E.*

LOW RANGE (1 drop=0.2 mg/l DO)

If the result from Step 6 is very low, such as 3 mg/l or less, it is advisable to test a larger sample to obtain a more sensitive result. This may be done by titrating directly in the DO sample bottle as follows:

1. Using the prepared sample left over from Step 4 above, pour off the contents of the DO bottle until the level just reaches the 30-ml mark on the bottle.
2. While swirling the DO bottle to mix the sample, add PAO Titrant dropwise, counting each drop, until the sample changes from yellow to colorless. Each drop of PAO Titrant added is equal to 0.2 mg/l dissolved oxygen in the sample. *See Note E.*

NOTES - Dissolved Oxygen

A. It is a bit tricky to stopper the DO bottle without trapping an air bubble. To avoid this problem, incline the DO bottle slightly and insert the stopper with a quick thrust. This will force air bubbles out. However, if bubbles do become trapped in Steps 2 or 4, the sample should be discarded and the test started over.

B. A small amount of powdered reagent may remain stuck to the bottom of the DO bottle at this point, but this will not affect the test.

C. Do not allow the PAO Titrant to stand in direct sunlight, as it is decomposed by ultraviolet radiation.

D. In samples that contain high concentrations of chloride, such as seawater, this floc will not settle. However, no interference is observed as long as the sample is allowed to stand in contact with the floc for 4 or 5 minutes.

E. A more sensitive test can be performed by using Starch Indicator Solution (Cat. No. 349-13, not included in kit) while titrating the sample with PAO Titrant. To use affectively, titrate the sample until the color just begins to change from yellow-brown to light yellow. Add two drops of Starch Indicator Solution. Continue titration, counting the drops of PAO Titrant until the sample color changes from blue to colorless. The total number of drops of PAO Titrant used indicates the exact concentration of dissolved oxygen in the sample.

Hardness Test

1. Fill the plastic measuring tube level full of the water to be tested and pour it into a mixing bottle.
2. Add 3 drops of Buffer Solution, Hardness 1 and swirl to mix.
3. Add 1 or 2 drops of ManVer® Hardness Indicator Solution, Hardness 2.
4. Add Titrant Reagent, Hardness 3 a drop at a time, with swirling of the mixing bottle while the drops are counted, until the solution in the mixing bottle changes from pink to blue. The Titrant Reagent, Hardness 3 dropper should be held in a VERTICAL manner and the drops should be dispensed at a rate not faster than one drop per second. The dropper should be held slightly above the top of the mixing bottle so that it will never come into contact with the side of the mixing bottle. THIS IS IMPORTANT.
5. The hardness, in grains per gallon as calcium carbonate ($CaCO_3$), is equal to the number of drops of Titrant Reagent, Hardness 3 required to bring about the color change.

pH Test

1. Fill the two glass sample tubes to the 5-ml mark with the water sample. *It is imperative that the tube be completely rinsed free of any solutions that may have been used previously.*
2. Add 6 drops of Wide Range 4 pH Indicator Solution to one of the tubes and swirl to mix.
3. Insert the prepared sample in the right opening of the color comparator.
4. Insert the tube of untreated water sample in the left opening of the color comparator.
5. Hold the color comparator up to a light such as the sky, a window, or a lamp and view through the two openings in the front. Rotate the color disc until a color match is obtained. Read the pH through the scale window.

NOTE - pH

The presence of chlorine in the water sample will cause a slight interference in the test. Remove up to 50 mg/l chlorine by adding one drop of Dechlorinating Solution (Cat. No. 1069-13, not included in kit) to the water sample before addition of the pH Indicator.