

Application News

No. A538

Spectrophotometric Analysis

Analysis of Mineral Water Hardness and Iron and Zinc Content of Supplements

Water contains trace amounts of calcium and magnesium and their content is expressed as water hardness. Hardness refers to the amounts of calcium ions and magnesium ions in water converted to an equivalent amount of calcium carbonate (CaCO₃), and is expressed in terms of milligrams per one liter of water. The total amount of both hardness types (calcium and magnesium) is referred to as total hardness.^[1] Generally, a total hardness of 100 mg/L or less is referred to as soft water and 100 mg/L or more is referred to as hard water.^[2] While most water in Japan is soft and well suited to tea and soup stock, hard water is suited to supplementing mineral intake. Presently, the daily use of supplements to make up for insufficient intake of nutrients etc., has become common place. In the food sector, a variety of products are being produced to enable intake of the required amounts of such nutrients.

Using Kyoritsu Chemical-Check Lab., Corp.'s PACKTEST series kit with the water analysis program for the UV-1280 UV-VIS spectrometer allows measurement of 22 types and 39 items, including total hardness and iron/zinc content.

This article investigates the total hardness of commercially-available mineral waters as well as the hardness of tap water using the water analysis program for the UV-1280. We also introduce the measurement results of iron and zinc content in a number of supplements.

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■ Total Hardness of Mineral Water

Fig. 1 shows the UV-1280 and Kyoritsu Chemical-Check Lab's PACKTEST series kit. We prepared seven commercially-available mineral water products and performed measurement using the conditions listed in Table 1. The water analysis program features a user definition function that allows users to create their own measurement items. In this instance, we added a total hardness item for each sample as shown in Fig. 2. Table 2 compares the results of measuring each sample three times against the values stated on each bottle. We can see that four of the samples are soft water and the remaining three are hard water. In addition to the differentiation into soft and hard water, the results show that differences exist in total hardness across all samples.



Fig. 1 UV-1280 and PACKTEST

Table 1 Measurement Conditions

| | |
|------------------|--|
| Instrument | : UV-1280 Water analysis program PACKTEST Total Hardness |
| Measurement item | : Total hardness |

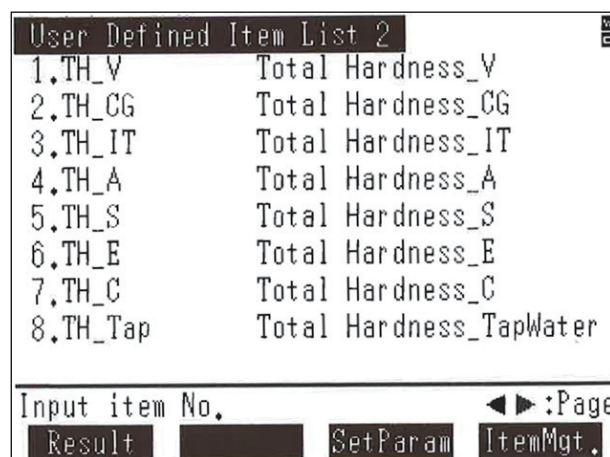


Fig. 2 Example of User-Defined Items in the Water Analysis Program

Table 2 Comparison of Stated Values and Measurement Results of Total Hardness of Commercially-Available Mineral Water

| Sample | Value stated (mg/L) | Measurement result (mg/L) | | |
|--------|---------------------|---------------------------|--------------------|--------------------|
| | | 1st | 2nd | 3rd |
| TH_V | 60 | 64.97 | 60.30 | 59.66 |
| TH_CG | 38 | 28.54 | 30.01 | 29.59 |
| TH_IT | 40.3 | 41.40 | 39.90 | 41.71 |
| TH_A | Approx. 20 | 21.31 | 22.87 | 22.35 |
| TH_S | 253 | 236 ^{*1} | 244 ^{*1} | 225 ^{*1} |
| TH_E | 304 | 304 ^{*1} | 296 ^{*1} | 285 ^{*1} |
| TH_C | 1468 | 1313 ^{*2} | 1354 ^{*2} | 1296 ^{*2} |

*1 Sample diluted by a factor of five with pure water

*2 Sample diluted by a factor of 20 with pure water

Variation in Total Hardness of Tap Water

Fig. 3 shows the results of measuring the total hardness of tap water over a period of about two weeks (April 4 to April 14, 2017). The trend graph makes obvious the variation in the total hardness of the tap water. The total hardness is generally in the 30 mg/L range and is stable.

