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Hydrogen ion concentration (pH) of paper extracts (hot extraction method)

1. Scope

1.1 This method measures the hydrogen ion concentration, expressed in terms of pH, of an aqueous extract of paper obtained by hot extraction (unfiltered and extracted by boiling water for one hour).

1.2 It may be applied to writing, printing and sized industrial paper, but it is not intended for unbuffered types such as electrical insulating and condenser papers. Values determined by this method will reflect changes resulting from heat-induced hydrolysis. Additives, such as those used in filled and coated papers can have an effect on the extract pH.

1.3 The cold extraction method is described in TAPPI T 509, "Hydrogen Ion Concentration (pH) of Paper Extracts (Cold Extraction Method)."

1.4 Surface pH measurement of paper is described in TAPPI T 529, "Surface pH Measurement of Paper."

2. Summary

This method consists of a boiling water extraction of the specimen for one hour followed by a pH measurement with a commercial pH meter.

3. Significance

The pH determination measures the extent to which the paper alters the hydrogen-hydroxyl equilibrium of pure water. The pH (acidity) is important because of its effect on the permanence of the paper. Although the acidity may be determined as the amount of water soluble acidity by titration with alkali, the hydrogen ion concentration (pH) is more indicative of the stability of paper than is the total acidity.

Approved by the Standard Specific Interest Group for this Test Method



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4. Definitions

- 4.1 *pH*, the negative logarithm (to base 10) of the hydrogen ion concentration of a solution.
- 4.2 *Paper acidity*, the extent to which water soluble material in the paper alters the hydrogen-hydroxyl equilibrium of pure water causing an excess of hydrogen ions, as measured by a commercial pH meter under specified conditions.
- 4.3 *Paper alkalinity*, the extent to which water soluble material in the paper alters the hydrogen - hydroxyl equilibrium of pure water causing an excess of hydroxyl ions, as measured by a commercial pH meter under specified conditions.

5. Apparatus

- 5.1 *pH meter*, a commercial pH meter including a glass electrode, a calomel reference electrode, and a potentiometer that will measure emf and indicate pH directly with a precision of 0.1 pH unit. The circuit should be compensated for temperature. Use of combination electrodes or FET electrodes (alternate acceptable electronic electrodes) is permissible.
- 5.2 *Erlenmeyer flasks*, 125-mL with standard taper joint.
- 5.3 *Reflux condensers*, preferably water cooled, West or Allihn Type, with 300-mm jackets, standard taper (ST) inner joints and drip tips; or *air condensers*, 10-mm diameter and 1000 mm long with ST inner joints and drip tips, ST joints to fit the flasks.
- 5.4 *Gas dispersion tube*, with 20 mm coarse fritted disc at 90° angle.
- 5.5 *Other apparatus*: 100-mL beakers; 100-mL graduated cylinder; 1000-mL volumetric flasks; stirring rods, all carefully cleaned and rinsed with distilled water before use.

6. Reagents

- 6.1 Reagent grade water used in this test method shall conform to ASTM Specification D 1193, Type I or II, Standard Specifications for Water (1).

NOTE 1: Water meeting this specification is typically sold by many manufacturers for use in HPLC, residue analysis, and spectrometry, and is packaged under nitrogen.

- 6.2 *Standard buffer solutions:*

6.2.1 *Potassium hydrogen phthalate buffer*, pH 4.01 at 25°C. Dissolve 10.21 grams of $\text{KHC}_8\text{H}_4\text{O}_4$ (A.C.S. Primary Standard or certified grade) in water and dilute to 1000 mL.

NOTE 2: As the buffer capacity of this solution is rather low, protect the solution from contamination with acids and alkalies. However, the pH is not affected by atmospheric carbon dioxide. The solution should be replaced after six weeks, or earlier if mold appears.

6.2.2 *Phosphate buffer*, pH 6.86 at 25°C. Dissolve 3.40 grams of monobasic potassium phosphate KH_2PO_4 (A.C.S. Primary Standard) and 3.55 grams anhydrous dibasic sodium phosphate, Na_2HPO_4 , in carbon dioxide-free and dilute to 1000 mL.

NOTE 3: The Na_2HPO_4 will absorb moisture at relative humidities exceeding about 40% at 25°C and should be dried for two hours at 110-130°C before use. This buffer solution is quite stable when protected from undue exposure to the atmosphere.

6.2.3 *Potassium hydrogen tartrate buffer*, pH 3.56 at 25°C. Add one gram of $\text{KHC}_4\text{H}_4\text{O}_6$ to 100 mL water about 30°C, shake for several minutes, cool at 25°C, decant, and filter to secure an approximately saturated solution.

NOTE 4: The pH is insensitive to changes of concentration, so elaborate precautions to ensure saturation are unnecessary. The temperature of saturation may vary from 22 to 28°C. Excess solid should be removed as it may cause erratic potentials at the liquid junctions. The tartrate solution is subject to molding accompanied by an increase of pH. Consequently, it cannot be used for more than a few days unless a preservative, such as a crystal of thymol, is added.

6.2.4 *Borax buffer*, pH 9.18 at 25°C. Dissolve 3.81 grams (air-dry weight) of $\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$ in carbon dioxide-free water and dilute to 1000 mL.