Development of the WQ-300 Series Multi-digital Water Quality Meter

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We developed the WQ-300 series of multi-digital water quality analyzers that can simultaneously select three items from pH, dissolved oxygen (DO), electrical conductivity, oxidation-reduction potential (ORP), and ion measurement items. The WQ-300 series includes a pH sensor with a non-refillable reference electrode that does not require replenishment of the internal solution, a 4-pole electrical conductivity sensor that can measure a wide range, and an optical DO sensor that is less affected by flow rate. Compared to the previous model of portable water quality meter, simultaneous display of all items with color graphic LCD, push-pull lock type connector for easy attachment/detachment of sensor, USB power supply for measuring without worrying about battery capacity, installation on the ground even though the screen is easy to see, the meter stand that supports operability, the wireless communication function that can wirelessly transfer stored data, and usability have been greatly improved. Therefore, the WQ-300 series is expected to be able to contribute to environmental water measurement beyond the range of conventional portable water quality meters.

Introduction

It is essential to measure the basic characteristics of water, such as water temperature, pH, electrical conductivity, and dissolved oxygen for environmental water monitoring, sewage maintenance, periodic inspection of construction site and factory wastewater. Since it takes time and effort to measure each measurement with each instrument, a multi water quality meter that can measure many items at once is often used. We have developed a U-50 multi water quality meter for these applications. The multi water quality meter has built-in sensors such as pH, electric conductivity, dissolved oxygen (DO), oxidation-reduction potential (ORP), turbidity, water depth and water temperature in a portable size device. However, a multi water quality measurement device is expensive and maintenance is difficult in surface water measurement that does not require a depth direction and indoor measurement of a sample collected on site. Therefore, we decided to develop a new WQ-300 series that can solve these disadvantages and market requirements.

Product overview

Figure 1 shows a multi-digital water quality meter. The weight of the meter and each sensor is very light, near 0.4 kg and near 0.2 kg. Up to 3 sensors can be connected to the meter, and measurements can be made by immersing the sensor in the sample. The meter is equipped with a screen that efficiently collects external light in the liquid crystal, which not only displays measurement items in a batch, but also realizes a screen that is easy to see in direct sunlight as well as in dark places. Until the conventional product, the analog data detected by the sensor was subjected to digital conversion processing on the meter side. However, as a drawback, it is possible to measure

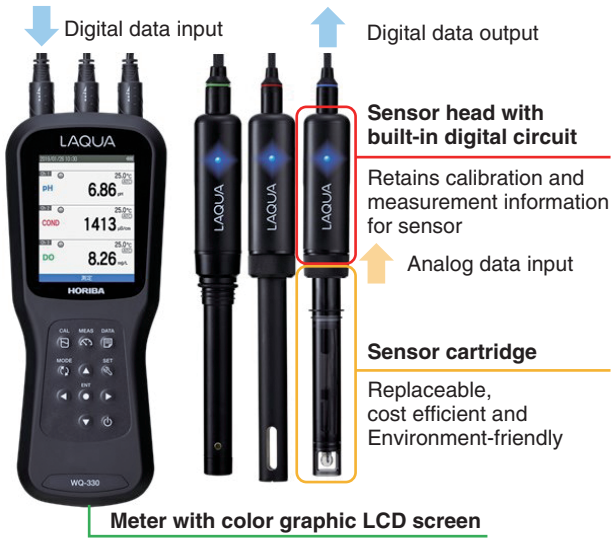

Figure 1 Product outline

only measurement item depending on the electronic board built in the meter, so there is no scalability. Further, the calibration data and the measurement settings are not inherited and the function does not work unless the meter and the sensor are paired when the sensor is replaced with another meter. As shown in Figure 1, the WQ-300 series solves these disadvantages by moving the electronic board from the meter to the sensor. A digital circuit is built in the sensor head and can hold information on measurement. The sensor is environmentally friendly, and the operation cost and the maintainability in on-site measurement are improved since the sensor is a replaceable cartridge type. In addition, conventional products often fluctuated the measured value due to noise from the outside. However, it is possible to measure with less noise effect by moving the digital circuit close to the sensor. Since data from the sensor to the meter is transferred digitally, this product can eliminate the noise effect and the increase in internal resistance due to the cable length. It can be extended to future water quality products.

Designed for a series of operations related to measurement

A carry case was prepared for the product to carry all the equipment required for on-site measurements. As shown in Figure 2, in the storage space, a replacement battery, calibration standard solutions, and an instruction manual can be stored in addition to a meter and sensors. This makes it possible to calibrate immediately before measurement after heading to the site, and also to evaluate by standard solution measurement for product confirmation when there is a problem with any measured value. The internal structure of the carry case is provided with a storage space according to the shape of the product and a storage space for cables that tend to be complicated when stored. Further, since it is difficult to prepare a sensor stand at the site, as in a laboratory, the calibration standard solution bottle can be fixedly installed and provided with a self-standing structure even if the sensor is immersed as it is. Therefore, all preparations can be completed in this case. The case is designed a series of operations of calibration, measurement, and setting can be smoothly performed so that the user only needs to take out the device after preparation.

Designed for simultaneous measurement

It was designed to be easy to carry during the operation of measuring the sample on site, and it is easy to handle 3 sensors (Figure 3 (left)). The meter is coated with soft resin to provide non- slip grip and not easily damage even if the product falls. Sensors can be mounted on 3 holders on the meter for carrying (see Figure 3), and each sensor head has 2 holders and one hook which can be used to attach up to 3 sensor heads during on-site measurement. This structure has made it possible to perform measurements with the measurement detection position of multiple sensors aligned (Figure 3 (right)).