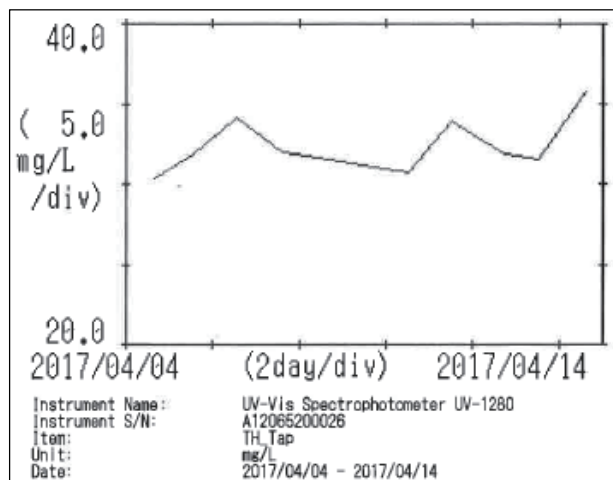


Fig. 3 Daily Total Hardness of Tap Water

Iron and Zinc Content of Supplements

Three commercially-available supplements that contain iron and zinc were analyzed using the conditions listed in Table 3. The water analysis program displays the measurement procedure on the screen, allowing users to analyze target components by simply following the on-screen instructions. The measurement range of iron and zinc is 0.1 to 8.0 mg/L and 0.03 to 0.4 mg/L respectively. Table 4 compares the values stated on each supplement package with the results obtained by measuring each supplement after dissolving them in 100 mL of 1% hydrochloric acid and diluting the solution. While low values were obtained for some supplements since they did not completely dissolve in the pure water, results generally matched the stated values.

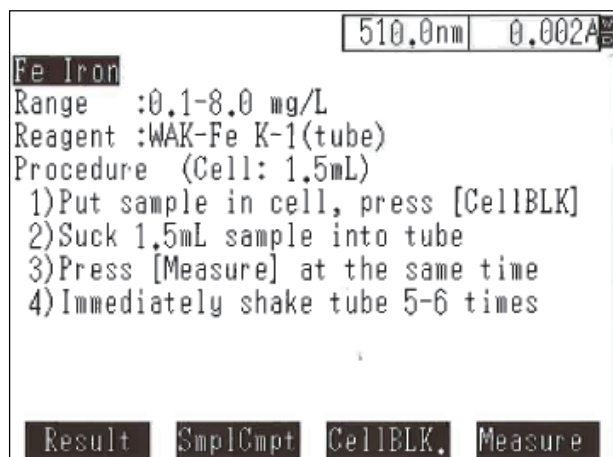


Fig. 4 Fe Measurement Procedure

Table 3 Measurement Conditions

| | |
|------------------|----------------------------------|
| Instrument | : UV-1280 |
| | Water analysis program |
| | PACKTEST Iron, Zinc (Low Range) |
| Measurement item | : Iron, zinc (low concentration) |

Table 4 Comparison of Stated Values and Measurement Results of Iron and Zinc in Commercially-Available Supplements

| Measurement item | Sample | Value stated | Measured value (converted to unit of stated value) | | |
|------------------|------------------|--------------|--|--------------------|--------------------|
| | | | 1st | 2nd | 3rd |
| Fe | NM ^{*1} | 3 mg | 2.94 (2.94 mg) | 3.06 (3.06 mg) | 3.15 (3.15 mg) |
| | F ^{*1} | 1.2 mg | 0.944 (0.94 mg) | 0.861 (0.86 mg) | 0.907 (0.91 mg) |
| | A ^{*2} | 18 mg | 1.15 (11.5 mg) | 1.31 (13.1 mg) | 1.27 (12.7 mg) |
| Zn(D) | NM ^{*3} | 10 mg | 0.109 (10.9 mg) | 0.122 (12.2 mg) | 0.092 (9.2 mg) |
| | F ^{*2} | 3.75 mg | 0.363 (3.63 mg) | 0.353 (3.53 mg) | 0.391 (3.91 mg) |
| | A ^{*3} | 14 mg | 0.143 (14.3 mg) | 0.163 (16.3 mg) | 0.137 (13.7 mg) |

*1 Sample diluted by a factor of 10 with pure water

*2 Sample diluted by a factor of 100 with pure water

*3 Sample diluted by a factor of 1000 with pure water

Summary

Using the water analysis program for the UV-1280 and Kyoritsu Chemical-Check Lab's PACKTEST series kit, we were able to confirm the total hardness of commercially-available mineral water and the variation in total hardness of tap water. The user definition function in the water analysis program allowed adding of measurement items and the trend function enabled viewing of daily variations at a glance. In addition, by diluting the iron and zinc contained in supplements, we were able to easily measure the iron and zinc content of those supplements.

References

- [1] Kyoritsu Chemical-Check Lab PACKTEST Total Hardness <http://kyoritsu-lab.co.jp/seihin/list/packtest/th.html>
- [2] The Mineral Water Association of Japan website <http://minekyo.net/>