Development of New-Model Water Quality Converter

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Abstract

As sewage treatment becomes more sophisticated, the importance of water quality measuring instruments is increasing as the number of installed instruments is on the rise. As a result, a large amount of time must be devoted to maintenance, and the ease of handling equipment is required. Moreover, an increase in the number of units makes it difficult to secure installation space and leads to an increase in costs, so equipment with high cost performance is required.

We developed a Dissolved Oxygen (DO) meter, Mixed Liquor Suspended Solids (MLSS) meter, a sludge concentration meter, and a turbidity meter in order to solve these current challenges: the standardization of converters for each measuring device, a 1:2 connection of converters and detectors, and the recording of various log data. In addition, the DO meter uses an optical electrode that is easy to maintain and has long maintenance intervals. We expect that the improved new water quality converter will satisfy the customer requirements.

1 Preface

Modern sewage treatment is becoming more sophisticated on control for saving energy and improving the quality of effluent. To achieve these goals, water quality measuring instruments are one of the essential items for acquiring the status data of ever-changing operating and processing conditions of the wastewater treatment plant.

We developed measuring instruments based on the concept of providing user-friendly water quality measuring instruments that can withstand use in actual wastewater treatment plants. In 1976, first sales began with a bubble-cleaning type dissolved oxygen meter. Since then, our products have undergone numerous improvements to meet user requirements, but recent advances in digitization have led to an increase in new demands. To meet these demands, this paper introduces a new water quality converter that has been completely renewed while inheriting the favorable features of our conventional products.

2 Target Models

There were four target model types: a Dissolved Oxygen (DO) meter, a Mixed Liquor Suspended Solids (MLSS) meter, a sludge concentration meter, and a turbidity meter. The former two are essential for the management of aeration tanks and are the most frequently used instruments in water treatment systems. Sludge concentration meters are used in both water treatment systems and sludge treatment systems, and are important for various types of sludge management. Turbidity meters are used as an alternative indicator, mainly to monitor Suspended Solids (SS) in treated water. This is also essential as the treated water is discharged into the environment after being disinfected.

3 Renewal Items

Table 1 shows the main improvement items. The features of the previous model, such as a function of grasping the operating status of the device by the self-diagnosis, Japanese language display, and interactive (conversational) operation, have been inherited. The details of the improved items are as follows.

3.1 Common Converter

The converter is of a type that can be used with the four models, so that all detectors can be connected. As a result, when it becomes necessary to

Table 1 Improvement Items

The newly improved items are shown.

○ : Applicable — : Not applicable

New function	DO meter	MLSS meter	Sludge concentration meter	Turbidity meter
Common converter	○	○	○	○
Digital communication between converter and sensor	○	○	○	○
1:2 connection	○	○	○	○
Measurement log	○	○	○	○
Management log	○	○	○	○
Improved guidance functions	○	○	○	○
Calendar clock functions	○	○	○	○
Optical electrodes	○	—	—	—
Multiple calibration data	—	○	○	—

change the detection target (i.e., from MLSS to DO), the user can perform measurement simply by installing a new detector. It can simplify installation and wiring work. In the unlikely event that the converter used for control fails, the converter of another measuring instrument with a lower priority can be used for an emergency response※1.

3.2 Digital Communication between Converter and Detector

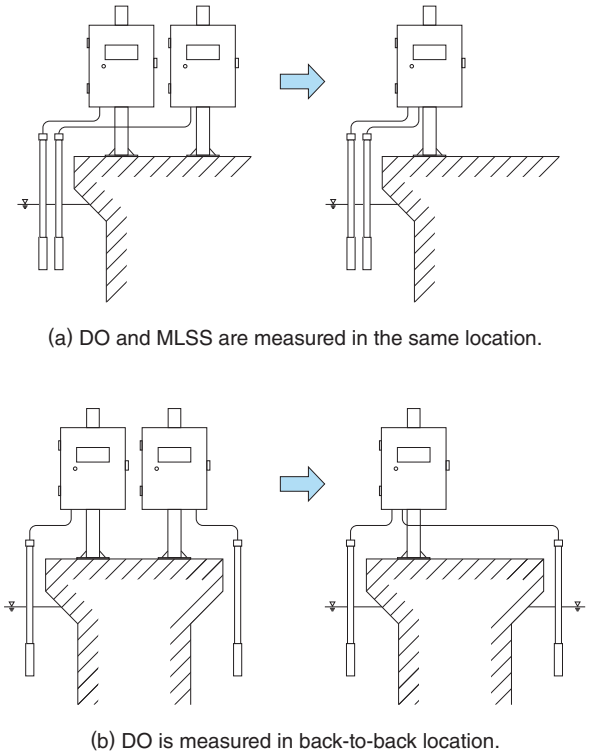
The conventional analog transmission has been changed to digital communication (RS-485) to reduce the influence of external noise.

