About LabtronX

▪ We keep your laboratory and monitoring equipment accurate and reliable

▪ Accuracy Assurance Program - Regularly scheduled calibration and maintenance on all your lab equipment and flow meters

▪ We make it easy and guarantee your satisfaction
About Eric Link

▪ Have worked at LabtronX for over 30 years
▪ Became the CEO about 10 years ago
▪ Bought the company from my father about 5 years ago
▪ Married with 6 kids
▪ Love sailing, the Preds, playing guitar, directing and writing plays, and my job.
What we will cover

Everything pH
  What pH is
  How do we measure pH
pH Calibration and Maintenance

Calibration and Maintenance Program

Information Overload Ahead
What pH is

Sorta
Water is 2 hydrogen + 1 oxygen molecules.
Water is 2 hydrogen + 1 oxygen molecules.

Also creates Adhesion

And the ability to dissolve everything!
How Salt Dissolves in Water

Natrium

Sodium (Na)
Chlorine (Cl)

NaCl crystal structure

NaCl in water

LabtronX
615-831-2554
Water is 1 Hydrogen + 1 Hydroxyl molecule.

Pure water has a pH of 7

Pure Water is non-conductive

Water dissolves everything!
Even dogs dissolve in water!
What Happens?

Water + Hydrochloric Acid → Extra Hydrogen

Water  Hydrochloric Acid

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The ratio of $\text{H} : \text{OH}$ determines the pH of the solution. For every 10 times the number of one over the other equals one pH unit.

- $1 \text{ H:1 OH} = \text{pH7}$
- $10 \text{ H:1 OH} = \text{pH6}$
- $1 \text{ H:10 OH} = \text{pH8}$
- $100 \text{ H:1000 OH} = \text{pH8}$
- $15 \text{ H:15000 OH} = \text{pH10}$
- $70000 \text{ H:70 OH} = \text{pH4}$
What is pH?

- pH is an attempt to measure the ratio of Hydrogen vs. Hydroxyl ions or the negative log of the activity of the hydrogen ion in an aqueous solution.

- For each 10 times more H to OH gives you 1pH unit of acid (below 7)

- For each 10 times more OH to H gives you 1pH unit of base (above 7)
How do we measure pH

Millivolts and Electrodes
All measurements start with zero or a reference point.

Your results are subject to method and technique.
A typical pH Electrode

A negative lead (reference) behind a salt junction and a positive lead (pH) behind a glass membrane to read a voltage.
The pH meter reads positive millivolts when solution is below pH 7 (extra H) and negative mV when it is above pH 7 (extra OH).
pH is backwards

or the negative log of Hydrogen activity
SLOPE OF THE ELECTRODE

<table>
<thead>
<tr>
<th>Millivolts / pH unit</th>
<th>% Slope</th>
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<tbody>
<tr>
<td>59.16mV</td>
<td>100%</td>
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Effects of Temperature

Temperature does not change the pH, only the pH reading (or slope)

ATC Probes (Automatic Temperature Compensation) compensate for the theoretical change in the mV output of the pH electrode as it is effected by temperature.

The further away from 7 the more temperature compensation.

Triode electrodes have pH elements with less surface.
pH Calibration and Maintenance

What we can check
Calibration

pH meters have two curves to be calibrated, one positive and one negative.

Calibrate with a pH7 and at least one other buffer to bracket your readings (4 or 10)

Check expiration and open dates of buffers

Once opened, 10 Buffer often fails first

Calibrate once a day... maybe once a shift
Electrode Health

96% Slope is a warning

94% Slope is when the electrode should be changed in the water and wastewater field.

Look for less than 15mV offset at pH7

Look for quick response at stable temperatures

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Refillable electrode vs. gel-filled

Liquid wicks better at reference junction than a gel

Filling hole allows better flow at reference junction

Warranty is typically twice as long on refillable electrode

Gels are known to respond slower and can have pH reading errors earlier
Storage and cleaning electrode

Store electrode wet to keep both junctions active

Do not use distilled water for storage

Using pH buffers can cause errors

pH electrode storage solution

(Shameless plug - LabtronX makes this right!)

Quick clean with toilet bowl cleaner
Checking the Meter

BNCs are the most universal input connectors

Meters can be checked with a mV generator to confirm accuracy and response

Shorting the input connector will give you 0mV (7pH)
Checking the Temperature

Digital equipment is precise but may not be accurate

Incorrect temperature is more likely to give you a bad slope than a bad reading

Using a separate ATC probe gives you more versatility
Too much information?

Want some more?
Ask a question.
Calibration and Maintenance Programs

Risk Management
What is your maintenance policy?

If it's not broke don't fix it.

If it breaks we'll get a new one.

MacGyver has nothing on us!

Patch it up and move on.

We're getting a new plant next year.

We have trained personnel who perform and document regular maintenance and calibration.
How do you know?

How do you know your numbers are right?

Accuracy

How do you know that they are always right
Or that your equipment will be working when you need it?

Reliability

Regular Calibration and Maintenance
Reasons Equipment Becomes Inaccurate

Consumable Components
Lightbulbs, Membranes, Glassware

Environmental Changes
Temperature, Pressure, Humidity

Miscalibration
Bad Standards, Procedures, or Technique

Unstable Systems
Power Fluctuations, Discoloration, Changes in Sample

Lack of Maintenance or Care
Physical Wear, Dirt, Insects

Equipment Failure
See Next Slide
Reasons Equipment Becomes Unreliable

Over-stressed Components
- Overuse or Over Limits

Error or Mistakes
- Lack of Knowledge or Information

Physical Attacks
- Environmental or Misuse

Poor Design, Assembly, or Installation
- Incorrect Equipment, Components, or Engineering

Lack of Maintenance or Care
- Inconsistent, Reactive, or Limited

Unimagined Incidents
- Accidents, Acts of God, or Sabotage
Setting Your Maintenance Policy

Why do it? Identifying Risks

What results do you expect? Setting Overall Goal

What do you do? Proactive Actions

How often do you do it? Cycles of Uncertainty

Who does what? Roles and Responsibilities

How can you answer these questions?