HORIBA
Process & Environmental

Case study

Usage example of non-replenishment pH electrode 6155 in water purification plant

1 Overview

pH measurement is widely used across various industrial processes and applications. The first pH electrode was commercialized by Beckman in the United States in 1935. On the other hand, our founder, Masao Horiba commercialized the first pH electrode in Japan in 1950. Although the measuring principle of pH remains unchanged, pH electrodes have evolved into various shapes and sizes to suit the user's needs and requirements such as maintainability, usability, and long life-span.

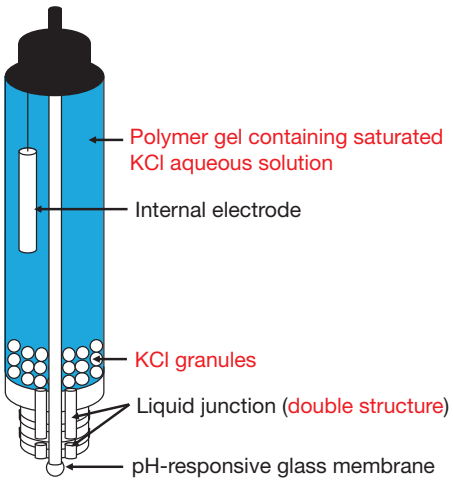
2 Issues

Industrial pH electrodes often require precise measurements in harsh environments over continuous and long period of time. As sample conditions differ depending on the process and the industry, there is no single electrode that can handle all kinds of samples. For instance, a conventional pH electrode requires the refill of internal solution periodically. The refilling process is a tedious process as it requires cleaning and calibration of the electrode. In addition, at sites where the sample velocity and fouling are high, there is a propensity for measurement errors to occur coupled with shortened lifespan of the electrode. Conversely, measurement is difficult for sample with very low conductivity. In the situations described above, it is ideal to have an electrode with high maintenance property, high measurement accuracy, and environmental resistance.

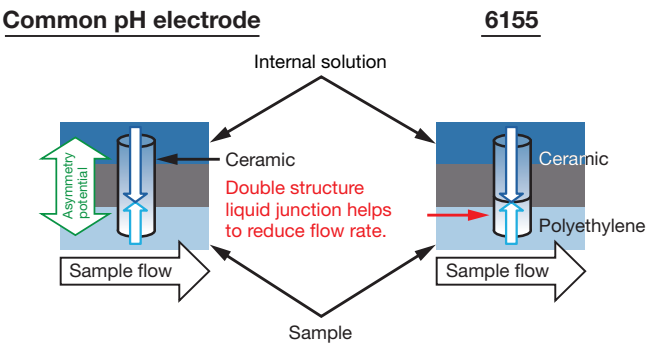
3 Advantages of the industrial non-replenishment pH electrode 6155

HORIBA has developed the non-replenishment pH electrode 6155 (hereinafter 6155) with maintainability, high measurement accuracy and environmental resistance. This is made possible by supersaturating the reference electrode with water-insoluble polymer gel containing KCl aqueous solution, therefore, replacement of the internal solution is not required. It is also difficult for voids to form inside the housing because the polymer gel hardly flows out of the sample and has excellent chemical decomposition resistance. This means that even in a pressurized environment such as in a distribution pipe, backflow of the sample is unlikely and sustainable measurement over long period of time is possible. In addition, the double structure of the liquid junction of the reference electrode mitigates the influence caused by flow rate of the sample. This is vital especially for samples with low conductivity as those samples that are easily influenced by flow rate can be measured accurately (samples with conductivity higher than 10 μ/cm can be measured within an error of 0.1 pH).

▶ Structure of 6155 Electrode



▶ Comparison of liquid junctions between a common pH electrode and 6155.



4 Example of field measurement

Field measurements were performed using the non-replenishment pH electrode 6155 along with HORIBA on-site industrial water quality meter at the intake of a domestic water purification plant. Image 1 depicts the installation site. The electrode immersed in the water tank at the top of the image is 6155 and the electrode installed in the flow-type holder with KCl tank at the lower right of the image is HORIBA's conventional electrode 6108, which is an internal solution replenishment type. 6155 does not require a KCl tank, which makes installation and maintenance easy. In addition, measurement of low conductivity sample such as tap water remains stable due to the unique double liquid junction structure. Table 1 and Figure 1 are the measurement data of the standard solution taken during periodic inspection 3 months after installing 6155. From the data, we can infer that measurement value of 6155 is almost unchanged and the sensitivity hardly deteriorated. Therefore, it can be concluded that 6155 has exceptional usability and could meet the demands of various field measurements as it exhibits excellent measurement stability, maintainability and environmental resistance.

