WI DNR Field Procedures Manual

Intranet Edition

Part C: Field Measurement

2001 pH ELECTOMETRIC

A. Scope:

The water quality parameter pH is one of the most important constituents affecting the chemical composition of groundwater. Anything that changes the pH in the sample will likely affect other constituents of interest as well. Aeration, oxidation and/or degassing of a sample can significantly alter its pH. Therefore, it is important to measure pH in the field. If specific conductivity is also to be measured, it is important to measure pH second due to the possibility of salt solutions from the pH probe potentially changing the conductivity if the sample. The water quality parameter pH is a measurement of the concentration of hydrogen ions in solution. The pH of a solution is expressed in quantitative terms on a scale of 0 to 14 pH units with 7 being a neutral solution, <7 = acidic solutions, >7 = basic solutions. The symbol pH is the logarithm of the reciprocal of hydrogen ion concentration in gram atoms per liter.

B. Safety:

Exercise caution when testing potentially harmful samples. If you believe the sample is toxic, acidic, or volatile, wear protective gloves and avoid fumes from the sample beaker. Also, handle and pack glass tipped pH probes and other miscellaneous glassware with care so that the glass will not break during transport in the field.

C. Instrumentation:

The measurement of pH using meters is an electrochemical process. The pH unit is determined by measuring the difference in electrical potential which occurs between two solutions of different pH separated by a membrane (glass, gel etc.). The two solutions consist of the sample solution and another solution of known pH which is called a buffer. The whole pH measuring system consists of a pH electrode, a thermometer (if not integrated in the meter) a sample solution, a reference electrode, and a pH meter. A wide variety of pH meters and electrodes are in use throughout the Department including digital meters, manually operated dial meters, glass electrodes and gel filled electrodes.

Preparation of the pH meter prior to field operation and frequent, regular maintenance of the meter and electrodes is extremely important for this sensitive instrument. The pH meters are most commonly powered by batteries. Check the battery supply prior to each use and keep a record of when the batteries need replacement. The electrodes are the part of the pH testing equipment which require the most maintenance. Refer to the specific directions provided with the electrode

to obtain the correct solutions for storage, refilling and rejuvenation of the electrodes. Keep a supply of fresh maintenance solutions on hand for the equipment. Depending on the electrode type, frequently change the fluids used to store, fill, and rejuvenate the electrodes to prevent permanent damage to the equipment. Obtain several bottles of fresh pH buffer solution to calibrate the instrument. Common buffer pH's are 4, 7, and 10 but the specific numbers you choose will depend on the solutions which you are testing. The following is a preparatory checklist of items needed to perform pH testing in the field:

1. pH meter and fresh batteries.
2. Electrode compatible to type of meter you are using (and cable).
3. Electrode holder.
4. Wash bottle with distilled, deionized rinse water.
5. Clean beakers (amount depends on number of samples taken).
6. 23 pH buffers (depending on type of meter).
7. Electrode filling solution.
8. Thermometer (if not integrated in the meter).

D. Interferences and Special Precautions:

To obtain an accurate pH reading the monitoring equipment must be extremely clean and in good working order.Sufficiently charged batteries and clean electrodes, beakers, and wash water, are essential. Be careful to use nonionic soap to clean all equipment and do not touch the glass electrode tip with anything unless absolutely necessary. Always allow an adequate amount of time for the pH readings to stabilize. If the readings do not stabilize within 23 minutes check the troubleshooting guide of your equipment manual for such advice as changing the batteries, cleaning, refilling, rejuvenating, or replacing the electrode.

E. Reagents and Standards:

1. Distilled, deionized water.
2. pH buffer solutions (units of 3, 7, and 10).
3. Nonionic soap.
4. Filling solution (see equipment manual for specifications).
5. Storage solution (see equipment manual for specifications).

F. Procedure:

1. Familiarize yourself with the manufacturer's instructions for using your particular meter.

2. Set up and calibrate the pH meter (with 2 buffer solutions) according to the manufacturer's instructions to cover the range of expected values. The temperature of the buffers and sample should be within 5 degrees centigrade of each other.

3. Rinse the electrodes thoroughly with distilled, deionized water.

4. Immerse the electrode in the sample.

5. Wait for the reading to stabilize (usually no more than 23 minutes).

6. Read and record the pH to the nearest 0.1 unit.

7. Remove the electrode from the sample.

8. Rinse the electrode with distilled, deionized water.

9. Store the electrode in the buffer solution (or solution recommended by the manufacturer) between sample measurements.

10. Recalibrate every 5 samples.

G. Documentation:

For each sampling event record the sample number, pH unit reading, temperature, and meter identification number. Maintain an equipment log book with the following information:

1. Equipment I.D. numbers.

2. Manufacturer and model of meter and electrode.

3. History of cleaning after each use.

4. History of regular calibration checks on the meter and electrode.

5. History of service or maintenance.

6. Age of the electrode.

H. Calculations:

Performed by meter.

I. Precision and Accuracy of Method:

Reserved.

J. References:

1. Lindorff, David E.; Feld, Jodi; Connelly, Jack; 1987, Groundwater Sampling Procedures

Guidelines: Wisconsin Department of Natural Resources, 91 p.

2. Lindorff, David E.; Feld, Jodi; Connelly, Jack; 1987, Groundwater Sampling Procedures Field Manual: Wisconsin Department of Natural Resources, 44 p.

3. Driscoll, Fletcher G., 1986, Groundwater and Wells: Johnson Division, St. Paul, MN, 1089 p.

4. Corning pH Meter 610A Instruction Manual, 1979, Science Products-Corning Glass Works, Medfield, MA.

5. Beckman 20 and 21 pH Meters Instruction Manual, 1984, Beckman Instruments, Inc. Irvine, CA.

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