3.3 1:2 Connection

In water quality measuring instruments currently on the market, the converter and detector are connected in the 1:1 connection mode. With this instrument, two detectors can be connected to one converter, and any two of the four types of detectors can be selected. For example, as shown in **Fig. 1**, to measure DO and MLSS at the same point or to measure adjacent tanks, it was conventionally necessary to install separate converters; but with this instrument, this can be accomplished with a single converter. This not only saves installation space, but also contributes to lower installation costs※2.

3.4 Measurement Logs

Past measurement values are saved, and changes in measurement values can be retrieved. The data storage capacity is 142 days when the recording cycle is 1 minute. Since also saved are the anomaly detection signals other than the measured values to be measured, the signs of anomalies and deterioration can be detected, while not immediately causing the failure, may lead to failures in the future. The measurement log data can be retrieved with the USB memory – out standard accessory to this product.



(a) DO and MLSS are measured in the same location.

(b) DO is measured in back-to-back location.

Fig. 1 Example of 1:2 Connection

An example is shown when a converter connects with two sensors.

3.5 Operation Logs

Since various operations such as setting changes and various event information such as alarm activation/cancellation are recorded, it is possible to check the past calibration dates, set change dates, and the occurrence status of alarms. Operation log data can be retrieved using the attached USB memory, our standard accessory to this product.

3.6 Improved Guidance Function

In general, water quality measuring instruments are simple to operate, and many operations are not required during normal measurement. When it becomes necessary to change some settings, however, it is often difficult to understand because the device display is simple. Equipment with a 7-segment display displays in alphabets, so it is impossible to work without looking at the instruction

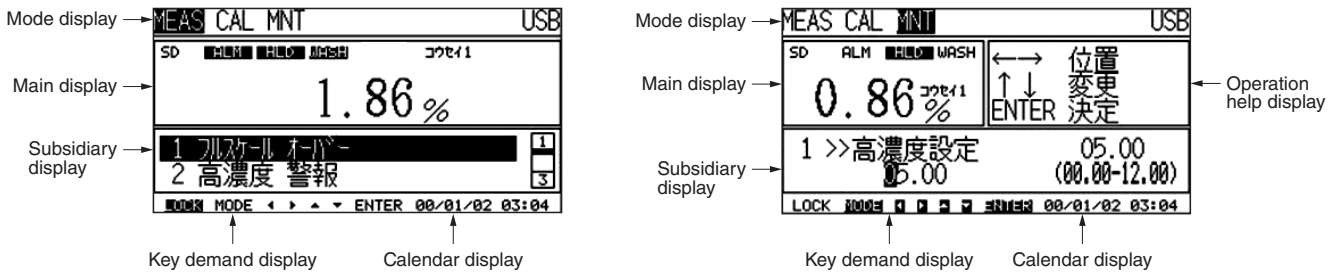


Fig. 2 **Example of Sludge Concentration Meter Display**

An example of sludge concentration meter display is shown. Guidance functions are improved in each mode and operability is improved.

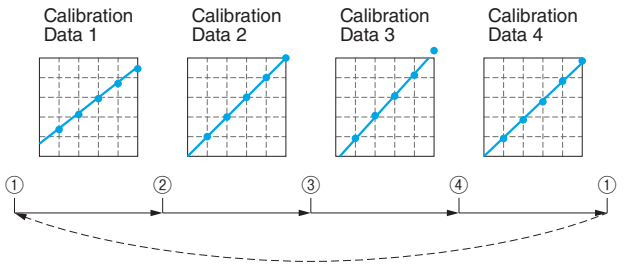
manual. Our company was one of the first to adopt a Japanese display. Further, this instrument has improved guidance functions, so once the basic operation is understood, it can be operated without looking at the instruction manual. Fig. 2 shows an example of a sludge concentration meter display. It is an example of a screen for setting a high-concentration alarm threshold. In normal measurement, the upper measurement mode is displayed, but when switching to maintenance mode, the main display is divided into two, and an operation help display appears. The key request display at the bottom flashes the key switches that can be a current acceptable operation. The operation help display shows what each keystroke does, so the user can make desired settings according to the display.

3.7 Calendar Clock Function

The calendar clock function is essential for the log function, but in addition, the calibration values of the MLSS meter and densitometer can be automatically changed according to the season (see Section **3.9**).

