pH Adjustment

ST. JOHN'S

Importance of pH

- pH plays an important role in everyday life
  - blood in our bodies
  - growing vegetables
  - plating chrome on car bumpers
- Water Treatment
  - many treatment processes are pH dependent
    - Disinfection
    - Coagulation
    - Corrosion Control

PH ph Ph pH

- What do the ***p*** and ***H*** in pH stand for?
  - The **p** stands for potential or power
  - The **H** stands for the Hydrogen atom
- **pH** is the correct written version
- pH refers to the amount of Hydrogen ions (H+) in a solution
- pH is calculated from the formula:

$$pH = -\log_{10}[H+]$$

Fundamentals of pH

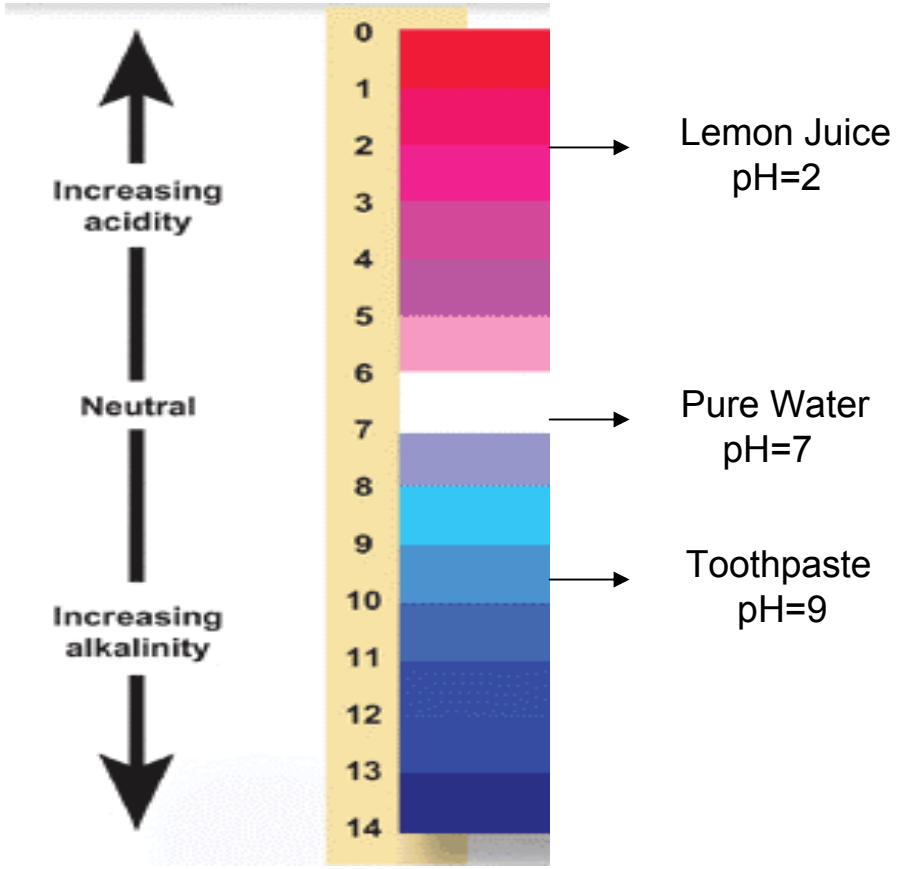
$$H_20 \leftrightarrow H^+ + OH^-$$

Water ↔ Hydrogen ion + Hydroxide ion

- The balance of the H^+ and OH^- determines the pH of water
  - $H^+ > OH^-$ = acidic solution
  - $H^+ < OH^-$ = basic (alkaline) solution
  - $H^+ = OH^-$ = neutral solution

pH Determination

- Every aqueous solution can be measured to determine its pH value, how **acidic** or **basic** a substance is
- pH is measured on a scale of **0 - 14**



pH Scale

- Each whole value below 7 is 10 times more acidic than the previous number
- For example, pH 3 is 10 times more acidic than pH 4 **and** is 100 times more acidic than pH 5
- For every number decrease we have to multiply by 10
- 10 x 10 = 100

pH Scale

- The opposite is also true
- Each pH value above 7 is 10 times more alkaline than the previous number
- pH 10 is 10 times more basic (alkaline) than pH 9 **and** is 100 times more basic (alkaline) than pH 8

How do we measure pH ?

