



The Importance of Water Quality

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What Counts!

- Bacteria
- pH
- Minerals
- Sanitation
 - During the flock
 - Between flocks
- Monitoring

Pathogens in Water

- Many potential disease causing organisms :
 - bacteria- from human and animal feces
 - viruses- shed by infected animals
 - protozoan- Giardia best known
- Total coliform often measured as indicator
 - Usually originate in intestinal tract
 - Presence in water supply indicates waste contamination or surface contamination
 - Persists in water longer than other bacteria
 - Giardia and some viruses can last longer

Coliform Contamination

- Florida survey of poultry farm wells
- 48.5% positive for coliforms
- 3% positive for fecal coliforms
- In 24 hours at 90 ° F, single E. coli multiplies into more than 24 trillion

Total Bacteria Important Indicator

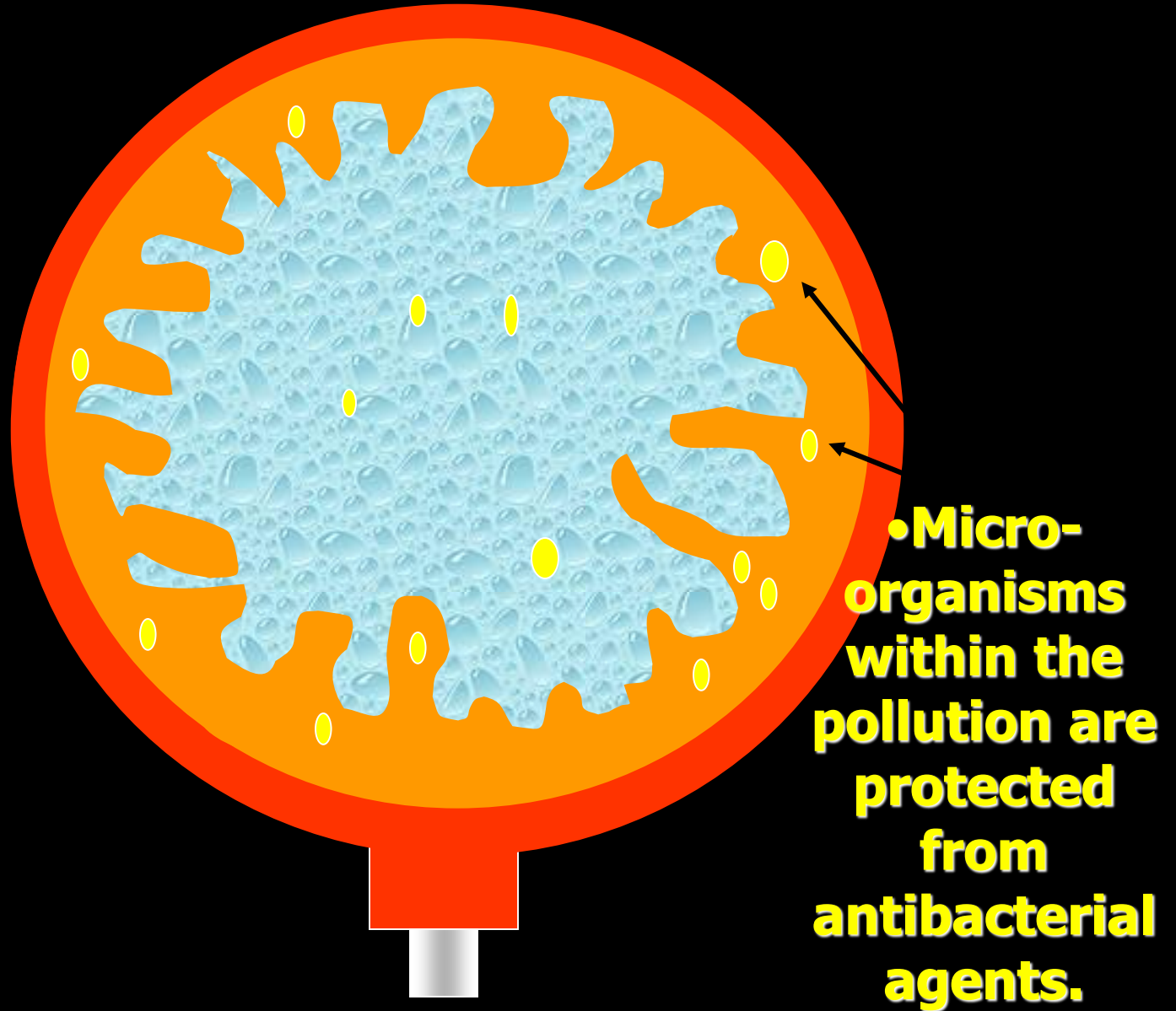
- Total Bacteria overlooked as a health threat
- Poor water line sanitation leads to biofilms
 - Thrives on vitamins and electrolytes
 - Low levels of some organic acids (citric)
 - Milk replacers (vaccination)
 - Minerals such as iron and sulfur
- Biofilms can protect pathogenic organisms
 - Salmonella can live for weeks in biofilms
- Cause air locks in lines (sulfur bacteria)
- Can return 2-3 days after cleaning