3.8 Optical Electrode (DO Meter)

The electrodes of the DO meter are of the optical type (fluorescence type). The only consumable part of the optical DO meter is the sensor cap (a cap with a fluorescent film attached), which has a long life and can be easily replaced. The optical type does not consume oxygen due to the principle of measurement, so it does not require a water flow rate. In an aeration tank, however, especially a tank using fine air bubbles such as full-surface aeration, the air bubbles tend to stay at the detection end, making accurate measurement difficult. This instrument is equipped with an air bubble washer as a standard feature that enables continuous cleaning,



①～④ means month, day, hour, and minute of calibration data switching, and this can be set arbitrarily. The calibration data switching period is one year each. After the lapse of one year, the same process is repeated.

Fig. 3 **Image of Multiple Calibration Data Switching**

Four kinds of calibration data can be saved. The month, day, hour, and minute can be arbitrarily set. Automatic calibration data switching is possible.

and prevents air bubbles from accumulating due to cleaning and flow velocity. Stable measurement can, therefore, be performed for a long period of time.

3.9 Multiple Calibration Data (MLSS Meter/ Sludge Concentration Meter)

Our MLSS meters and sludge concentration meters use an algorithm that minimizes the influence of sludge color as much as possible. Since the measurement is based on an optical principle, however, changes in particle density and color due to seasonal fluctuations can affect the measured values.

Conventionally, in such cases, calibration was performed each time, but with this instrument, four types of calibration data can be saved, and the calibration data can be replaced by panel operation as needed. In addition, if the calibration data switching setting is automatically selected, the calibration data can be automatically switched according to the arbitrarily set month, day, hour, and minute. Fig. 3 shows an image of multiple calibration data switching. It can be applied not only to seasonal

Table 2 Specifications of New Water Quality Converter

Specifications of the new water quality converter are shown.

Output signal	Output signal	DC4～20 mA (Permissible load resistance 600 Ω or less)
	Signals during maintenance	No-voltage contact (1a) output (Contact capacity: AC100 V, 0.5 A)
	High concentration alert	No-voltage contact (1a) output (Contact capacity: AC100 V, 0.5 A)
	Low concentration alert	No-voltage contact (1a) output (Contact capacity: AC100 V, 0.5 A)
	Fault signal	No-voltage contact (1a) output (Contact capacity: AC100 V, 0.5 A)
	Cleanse command signal (For sensor cleansing)	No-voltage contact (1a) output (Contact capacity: AC100 V, 0.5 A) or AC 100 V output (By internal switchover)
Input signal	Output hold control	No-voltage contact input (Contact capacity: DC24 V, 10 mA or more) Signal mode: Holding by closed contact (Setting changeable)
Log record items	Measurement log	Time, measured values (Recording period: 30 s～10 min variable)
	Management log	Time, converter setup operation record, alert record, error record, I/O signal operation record)
Log record capacity	Measurement log	142 days Max. (For 1-minute sampling intervals)
	Management log	For 7 years Max. (When 8 items are recorded a day)
	※ According to the sampling intervals and alert frequency, the number of recording items can change from the days specified above. When the recording capacity is exceeded, the oldest item is deleted and the newest one is added.	
USB memory (For log data takeout)	Applicable standard	USB2.0
	Required capacity	50 MB or more
	※ The USB memory attached to this converter shall only be used, without fail. If any item other than the standard accessory is used, normal operation cannot be assured.	
Display system	Digital display by fluorescent indicator (With auto-lighting function by human sensor)	
Power source	AC100 V ± 10%　50/60 Hz 20 VA (AC200 V type available)	
Maintenance outlet	AC100 V exclusive (not applicable to AC200 V type)	
Operating temperature	−10～50℃	
Operating humidity	5～90% RH	
Storage temperature	−20～65℃	
Storage humidity	5～90% RH	
Construction	Splash-proof type (Protective grade: Equivalent to IP-64)	
Casing material	SS t1.2	
Color of coating	2.5Y7.5/0.3	
Mass	Approx. 6 kg	

fluctuations, but also to cases where the measurement target changes in a short period of time. For example, excess sludge is treated in the morning and thickened sludge is treated in the afternoon. Switching at this time, however, is only made through manual operation.

4 Specifications

Table 2 shows the specifications of the new water quality converter. Here, the specification is only for the converter, which is the focus of this report.

5 Postscript

We introduced a water quality measuring instrument that has been renewed by incorporating customer feedbacks as much as possible.

Going forward, we will continue to seek feedback from our customers, especially those using our instruments at the facilities. We will work hard to improve our products further. We would also like to thank our customers for your valuable opinions and advice.

(Notes)

※1. For actual operation, adjustments must be made by our engineers.
※2. Only when an order is received in advance for 2CH specifications. When changing the existing 1CH specification to 2CH, modification and adjustment by our engineers are required.