FLXA402 and SA11 New Liquid Analyzer Contributing to the SDGs

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Yokogawa provides liquid analyzers such as pH analyzers, dissolved oxygen analyzers and conductivity analyzers. These are used for water quality management and waste water treatment, thus contributing to environmental preservation. Liquid analyzers must operate stably and continuously to prevent polluted water from being discharged into public water bodies, and to enable water and sewage to be treated efficiently. On the other hand, sensors must be exchanged and calibrated periodically due to deterioration and dirt. Managing the discharge of fresh and sewage water involves issues of both capital expense (CAPEX) and operating expense (OPEX) because multiple analyzers must be purchased and maintained.

To overcome these issues, Yokogawa has launched, as part of SENCOM platform 4.0, the new FLXA402 liquid analyzer, which improves maintenance efficiency with multiple sensor inputs, and the SA11 SENCOM smart adapter, which enables the replacement of only sensors. This paper describes the characteristics of the FLXA402 and SA11.

INTRODUCTION

In many developed countries quality standards have been established for the water discharged from factories and plants to prevent water pollution of public water bodies and groundwater. In addition, the quality of household wastewater has been improved by upgrading sewage systems and septic tanks. Since releasing the P/H Cell 2-wire liquid analyzer for analyzing processes in 1971, Yokogawa has developed and launched various liquid analyzers such as dissolved oxygen analyzers and conductivity analyzers. These analyzers are used in a wide range of areas including quality management of treated water, sewage water, river water, and tap water, thus contributing to environmental preservation.

Liquid analyzers are composed of two parts, the sensor part with detectors and the converter part to convert analog signals from sensors into measurement values. Yokogawa's liquid analyzers have been improved several times since their first launch. In earlier models, such as the EXA450 series 4-wire converters, a converter was used in combination with a sensor for each measurement item such as pH and conductivity. Later models, such as the FLXA21 and FLXA202 2-wire analyzers, enabled the same item to be measured with two sensors connected to a single converter, which helped reduce cost for customers[(1)].

However, customers with the former liquid analyzers still wish to do the following:

(1) To reduce the number of converters by measuring pH and conductivity with a single converter
(2) To improve the efficiency of installation and maintenance
(3) To enrich the data communication functions between

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converters and host devices such as DCS

In response to such needs, Yokogawa has developed the FLXA402 4-wire liquid analyzer that features functions for multiple sensor input, device diagnosis, and communication with host devices such as DCS. Details of the FLXA402 will be described in Chapter FLXA402".

The FU20F digital smart sensor, with integrated sensor and measurement functions, also requires the following improvements:

(4) The ability to use the device diagnosis function alone without using the converter function, and to replace only the sensor part

(5) Improvement in sensor maintenance work

(6) The ability to flexibly construct data monitoring systems with direct connection to DCS and other host devices, recorders, indicators, and tablets

Yokogawa has developed the SA11 SENCOM smart adapter by incorporating such improvements and has released it as part of the SENCOM 4.0 platform. Details of the SA11 will be described in Chapter SENCOM SA11.

SENCOM 4.0 PLATFORM

The SENCOM 4.0 platform consists of the FLXA402, the SA11, and other peripheral devices, and is a next-generation platform for liquid analyzers that helps solve the problems faced by customers throughout the entire lifecycle of products. Composed of a converter, SENCOM smart adapters, sensors, and a display, this platform offers customers the ideal environment regardless of the system size (Figure 1).

Figure 1 SENCOM 4.0 platform

FLXA402

Multiple Sensor Inputs

Analyzers must be replaced periodically to comprehensively manage discharged water, clean water, and sewage water. Therefore, maintaining and managing analyzers involves significant costs, including for purchasing and maintenance. For this reason, there was a strong need to measure both pH and conductivity with a single converter. The FLXA402 can accept any sensors including conventional analog sensors (pH/ORP, conductivity, inductive conductivity, and dissolved oxygen sensors), optical dissolved oxygen sensors, and digital sensors comprising the SA11 SENCOM smart adapter and its dedicated sensors. By using an SA11 and BA11 junction box, up to five sensors can be connected to the FLXA402 (Figure 2). In line with the increased number of sensors connected, the FLXA402 features up to four 4-20 mA current outputs and two contact inputs for washing. The human machine interface (HMI) can display up to four measurement values, and another four values on a screen by switching the tab (Figure 3). The HMI can also display the difference between, and the average of, the signals from two sensors, and the values before and after computation, on a screen. Measured values of pH and conductivity generally need to be compensated for temperature to avoid the influence of liquid temperature. However, some sensors are not equipped with elements to measure temperature. The FLXA402 features a 4-20 mA current input circuit, which the previous liquid analyzers did not have, and a function to compensate temperature based on external temperature input, to improve the reliability of measurement values. Thus, a single FLXA402 is used efficiently, reducing cost and saving space.