Bacteria Levels in Water

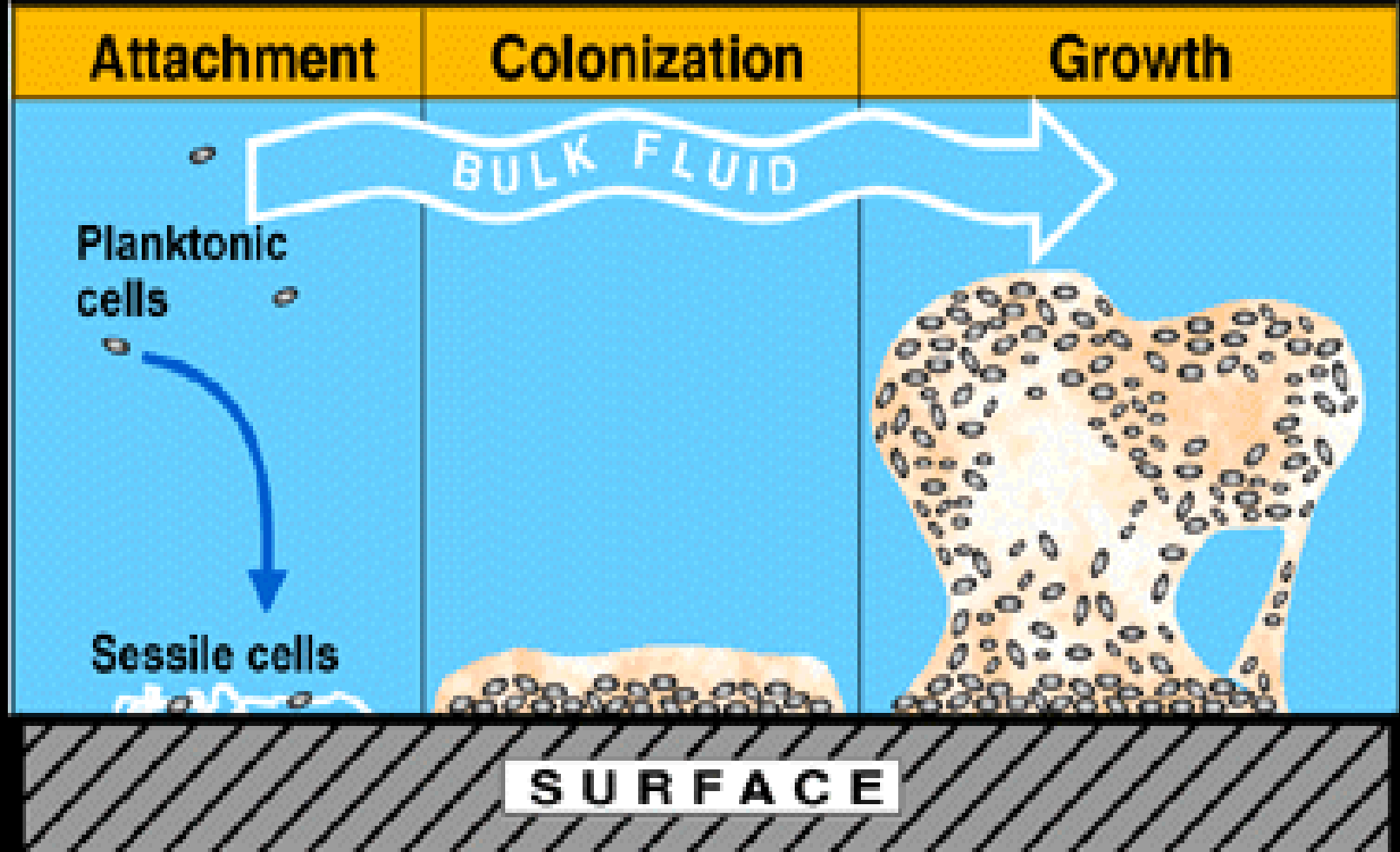
When in Doubt-Test!!

