Designation: D8294 – 21

Standard Practice for Estimating pH to Verify Status of Aqueous Samples[1]

This standard is issued under the fixed designation D8294; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice provides information on verifying the pH of aqueous samples before analysis. This practice is not intended to be used for non-aqueous samples like oil or grease.

1.2 This practice may also be used in adjusting pH of samples during various analytical steps.

1.3 Wide-range pH papers/strips are used for a rapid indication of pH to within about 1 pH unit, and narrow-range pH papers/strips are used to indicate pH within about 0.5 pH units.

1.4 In some instances, a universal liquid indicator may be used.

1.5 *Units*—The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.6 This practice offers a set of instructions for performing one or more specific operations. This document cannot replace education or experience and should be used in conjunction with professional judgment. Not all aspects of this practice may be applicable in all circumstances. This ASTM International standard is not intended to represent or replace the standard of care by which the adequacy of a given professional service must be judged, nor should this document be applied without consideration of a project's many unique aspects. The word "Standard" in the title means only that the document has been approved through the ASTM consensus process.

1.7 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.8 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D1293 Test Methods for pH of Water

3. Terminology

3.1 *Definitions:*

3.1.1 *pH paper, n*—pieces of paper usually supplied as small rolls that change color depending on the pH.

3.1.1.1 *Discussion*—pH paper is an inexpensive, robust, and relatively accurate way of estimating the pH of an aqueous liquid. A strip of filter paper is soaked with different pH indicators, or a mixture of indicators (universal indicator), and allowed to dry. Touching solution to the paper or dipping the paper in an aliquot of solution causes the color of the indicator on the paper to change according to the pH. The color and relative intensity of the color is compared to a chart from which pH is estimated. Using only one indicator per paper enables a better estimate of a narrow pH range.

3.1.2 *pH paper/strip, n*—throughout this practice, the term is used as a reference to both, pH paper and pH strip.

3.1.3 *pH strips, n*—strips of plastic with one or more squares or rectangles of pH paper fastened to one end.

3.1.3.1 *Discussion*—pH strips are more rugged than pH paper. They consist of one or more (usually up to four) small squares or rectangles of pH paper attached to one end that are dipped into an aliquot of the sample. In contrast to indicator papers described in 3.1.1, pH strips typically have the indicator chemically bound or fixed to the paper to prevent it from leaching into the sample. However, products that contain impregnated filter papers on test strips are also available and these may release indicator into the sample. When necessary, the type can be checked by putting a test strip "face down" on absorbent paper. Each square features a different pH indicator resulting in different colors and intensity in relation to the pH. The color and intensity of each square is compared to a chart from which pH is estimated. The different indicators/colors of each square provide users with greater confidence in their estimation of the pH.

[1] This practice is under the jurisdiction of ASTM Committee D19 on Water and is the direct responsibility of Subcommittee D19.05 on Inorganic Constituents in Water.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

3.1.4 *screening analysis, n*—preliminary qualitative or semi-quantitative test designed to give the user specific information before conducting quantitative chemical analysis.

3.1.5 *universal pH indicator, n*—pH indicator composed of a solution of several compounds that exhibits several smooth color changes over a pH value range from 0 to 14.

3.1.5.1 *Discussion*—There are several commercially available universal pH indicators. A universal indicator solution is typically composed of water, phenolthalein, methyl red, methyl orange, bromothymol blue, thymol blue, and thymolphthalein among other ingredients and stabilizers. A clear liquid can be added to an indicator solution. For non-clear samples, it is best to use pH papers/strips.

3.1.6 *very weakly buffered solution, n*—in the context of pH paper/strip testing, a very weakly buffered solution is a solution that does not meet one of the following criteria: (*1*) the H^+-concentration is $>10^{-4}$ mol/L (pH < 4), (*2*) the OH-concentration is $>10^{-4}$ mol/L (pH > 10), and (*3*) the concentration of a buffer active in the respective pH-range is $>10^{-4}$ mol/L.