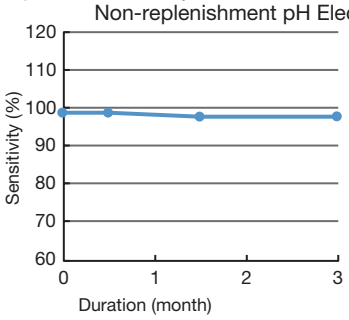
Image 1 Measurement Site

Table 1 Standard Solution Measurement Data Three Months after Implementing Non-replenishment pH Electrode 6155

Standard solution	Measured value		Results
	Calibration value	After 3 months	
pH4	4.01	4.07	Within ±0.1 (more accurate measurement is possible with periodic calibration)
pH7	6.86	6.94	Within ±0.1 (more accurate measurement is possible with periodic calibration)
pH9	9.18	9.28	Within ±0.1 (more accurate measurement is possible with periodic calibration)

Figure 1 Sensitivity of Standard Solution Measurements Three Months after Implementing Non-replenishment pH Electrode 6155*

*Transmitter failure ranges: >68% and <110%



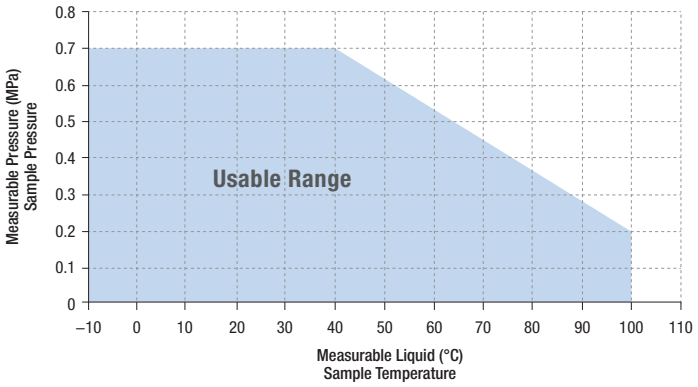
Sensitivity (%)	
pH 4 - pH 9	97.6
pH 4 - pH 7	95.8

Non-replenishment pH Electrode 6155 Specifications

Product name	Industrial Gel-filled pH Electrode	
Model	6155 Series	
Electrode structure	Lead type GRT composite electrode	Connector type GRT composite electrode
Measurement range	0 to 14 pH*1	
Sample water temperature	-10 to 100°C (no freezing)	
Sample water pressure	Up to 0.7 MPa (under 40°C)*2	
Sample water conductivity	10 µS/cm or more*3 Flowrate needs to be lower than 0.05 m/s.	
Storage temperature range	0 to 50°C, Relative humidity 85% or less (when unopened)	
Liquid junction structure	Double liquid junction structure	
Comparative electrode internal liquid	Water-insoluble polymer gel Potassium chloride supersaturated	
Direct screw thread type	–	NPT 3/4
Wetted material	Glass, PVDF, FKM, PE	
Cable length	5 m (standard)/ 10 m/15 m/20 m (MAX)	Option 5 m/10 m/15 m/20 m (MAX)
Temperature compensation component	Pt 1000 Ω (at 0°C)	
Compatible converter	· HP-200/300 Series (excluding explosion-proof) · HP-480/960 Series	
Terminal connection	Square destination opening crimp terminals (4 mm) G, S, R, T, T, E	

*1. We recommend 6108 if high accuracy is required for strong alkali sample.
*2. 40°C or more of the pressure range, please refer to the following Figure 2.
*3. When measuring low conductivity samples under high pressure conditions, the measured value may fluctuate by about 0.3 pH (pH)/200 mV (ORP).
By reducing the sample flow rate, the fluctuation range can be reduced.

Figure 2 Pressure Range above 40°C



HORIBA Advanced Techno
HORIBA Advanced Techno, Co., Ltd.
Head Office
31 Miyanonishi-cho, Kisshoin, Minami-ku, Kyoto, 601-8306, Japan
Phone: 81 (75) 321-7184 Fax: 81 (75) 321-7291
http://www.horiba-adt.jp

HORIBA
HORIBA, Ltd.
Group Head Office
2 Miyanohigashi-cho, Kisshoin, Minami-ku, Kyoto, 601-8510, Japan
Phone: 81 (75) 313-8121 Fax: 81 (75) 321-5725
http://www.horiba.com

Printed in Japan 2009SK00