Farm	CFU/ml
A-- At well head	2,700
A-- At end of line	26,600
B-- At source (community)	203,000
B-- At end of line	2,340,000
C-- At source (community)	600
C-- At end of line	282,000
D-- At well head	0
D-- At end of line	4,775,000

BioFilms



Biofilm formation:



© MSU-CBE

P. Dirckx

As biofilms grow and change, they release organisms into water



Bordetella found in this regulator



Do You Inject Into Your Water Supply Like This?



Or Like This?

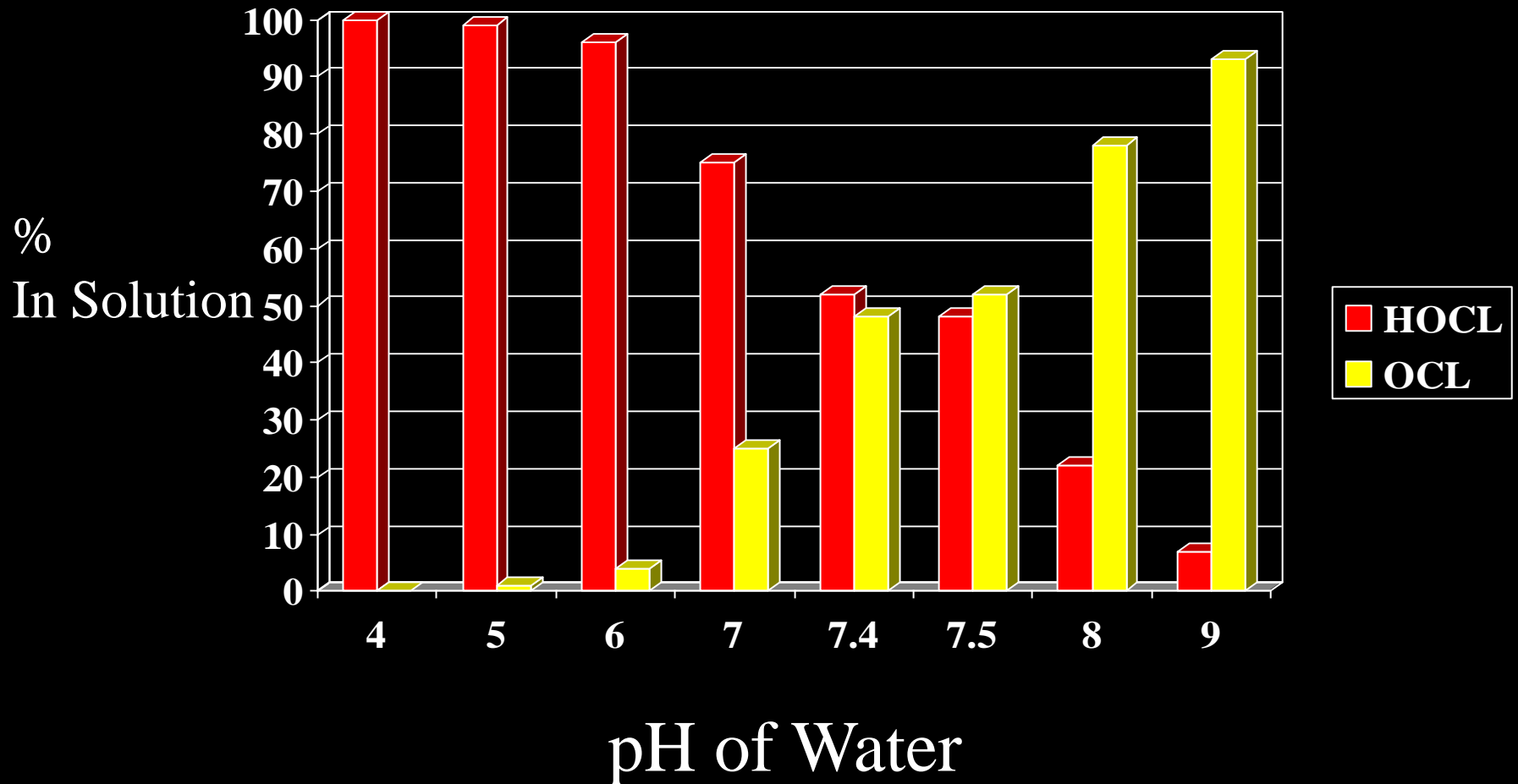
When to Test for Bacteria

- Noticeable change in color, odor or taste
- Flooding has occurred near well
- Person or animal becomes sick from waterborne disease
- Maintenance on water supply system
- Persistent poor performance
- Loss of pressure in water system
- Unfortunately we rarely drink same water supply

Effect of pH on Water Quality

- pH scale measures how acidic or basic
- pH change of one indicates ten fold change
 - pH of 6 ten times more acidic than pH of 7
- pH of less than 6.5, corrosive water
- pH < 5.9,
Once believed to cause poor performance
 - We now know birds tolerate pH 3
- pH > 8.0
 - Reduction in chlorine effect (chloric ions,)
- Chlorine most effective in pH 6.5 - 7.5

How pH Affects Chlorine Ratio of Hypochlorous Acid to Chloric Ion



Hypochlorous Acid

- Hypochlorous acid is 80 times more effective as a sanitizer than chloric ion
- Free chlorine not considered effective unless it is 85 % Hypochlorous acid
- Forget the chemistry lesson:
- *pH range of 4 to 6.5 is best when using chlorine sanitizers*