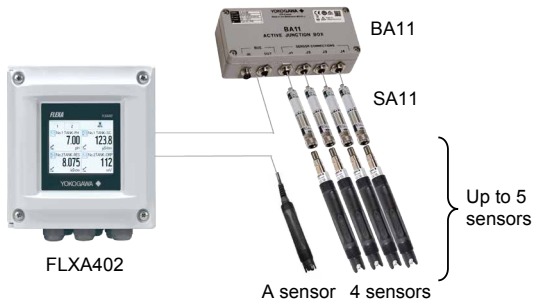

Figure 2 Combination with the BA11

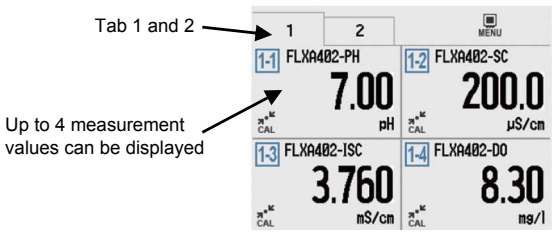

Figure 3 Measurement screen of the FLXA402

Improved Efficiency of Installation and Maintenance

The FLXA402 features an SD card slot as standard. The setting values for a converter are stored in an SD card, and can be copied to another converter. This function helps reduce the time required for starting up a new converter and updating the setting values of an existing converter. The firmware can also be updated for functional improvement by using an SD card. The HMI screen, which uses a color LCD panel, is visually easier to grasp than that of the previous models (Figure 4). Loop tests with host devices can be performed efficiently. The HMI supports 11 languages for the convenience of users across the globe.

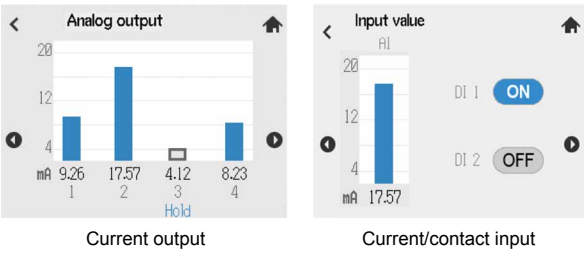

Figure 4 Screen of the FLXA402

Yokogawa provides the FieldMate tool for setting and adjusting field devices and environmental devices in the field. FieldMate makes it easy to perform setting, /calibration, and historical management of the FLXA402 and the SA11 on graphic screens. FieldMate can also be connected to the FLXA402 via Bluetooth and used as a display device in the field. When a converter is mounted in a high location requiring high-place work, Bluetooth connectivity allows the converter to be set from the ground, improving the work efficiency and eliminating the risk of accidents associated with working at high locations.

Multiple Communication Protocols

The FLXA402 uses RS485, Ethernet, and HART physical layers for digital communication. It also supports ModbusTCP, Modbus/RTU, and HART7 protocols for communicating with host devices, enabling connection to a wide range of devices from PCs to DCSs. Using these digital communications, users can transmit measured values, alarms, device information, and various diagnosis data to host monitors or monitoring systems such as DCS. Users can also set converters from host monitors and monitoring systems. An industrial IoT (IIoT) environment can be constructed by connecting the FLXA402 to the cloud, which facilitates maintenance in the field. The FLXA402 features up to four current outputs to maintain upward compatibility with the previous models. In addition, the use of Modbus helps reduce capital investments such as wiring cost.