- **Approximate** - color change comparable to color chart

OR

- **ACCURATE** - electronically recorded reading
  - A pH meter is ALWAYS recommended for precise measurement

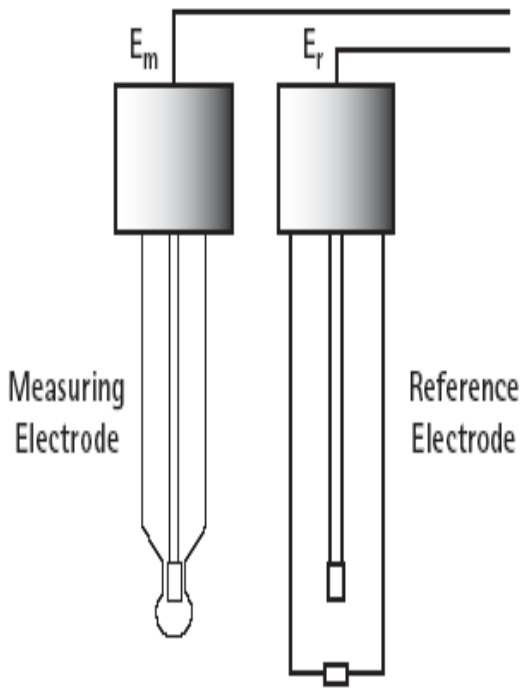
Measuring Tools

- **Litmus paper** is used as a general acid – base indicator
- **pH tape/paper** is used for approximations
- **Liquid indicators** are used for approximation
- **Pocket pH meters** are used for field trending

  + / - 0.2
- **pH meter** is used for accuracy, reproducibility, precise and continuous measurement

  + / - 0.1 / 0.01 / 0.001 (user decides)

How does a pH meter work?



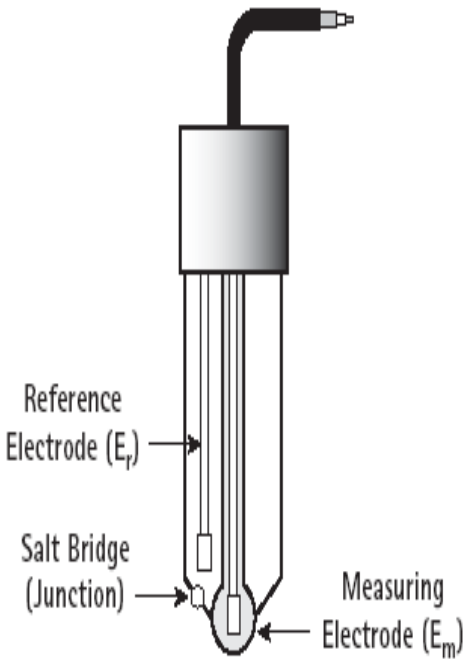
Electrometric method

- determined by using two electrodes,
  - *measuring (glass) electrode*
  - *reference electrode*
- two forms:
  - *Electrode pair*
  - *Combination*
- measures the voltage (difference in potential) generated between the two electrodes.

How does a pH meter work?

- The difference between the electrical potential of the solutions inside and outside the thin glass membrane creates an electromotive force in proportion to the difference in pH.
- This relationship is linear with pH.
- Measured in mV which is converted to values on the pH scale.

Electrodes

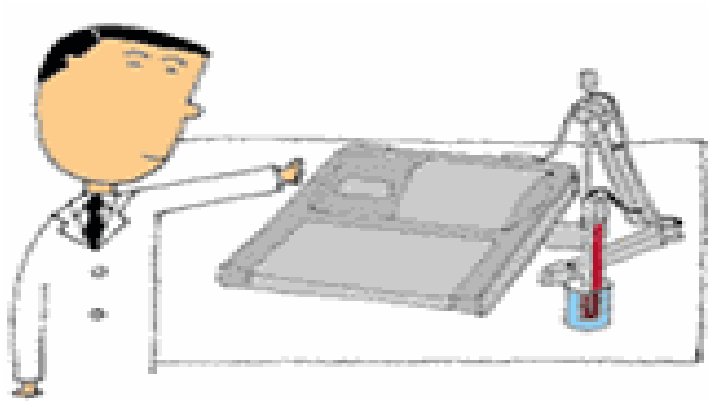


Combination electrode – contains both the reference and measuring electrode in the one body.