3.1.6.1 *Discussion*—For example, rainwater and desalted water are typically considered very weakly buffered solutions.

3.1.7 *weakly buffered solution, n*—in the context of pH paper/strip testing, a weakly buffered solution is a solution that does not meet one of the following criteria: (*1*) the H^+-concentration is $>10^{-3}$ mol/L (pH < 3), (*2*) the OH- concentration is $>10^{-3}$ mol/L (pH > 11), and (*3*) the concentration of a buffer active in the respective pH-range is $>10^{-3}$ mol/L.

4. Summary of Practice

4.1 pH paper/strip is dipped into an aliquot of sample solution or sample solution is dropped onto a pH paper/strip and the pH is estimated from a color chart.

4.2 In some cases, an indicator solution may be added to the sample, and pH is estimated from a color change using a color chart or an absorbance reading.

5. Significance and Use

5.1 This practice is intended for use by samplers, technicians, or analysts to verify that samples are preserved or at the proper pH specified in analytical procedures.

5.2 The pH is indicated within about 1 pH unit for wide-range paper and within 0.5 pH units for narrow-range paper.

5.3 Unless stated otherwise in the test method, a wide-range paper estimating pH within 1 unit is suitable.

5.4 A narrow-range pH paperstrip may be used for test methods with tighter pH requirements; however, accuracy better than ±0.5 pH units of the estimate should not be implied.

5.5 Rapid pH tests allow users to make spot determinations directly without auxiliary equipment.

6. Interferences

6.1 Most products on the market are intended to be used with well-buffered solutions. Weakly buffered solutions (as in accordance with 3.1.7) may be tested with color-fixed pH papers/strips in which the indicator is chemically bound to the fiber (3.1.1) when the pH paper/strip is left in the sample until the color no longer changes (5–10 min). Very weakly buffered solutions (as in accordance with 3.1.6) are not suitable for pH paper/strip testing.

6.1.1 Specifically, do not use for high-performance liquid chromatography (HPLC) eluents or deionized water.

6.2 The degree of dissociation by pH indicators is influenced by neutral salts, proteins, colloids, and organic solvents. Salt error is specific to each indicator; however, generally the higher concentrations of neutral salts tend to shift indicator acids to read too low and indicator bases to read too high.

6.3 Materials that mask the pH paper/strip, for example, oils, grease, paint, syrup, and so forth may cause the visual estimation of color on the pH paper/strip to be difficult.

6.4 Oxidizers can bleach the pH paper/strip. Dechlorinate samples with the test-method-required reagent first before adjusting and checking pH.

6.5 Indicator papers (3.1.1) may "bleed" indicator into the sample solution. Most pH strips (3.1.3) do not, but this needs to be verified for the brand used when necessary.

6.6 Some test methods, such as volatile organics, may require verification of pH after the analysis is completed.

6.7 This practice may not be suitable for color blind technicians.

6.8 Measurement in colored solutions may not be accurate. Compare against a meter using Test Methods D1293.

6.9 pH papers/strips are optimized for use at 20°C. Usually, the effects of temperature on reading results are negligible. However, if needed, verify accuracy of pH measurements using buffers at the sample preservation temperature.

6.10 Surfactants may influence the reaction color of the pH indicator, which then cannot be assigned anymore to the color chart. Change the type of pH paper/strip in this case.

7. Reagents

7.1 Reagent-grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society where such specifications are available.[3] Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.

7.2 Wide-range papers that indicate full pH units have an expected precision of ±1 pH unit.

7.3 Narrow-range papers that indicate half pH units have an expected precision of ±0.5 pH units.

[3] *ACS Reagent Chemicals, Specifications and Procedures for Reagents and Standard-Grade Reference Materials*, American Chemical Society, Washington, DC. For suggestions on the testing of reagents not listed by the American Chemical Society, see *Analar Standards for Laboratory Chemicals*, BDH Ltd., Poole, Dorset, U.K., and the *United States Pharmacopeia and National Formulary*, U.S. Pharmacopeial Convention, Inc. (USPC), Rockville, MD.