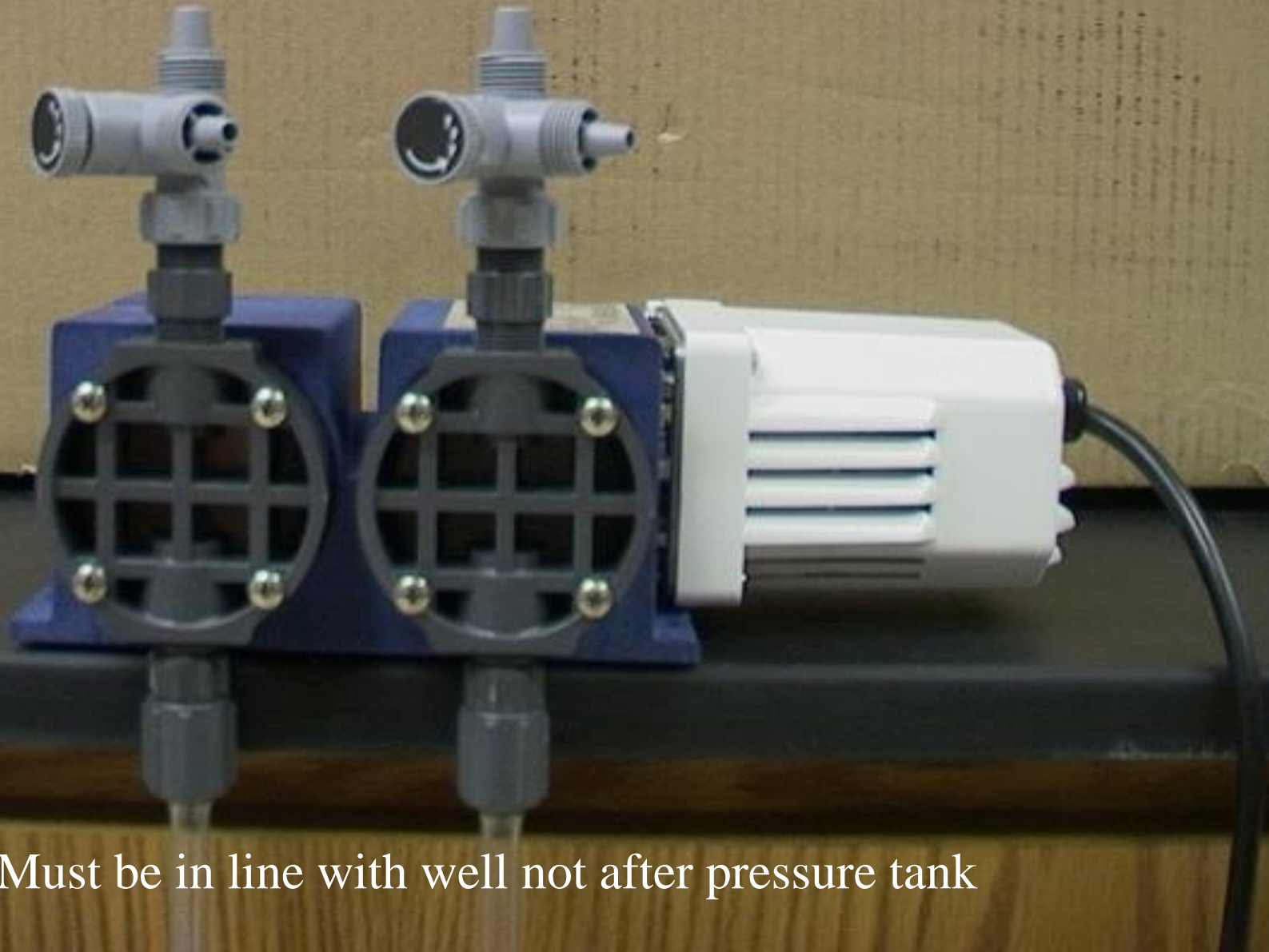
NEVER!!