- **Refillable** – needs to be refilled with electrolyte solution. Lifespan determined by usage and care/storage.
- **Gel Filled** – permanently sealed with a gelling agent added to the reference electrolyte solution. Should last 6 months to 1 year.

pH Meters

- HACH
- Thermo Scientific Orion
- Oakton
- Hanna
- Others



- Need TLC, *read the manual first*

Sample Collection

- Sample should be collected in glass or plastic containers (minimum of 100 mL)
- Sample should be collected without agitation, as too much agitation can cause a loss of CO_2 and increase pH of sample
- Sample should be analyzed as soon as possible after collection

Bench pH Measuring

You will need:

- pH meter and manual
- 100 mL sample
- beakers/ flasks
- standardized buffers
- distilled water (Drugstore)
- magnetic stirrer with magnetic stir bar or stirrer probe
- styrofoam (small piece)

Our Procedure

1) Calibrate lab pH meter
2) Sample collection throughout plant/distribution system
3) Between measurements, rinse electrodes with distilled water and then with the next sample to be measured
4) Pour sample in beaker and immerse electrode
5) Add magnet, turn on stir plate
6) Record pH and temperature when meter says ready/ hold
7) When finished ensure electrode is placed in storage solution

How do we know our pH meters are reading correctly?

- follow our SOP pH procedure
- calibrate meters daily
- record standard results for quality control
- participate in external proficiency testing, CALA (***C***anadian ***A***ssociation of ***L***aboratory ***A***ccreditation)

Calibration

- Standard Buffers 4, 7, 10
- Rinse small beaker with buffer
- Pour ~ 40ml of buffer in beaker
- Each individual meter has its own set of step by step calibration instructions
- Discard after calibration, never pour used buffer back into original bottle

Electrode Do's and Don'ts

DO's

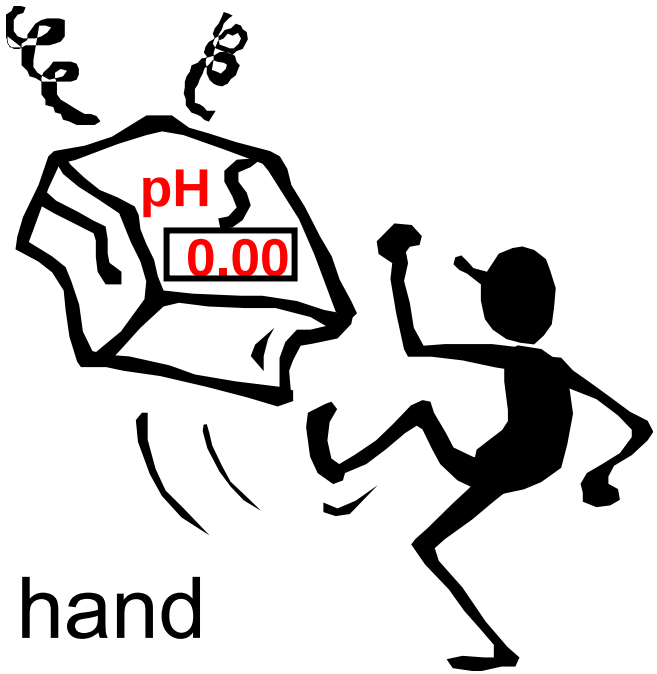
- Do store electrode in electrode storage solution
- Do calibrate meter daily
- Do keep electrode moist

DON'Ts

- Do not store electrode in distilled water
- Do not leave exposed to air
- Do not wipe electrode but blot with lint free tissue

Replace your Electrode

- Erratic readings
- Sluggish
- Readings don’t change
- Won't calibrate properly
- Keep a spare electrode on hand



Factors Affecting pH

- Temperature
  - Need an Automatic Temperature Compensator (ATC probe)
  - Make sure samples and buffers are at the same temperature
- Heat from magnetic stirrer transfers to sample
- Exposure to air – CO_2 loss –"drifting"

Inline vs Bench pH Measurement

Inline pH analyzers

- continuous contact with the sample
- conditioned to the process stream
- does need calibration and maintenance
- should be checked periodically against bench top meter

Bench top meters

- influenced by exposure to atmosphere so you may experience " drifting"
- gain or loss of CO_2 may result in different pH readings.
- does need calibration and maintenance daily

➢ **If comparing the two, +/- 0.1 is ideal but +/- 0.2 is realistic**

BBBP

- 9 inline pH analyzers in the plant
- 5 inline pH analyzers in the distribution system
- 2 bench top Thermo Orion pH meters, with Ross Ultra electrodes (lab)
- 1 HACH HQ40d Dual-Input Multi-parameter meter with Refillable pH, Conductivity and LDO probes, for field use (BAT)

Windsor Lake

- 20 inline pH analyzers in plant
- 1 bench top Thermo Orion meter - lab
- 2 HACH HQ40d, BATs for field analysis
- 1 Oakton meter - field analysis

Helpful Hint

- When you visit your colleague in a neighboring town, take your pH meter and the two of you check the pH of a common water at the same time.
- Again remember there are slight differences between probes but you should only have a variance of +/- 0.2.