Figure 3 Sensor holders and hooks

High-precision measurement independent of the environment at the measurement site

The sensor developed for the WQ-300 series was designed with high precision in field measurement and operability. The newly developed pH sensor uses KCl gel electrolyte formed in the bio polycarbonate housing which does not

Figure 2 Carry Case outline

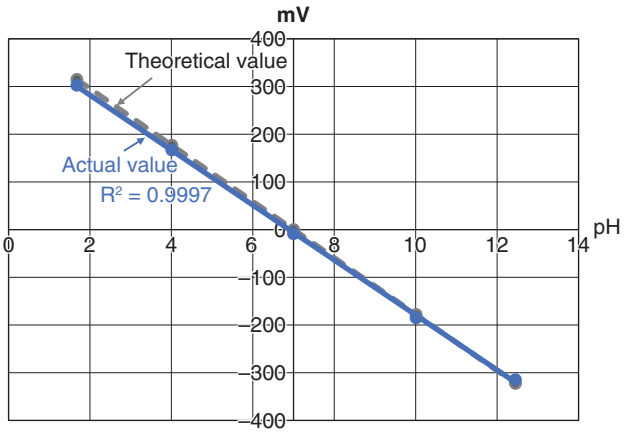

Figure 4 Linearity of non-filled type pH sensor

need to refill the internal solution for the reference electrode in order to facilitate daily pre-measurement preparation and on-site measurement. As shown in Figure 4, even on the acid side and the alkali side, the correlation coefficient with respect to the theoretical value is 0.9997, which can be measured with high accuracy. Regarding the electric conductivity measurement, as shown in Figure 5, the four-pole electric conductivity measuring method that can measure a wide range with high accuracy was adopted. Since the sensor is made of carbon, it can be brush- cleaned for physical contamination caused by a turbid sample. For the DO measurement, as shown in Figure 6, the optical dissolved oxygen method that can reduce the influence of the flow rate is adopted. In addition, the meter is equipped with an atmospheric pressure detector, which performs automatic atmospheric pressure correction when calibrating the DO value that changes with the atmospheric pressure of the measurement environment. Furthermore, by combining with an electric conductivity sensor, the salt concentration is converted from the electric conductivity value measured from the sample, and the salt value is automatically corrected to the DO value. In this way, by using these functions provided in the product to compensate for environmental changes related to measured values, highly accurate measurements that are not affected by the measurement environment can be performed automatically.

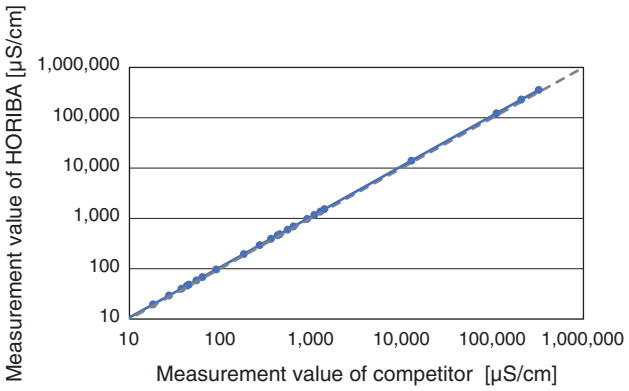

Figure 5 Linearity of 4-cell conductivity sensor

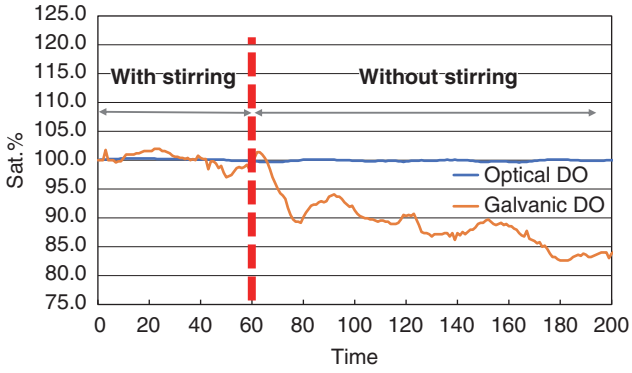

Figure 6 Comparison of flow rate effect of common electrochemical and fluorescent DO sensor

Conclusion

The multi-digital water quality meter WQ-300 series introduced this time enables high-precision measurement by automatically compensating for measurement errors due to environmental changes, in addition to the product design that enables smooth on-site and also laboratory measurement. Further, the measurement range is expanded and handling is facilitated. Therefore, the measurement of environmental water can be performed more easily and with higher accuracy than previous products, and this product can also be used for applications that require simultaneous measurement according to environmental effects.

The deep blue seas, clear beautiful rivers, highly transparent lakes and marshes, water is a life-essential resource. However, our precious water resources are threatened by various human activities that generate waste water, such as sewage water, plant waste water, and agricultural waste water. This leads to eutrophication and organic pollutant contamination, resulting in wide-scale environmental destruction. This problem is common all over the world, and tasks analysis instrument manufacturers with the important role of providing instruments for accurately monitoring and controlling water quality. To that end, we are committed to continue developing water quality measuring equipment as our contribution to environmental problem solutions; supply water control; and sewage treatment process control.

* Editorial note: This content is based on HORIBA's investigation at the year of issue unless otherwise stated.

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