Mix bleach and acids in the same
stock solution container

Growers have told me a green
cloud chased them out of their
medication rooms



Dual injection pumps



Must be in line with well not after pressure tank

Injecting Strong Acids

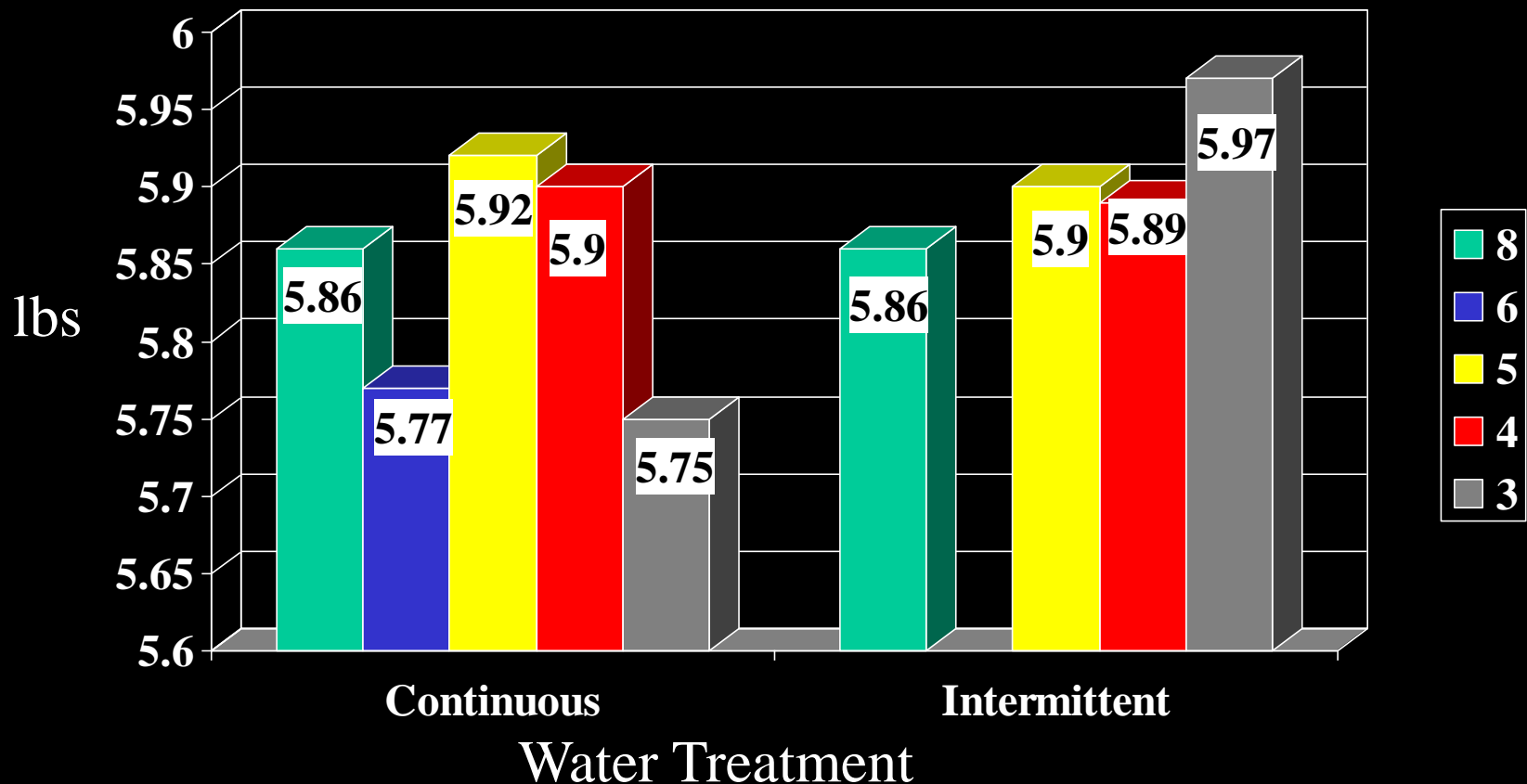
Stenner Pump

- Different gpd to meet needs of any farm
- Change duckbill check valve-\$4.80
- Stenner.com
- Steve Sullivan
- 800-683-2378