Guidelines

- The Canadian Drinking Water Quality Guidelines recommend a pH of 6.5 - 8.5 as an acceptable range.
  - At pH < 6.5, corrosion may be significant
  - At pH > 8.5, incrustation and scaling may be increased, chlorine efficiency may decrease
- A suggested pH of 7.0 would require a pH range of 6.8 to 7.2.*

Acids and Bases

- When **chlorine** is added to water a variety of processes take place to forms **acids**
- When **soda ash** or **lime** is added to water **bases** are formed**.**
- Add acid (chlorine) and base (lime) together and get a pH of 7 (neutral)

NL Waters

NL Data	pH		
Supply	Min	Average	Max
Surface Raw	4.09	6.43	8.81
Surface Treated	2.11	6.40	11.1
Ground Raw	5.47	7.61	9.97
Ground Treated	5.75	7.66	9.58

How do we adjust pH?

- Most NL waters are on the acidic side of the pH scale, therefore we need to add a base to get a neutral product.
- Chemicals used:
  - Soda Ash
  - Lime
- How are these added to the water?
  - Add soda ash or lime to water to make a percent solution

Percent (%) Solution

- mixture of a soluble chemical completely dissolved in water is a percent solution
- done by weighing out a desired amount of dry chemical and adding to water to produce a total given weight
- Examples
  - Soda Ash - Mix 9:1 ~10%
  - *Chain Saw Fuel – Mix 50:1 ~2.0% (1.9)*

Percent (%) Strength

- Percent strength by weight (lbs / lbs)
- Equals (weight of solute divided by the weight of solution) times 100
- Solute is soda ash
- Solution is the weight of solute plus the weight of solvent (water)
- 1 Imperial gallon = ~4.54 litres or ~10 pounds

AWWA Standard B201-08
Soda Ash

- The standard states that slurries of 30% soda ash can be made. It is withdrawn from the upper portion of the tank for application to the treatment process.
- Ideally start with a lower percent solution and increase dosage set-points on metering pump.
- Change solution strength, adjust metering pump.

Solutions / Slurries

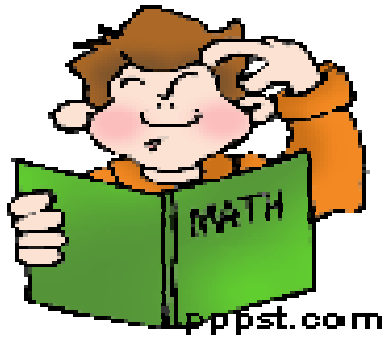
- 10% soda ash (Solution)

	1 part by weight of powder (**Solute**)
+	9 parts by weight of water (**Solvent**)
=	10 parts (**Solution** weight)

- Water does not have to be weighed, since 1 gram is approximately equal to 1 ml
- 1 Imperial gallon is equal to ~10 pounds

Example Calculation

- **% strength (by weight)**



$$= \left(\frac{\text{weight of solute}}{\text{weight of solution}} \right) \text{X } 100$$