SENCOM SA11

Improved Device Diagnosis Function and Suppressed Maintenance Cost

Yokogawa has been providing SENCOM smart sensors since 2013, and has accumulated a solid track record in the field of digital sensors[(2)]. Sensors must be recalibrated or replaced periodically due to degradation or accumulation of grime, depending on the characteristics of the liquid to be analyzed. However, SENCOM smart sensors do not have built-in calibration algorithms. Therefore, they must be connected to the FLXA21/202 2-wire converters, which have calibration algorithms, or to the SPS24 SENCOM PC software, for calibration. SENCOM smart sensors do not have calculation functions for device diagnosis either, and hence device diagnoses must be conducted by the FLXA21/202 or the SPS24. Moreover, a SENCOM smart sensor has an integral structure including both the sensor part and the converter part, as shown in Figure 5. When the sensor part reaches the end of its lifetime and needs to be replaced, the entire sensor including the converter part must be replaced. To solve such problems, Yokogawa has released the SA11 SENCOM smart adapter that features a calibration algorithm and device diagnosis functions, to enable separation of the sensor and converter parts. The sensor is an independent part with a connector for connection with the SA11. To enable the SA11 to be connected to various sensors, an ID chip is built into each sensor with a record of the serial number for recognizing individual sensors and sensor calibration information (Figure 6).

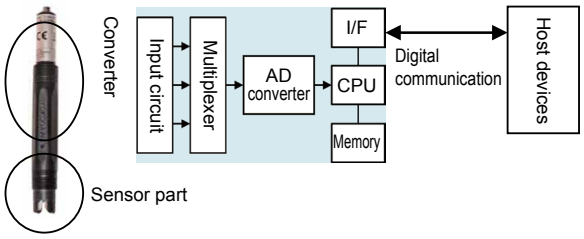

Figure 5 Configuration of SENCOM smart sensor

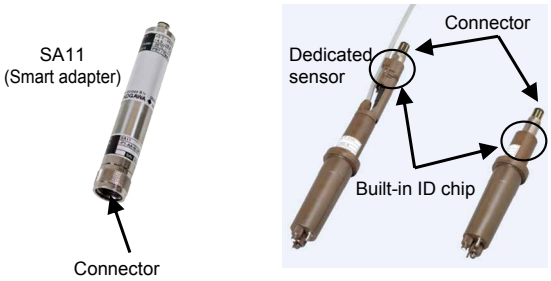

Figure 6 SENCOM adapter (left) and dedicated sensor (right)

The advantages of built-in ID chips will be described in Chapter Improving Maintenance Efficiency. The SA11 SENCOM smart adapter enables the sensor part to be replaced alone separately from the converter part, and hence reduces the maintenance cost and waste. Thus, the SA11 is an eco- and human-friendly product, and is used in combination with dedicated sensors that convert signals from sensor elements to physical quantities such as pH, communicate with host devices, and have sensor calibration and device diagnosis functions and built-in ID chips.

Improving Maintenance Efficiency

Sensors deteriorate gradually and need periodical calibration, as stated earlier. Users of conventional sensors must connect the sensors to converters in the field for calibration. In contrast, the dedicated sensors with ID chips can be detached from the SA11 and calibrated in laboratories or other places safely and easily, using the sensor parameters and calibration data stored in the ID chips. A dedicated sensor can be replaced with a new sensor that has been pre-

calibrated in a laboratory. As a result, the time required for field maintenance is reduced, and the measurement downtime for calibration is also reduced (Figure 7).

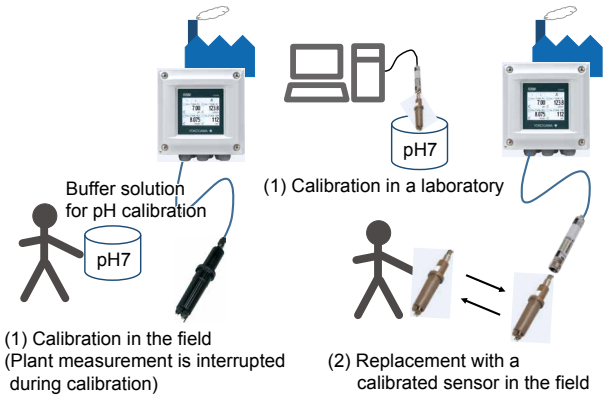

Figure 7 Conventional calibration (left) and calibration using SENCOM (right)

FieldMate can be used for calibrating sensors in a laboratory. By connecting a sensor with the SA11 and connecting the SA11 with FieldMate via Bluetooth using the IB100 (Bluetooth I/F), up to four sensors can be calibrated simultaneously (Figure 8). Thus, operators can calibrate multiple sensors that need recalibration at the same time, reducing the time for calibration. Also, sensors can be calibrated when the operator is not busy, enabling operators to use their time more flexibly.