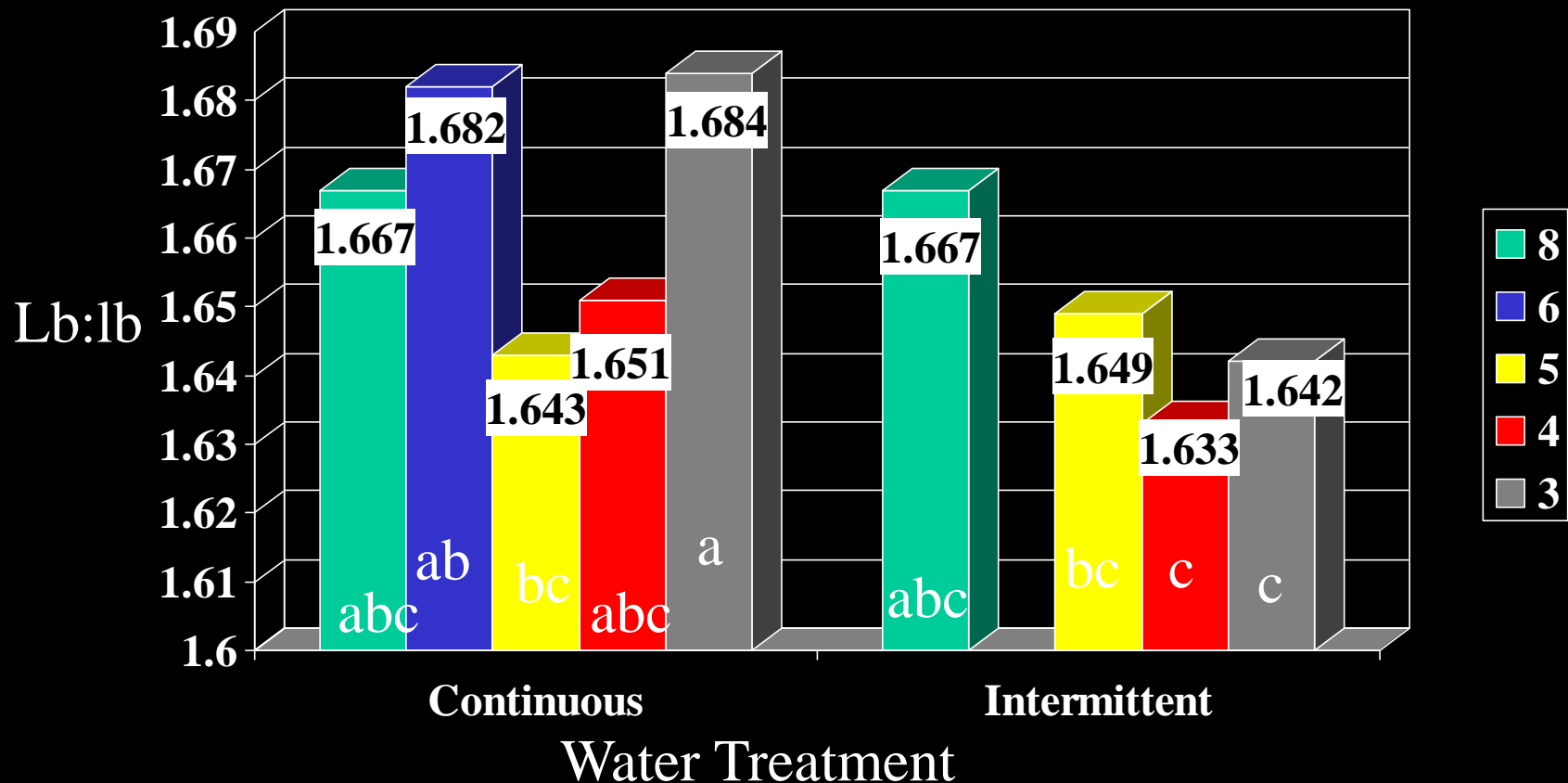
Birds Tolerant of Low pH

42-Day Male Broiler Weights



PWT used to adjust the pH

Impact of pH on 42-Day Male Broiler Feed Conversion



PWT used to adjust the pH

Effect of Drinking Water pH on Broiler Digestive Tract

pH	3	4	5	6	Control
Crop	4.33c	4.34c	4.62b	4.95b	5.57a
Gizzard	3.62	3.72	3.70	3.95	4.16

PWT used to adjust water pH

The Rest of the Acid Story

- Acidifiers are not sanitizers
- Acidifiers need contact time and pH of 4 or less to damage or kill most bacteria
- During high water usage, contact time is minimal
- Can even get fungal blooms from low pH (thick slime)
- One size fits all directions for acidifiers may result in poor pH adjustment for high pH water

Take home message: Use acidifiers as part of a sanitation program not in replace of it

Water Acidification Not Enough

Product	pH	APC Count CFU/ml
Control	8	8.2 mil
Citric Acid	7	5.6 mil
CA	6	4.4 mil
CA	5	4.0 mil
CA	4	2.3 mil