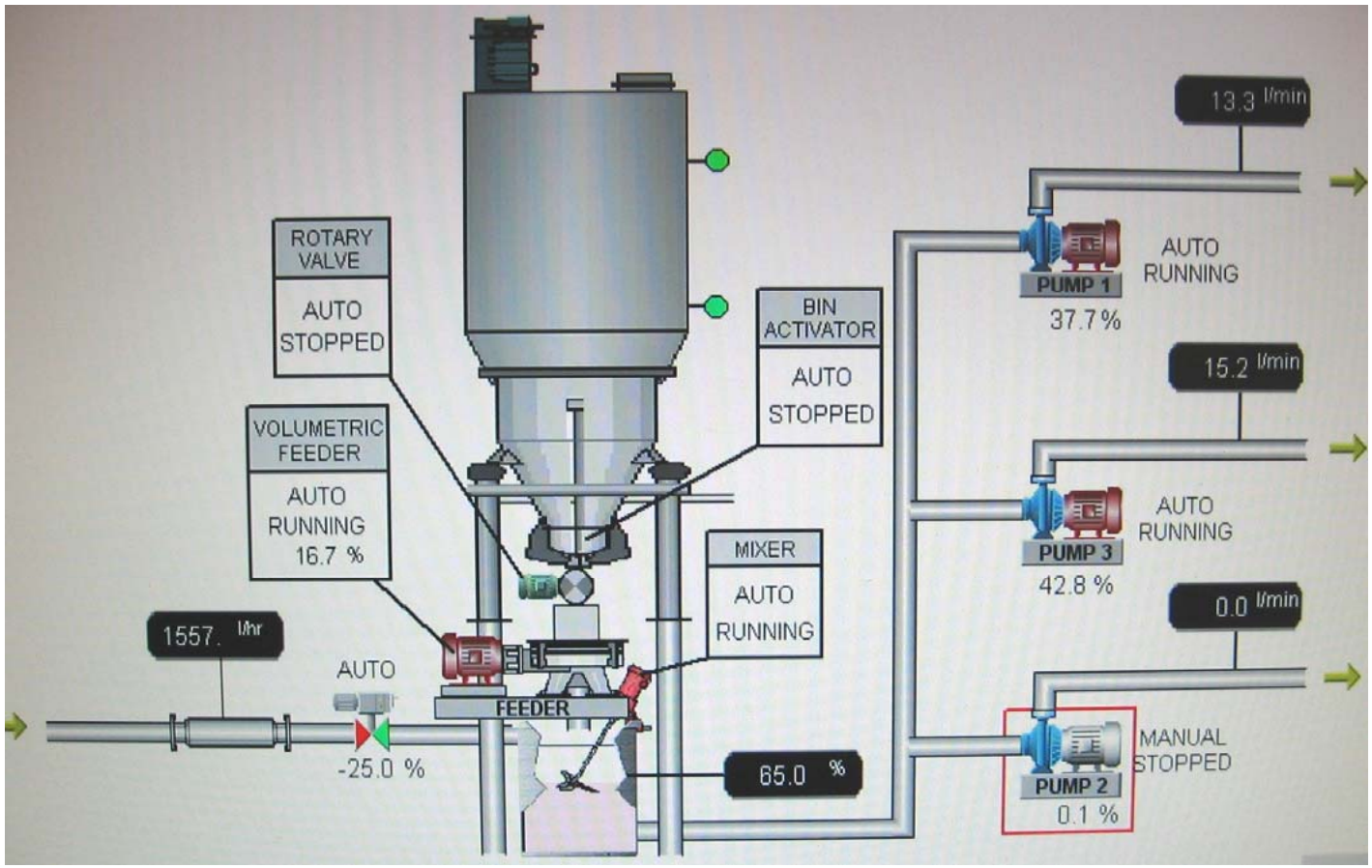
$$= \left(\frac{\text{25 lbs of chemical}}{\text{400 lbs of water + 25 lbs of chemical}} \right) \text{X } 100$$

= **5.9% strength**

Solutions of Soda Ash

Solvent (Water)			5%	7.5%	10%	15%	20%	25%
litres	gallons	pounds	Pounds of Solute (Soda ash) to be added					
25	5.5	55	2.9	4.5	6.1	9.7	13.8	18.3
50	11.0	110	5.8	8.9	12.2	19.4	27.5	36.7
75	16.5	165	8.7	13.4	18.3	29.1	41.3	55.0
100	22.0	220	11.6	17.8	24.4	38.8	55.0	73.3
125	27.5	275	14.5	22.3	30.6	48.5	68.8	91.7
150	33.0	330	17.4	26.8	36.7	58.2	82.5	110.0
175	38.5	385	20.3	31.2	42.8	67.9	96.3	128.3
200	44.0	440	23.2	35.7	48.9	77.6	110.0	146.7

BBBP Lime Slurry



BBBP Lime Slurry

- weekly grab samples to confirm % lime slurry
- decreased lime percent from 1.5% to 1.2% to 1.0%
- less precipitation in lime feed supply lines
- SCADA will automatically pace metering pumps when adjustments are made in lime slurry%

An Example (Nova Scotia)

- Lime tank is a 300 L
- 10 % solution
- chemical pump dial stroke set at 70
- pump rate is set at 90%
- this brings pH up from 6.8 to ~ 8.0. (Coagulation Plant)
- the pump and valve get cleaned out once a month
- massage anything that settles through the line
- clear tubing

Conclusion

- **Obtain accurate pH values**
  - measure pH with a pH meter
- **pH adjustment**
  - consistent slurry ~ 10%
  - monitor dosing with metering pump
  - check lines for clogging

Reference Material

- www.hach.com
  What is pH and how is it measured?
- www.thermo.com
  pH Electrode Handbook

Tech Support Toll Free Phone Number

Questions/ Comments

Thank You

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