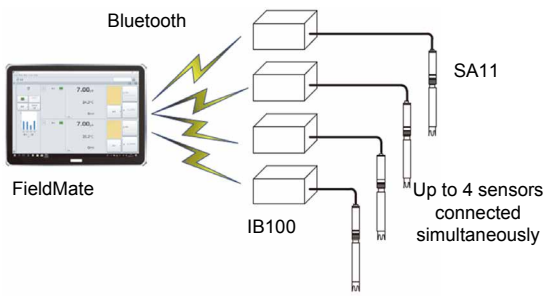

Figure 8 Connection with FieldMate

Many customers still manage the calibration results by handwriting them in calibration record ledgers, but sometimes forget to record the results and so must perform the calibration again. FieldMate can manage the results of past calibrations for each sensor and output them in a flexible template. This eliminates the labor of handwriting and the risk of forgetting to record, and helps improve maintenance efficiency.

Simple and Flexible System Configuration

The digital communication of the SA11 uses the RS485 physical layer and Modbus communication protocol. Therefore, the SA11 can be connected directly to various devices such as the UM33A-S digital indicator with alarms and control systems, recorders, data loggers, and indicators that are compatible with Modbus, as well as the FLXA402 (Figure 9), enabling a simple system to be configured for data monitoring, calibration, setting, and adjustment operations.

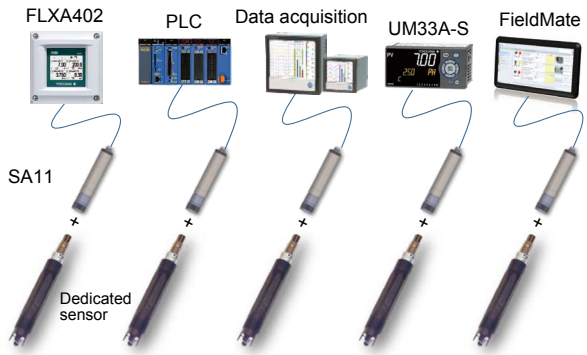

Figure 9 Examples of connection with the SA11 SENCOM smart adapter

FUTURE DEVELOPMENT

The SA11 SENCOM smart adapter currently features only an adapter for pH analyzers, but will be expanded to handle other liquid analyzers such as conductivity analyzers. In addition, acquisition of certifications for intrinsic safety and type-N explosion-proof is planned. With such certificates, Yokogawa plans to provide the SA11 to customers in the oil and gas industry where demand for 2-wire analyzers is high, in combination with the FLXA202 2-wire liquid analyzer that has already received various explosion-proof certifications.

The FLXA402 can be connected with the DO70G optical dissolved oxygen sensor that has the Modbus RTU (RS485) protocol, and can also be connected with many other sensors by using the converter hardware in common and modifying the firmware, as long as the sensor has the Modbus RTU protocol. Existing sensors can be used with the FLXA402 by modifying the sensor interface to be compatible with SENCOM and using Modbus communication.

CONCLUSION

Yokogawa develops and provides various liquid analyzers such as pH, dissolved oxygen and conductivity analyzers. These analyzers have been used for water quality management and waste water treatment processes, and have contributed to environmental preservation. However, the analyzers incur a high capital expense (CAPEX) and operating expense (OPEX), as multiple analyzers must be purchased and their sensors calibrated and periodically replaced.

The FLXA402 enables multiple sensor inputs and reduces both investment cost and mounting space. The features of the FLXA402, including support for SD cards, a useful color LCD panel, user-friendly HMI, and various communication protocols, also improve work efficiency.

With the newly added functions for calibration and device diagnosis, the digital sensors of the SA11 SENCOM smart adapter and sensors with ID chips facilitate maintenance without requiring expertise. These sensors also reduce waste

and are eco-friendly. The SA11 can be connected directly to control systems, recorders, and indicators that are compatible with Modbus, and enables systems with simple configurations to be constructed for data monitoring, calibration, setting, and adjustment.

Yokogawa is committed to achieving the Sustainable Development Goals (SDGs) by reducing the installation cost and improving maintenance efficiency by using the FLXA402 and the SA11, reducing waste by using sensors with ID chips, and preserving water quality in the environment.

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