pH METER

Guide to care and maintenance of pH electrodes

Introduction

Analysts often encounter pH measurement problems caused by poor electrode performance. This can include errors on calibration, drifting or unstable readings and sluggish response. Diagnosis and rectification of these problems can be time consuming, however many common faults can be prevented through adequate care and maintenance of the pH electrode and any problems diagnosed using simple check procedures.

A pH electrode has a finite life which is generally 18 months to 2 years depending on use and how it has been maintained. Reasons why an electrode might fail include:

- Age - they do wear out over time.
- Poor maintenance – electrodes must not be allowed to dry out and must be cleaned after use.
- Use with incompatible substances – for example Tris buffers are incompatible with electrodes containing AgCl.

This guide describes the correct care and maintenance steps required to prevent the occurrence of common problems. Adopting the guidance will allow analysts to achieve high quality pH measurements with reduced incidence of poor performance from their pH measurement system.

Electrode cleaning

During use, electrodes can suffer from contamination to the membrane and diaphragm which will result in noisy or unstable readings, measurement errors or slow electrode response. Given below are various cleaning procedures that can be employed as either a preventative measure or as a corrective action to maintain or restore the performance of a poorly functioning electrode.

Between samples:

- Rinse the electrode with deionised water or appropriate solvent.

At the end of each day of use:

- Rinse in methanol.
- Soak the electrode in 0.1M HCl for 5 min.
- Remove and rinse well with deionised water.
- Soak in 0.1M NaOH for 5 min.
- Remove, rinse again with deionised water and store in appropriate pH electrode storage solution[1].

[1] Do not use 025 192 storage solution for Tris-compatible electrodes such as 924 030 or 924 050 as it contains AgCl. Use 3M KCl acidified to pH 5-6.

If the electrode has been used in samples containing high concentrations of protein:

- Add 1% pepsin to 0.1M HCl solution and leave the electrode to soak in this solution for 15 minutes. Alternatively, use part code 025 161 pH Electrode Cleaning Solution.
- Remove and rinse with deionised water.
- Soak in pH 4 buffer for 10 min before use.

If the electrode has been used in greasy, oily or inorganic samples:

- Rinse with detergent or ethanol solution.
- Soak in 0.1M tetra-sodium EDTA solution for 15 min.
- Remove and rinse with deionised water.
- Soak in pH 4 buffer for 10 min before use.

If the electrode's reference electrolyte has been contaminated:

- Empty the contaminated filling solution and refill with the specified filling solution[2].
- Rinse the electrode with deionised water and soak in pH 4 buffer for 10 min before use.

Periodic maintenance

A regular visual check of the pH electrode will help to identify potential issues.

- Check that the filling solution is above the internal elements (not applicable for gel filled electrodes). If not, re-fill the electrode with the specified filling solution.
- Look for signs of blockage or discoloration of the reference junction. If observed, follow the regeneration procedure below.

Checking pH electrode performance

Often an indicator of poor electrode performance is a failure to calibrate when using pH buffers. The "error EO outside limits" indicates that the pH meter does not recognize the response given by the electrode as it is outside the values it is expecting for a given buffer.

It is quite simple to check the response of the pH electrode by measuring the mV given in each of the pH buffer solutions.

- Set the pH meter to read mV.
- Place the pH electrode in pH 7.00 buffer. At pH 7.00 the reading should be in the range 0 ± 30mV (this is the zero potential).
- Rinse the electrode and place in either pH 4.00 or pH 10.00 buffer. At pH 4.00 or pH 10.00 the reading should read more than 150 mV above or below the zero potential (this is the slope).

If any of the readings are outside these limits you should either replace the electrode or follow the regeneration procedure below.

pH electrode regeneration and reconditioning

Prolonged use, excessive alkaline immersion, or high-temperature operation will cause surface leaching of the membrane glass. The result is an extremely noisy and/or sluggish

[2] For recommended filling solutions, please see http://www.jenway.com/product.asp?dsl=4081.

response, which cannot be remedied simply by cleaning the electrode. If this occurs, the following procedures will often provide stability and pH sensitivity. Always consider the electrode's materials of construction before following these procedures.

1. Empty the reference chamber, rinse with deionised water, empty and refill with the specified filling solution.
2. Soak the electrode in hot (50°C – 60°C) filling solution for a few minutes.
3. Soak the electrode overnight in pH 4 buffer.
4. Remove any exterior salt deposits with distilled water.
5. If the filling solution does not flow through the junction by this time (generally due to an unusually low junction porosity), use gentle suction to pull filling solution through the junction and repeat from step 2.

Recheck the performance of the electrode by repeating the performance check described above.

Sometimes the material clogging the junction requires more severe action. Should the above fail, proceed as follows:

1. If possible, use a solvent specific to the solution or material plugging the junction.
2. Soak the electrode overnight in 0.1 M HCl.
3. If measurements have been made in samples containing protein, remove protein deposits by soaking the electrode bulb in 0.1 M HCl containing 1% pepsin.
4. Repeat from step 1.

If all these fail, the electrode should be discarded safely and replaced.

• pH electrode storage

Electrodes should be stored in pH 4.0 buffer solution between readings and in electrode storage solution (025 192[3]) for long-term storage. If storage solution is not readily available, liquid–filled electrodes can be stored in pH 4.0 buffer solution in the short term but this may result in the filling solution taking on a pink tinge. Acidified 3M KCl solution can also be used. The latter is not ideal for long term storage for AgCl/KCl electrodes, but provided the pH is not below 4, it should be fine. If the storage solution is too acidic, you may see drift when trying to measure the pH of a weak sample because the HCl (or whichever acid was used to acidify the storage solution) will leak into the sample and contaminate it.

We usually recommend storing the probes in the same solution as the external fill, this is because having the same solutions and concentrations on both sides of the membrane, will ensure no migration of salts or ions during storage.

To return an electrode to long-term storage, prepare it in the same condition in which you received it; usually, this means simply moistening and replacing the end cap of gel–filled electrodes to protect and keep the sensing membrane active. To store liquid–filled reference and combination electrodes, refill with electrolyte, cover the fill hole and moisten and replace the protective plastic cap.

Important note: Never store an electrode in distilled or deionised water. This may lead to slow, sluggish response.

[3] Do not use this storage solution for Tris-compatible electrodes such as 924 030 or 924 050 as it contains AgCl. Use 3M KCl acidified to pH 5-6.