Cleaning of Acrylic Painted Surfaces
Washington DC, April 30 – May 3, 2013

TITLE

pH Meters

INSTRUCTOR

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TECHNICAL NOTE

INTRODUCTION

pH measurements are made in a number of ways, each has advantages and disadvantages. The most common method of measuring pH is with a pH meter using a glass pH electrode. In fact there are two electrodes, the glass pH sensing electrode and a reference electrode.

pH is determined by measuring the potential (voltage) difference between an electrode behind the glass membrane in 0.1M HCl (pH = 1.0) and the reference electrode which is in contact with the test solution. For each pH unit of difference between the 0.1M HCl solution on the inside of the electrode and the test solution a 60mV potential develops across the glass membrane.

Most of the pH meters used in conservation use a "combination electrode" where the single electrode unit contains both the pH and reference electrodes in a single unit.

The glass membrane of the electrode should always be kept wet to prevent dehydration of the hydrated glass gel layer on the external surface of the electrode. A dry electrode, as when first received, should be soaked in pH 7 buffer or pH electrode storage solution for several hours before being used. If the electrode has dried out, it can be reconditioned in a 0.1M HCl solution,

Before measuring the pH of a solution, sample or calibration buffer, the electrode should be rinsed with distilled water and blotted dry. Wiping the glass can cause a static charge to build up which can damage the meter. The glass membrane is quite thin making the electrode very fragile and is easily damaged.

Before using a pH meter it has to be calibrated. Calibration is done with one or preferably two buffer solutions. Better meters allow two calibration points. The first calibration is done at a pH of 7 (pH 7.01 @ 25°C is the commonly used buffer solution). The buffer solution, the pH electrode and the solutions to be measured should all be at the same temperature. The electrode should be allowed to equilibrate for at least a minute in the pH 7 buffer solution before calibrating the meter. The solution should be stirred before the reading is made. The meter is then adjusted to register the stated pH of the buffer solution.

The second calibration point should be made in a pH 4 or pH 10 buffer solution depending on if the solution to be measured is acidic or alkaline. The electrode should be rinsed with distilled water and blotted dry between each measurement. Once the reading has stabilized, the second calibration adjustment is made to set the meter's reading to match the stated pH of the buffer solution.

After the pH 4 or 10 value is set, the electrode should be rinsed, blotted, and the pH 7 buffer checked again. It may be necessary to readjust the pH 7 calibration. If this is the case, the 4 or 10 should be rechecked again, too.

Fresh buffer solution should be used when calibrating and used buffer solution discarded. The calibration solution absorbs carbon dioxide from the air and the pH can change even though the solutions are buffered to prevent this. This effect is greatest for the pH 10 buffer. Calibration buffer stock solutions should be kept capped.

Ideally, pH meters should be recalibrated every couple of hours during use.

As the electrode ages the glass membrane can become less responsive to the solution pH. If an electrode cannot be calibrated to give acceptably accurate readings in two calibration buffers, the electrode may need to be replaced. (Or in the case of a meter with a non-replaceable electrode, the entire meter may need to be replaced.) An electrode may be able to be reconditioned by soaking it in a 6M HCl solution (50% concentrated HCl) followed by soaking briefly in water.

The electrode should not be stored or even soaked in distilled water as the water can leach ions out of the glass membrane (the "hungry water" phenomenon know to paper conservators). For combination electrodes, it is best to store the electrode in a commercial pH electrode storage solution or 3M KCl.

BIBLIOGRAPHY

Harris, Daniel C. Quantitative Chemical Analysis, 6th Ed. W.H. Freeman and Co. 2003. pp 323-329.
http://en.wikipedia.org/wiki/PH_meter