Lots of bacteria then products like citric acid may become food

5 minute exposure

Minerals

- Iron-red water
- Manganese- black solids
- Small quantity- bitter metallic taste for people
 - .3 ppm Fe-Iron
 - .05 ppm Mn-Manganese
- Birds not sensitive to mineral tastes
- Promote the growth of creniform organisms
 - Form heavy gelatinous stringy masses that slough off
 - Reduces pipe volume
 - Clogs drinkers
- Iron promotes *Pseudomonas* and *E. coli*
- Mineral deposits cause drinkers to stick
- Chlorinate and then filter

Sulfur

- Sulfur
 - Typically smells like a match head
 - Black residue in water, on filters
 - Will react with chlorine then can be filtered
 - Will gas off if water held in storage tank and/or aerated
- Hydrogen sulfide
 - Rotten egg smell
 - From sulfur bacteria
 - Can air lock water lines!!!
 - Shock chlorinate well to eliminate from system
 - Thoroughly clean water system
- Important to maintain 24-7 water sanitation

Parker Hannifin Filter

- Farm Guard Series
- 10 to 120 GPM
- Pleated filter
- Capacity of 180 string filters
- Can be washed, reused
- Casing will not dent, rust, chip or corrode
- Still need contact time (>20 minutes, pH 7-7.5) to precipitate iron





•Aquatech Dirt Master



Water Sanitation

- Chlorine most common water sanitizer
- Most effective in acid form
- Affected by:
 - pH of water
 - Inadequate concentration
 - Water temperature, below 65 °F not very effective
 - Presence of organic matter, will hide bacteria
 - Exposure time, too short will not work
 - Growth stage and type of bacteria or biofilm present
- Bottom line-Using bleach does not mean that birds are drinking sanitized water

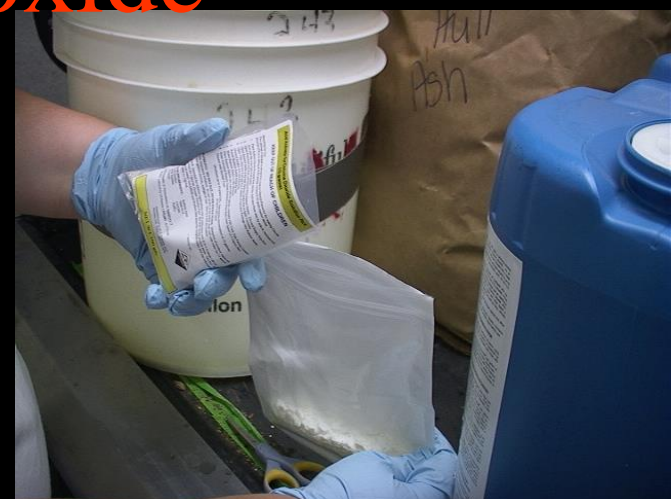
Water Treatment by Chlorination

- Rule of Thumb:
3-5 ppm free available chlorine at end of line
- Test for total and free chlorine
 - Once these two numbers are the same reading, system is clean
- High chloride levels – chlorine may not be best sanitizer choice

Chlorine Dioxide

- Strong oxidizer
- Effective over wide pH range (6-10)
- Target residual in drinking water-0.8 ppm
- Two types available
 - Ready to use products-5% solutions
- Products which must be made on site
 - Chlorine dioxide explosive in concentrations $>10\%$
 - Therefore must inject an acid and sodium chlorite to form chlorine dioxide
 - This requires a two injectors
- Disadvantages
 - Expensive

New Chlorine Dioxide-



Add dry acid to dry sodium chlorite packet then place in stock solution



Allow to sit over night then ready to use at 1:128, Can't use ORP

Ozone

- Advantages
 - More effective than chlorine for inactivation of viruses
 - Oxidizes iron, manganese and sulfides
 - Controls taste, color and odors, great for
 - Requires a very short contact time
 - Biocidal activity not influenced by pH
 - Only residual is oxygen
- Disadvantages
 - Very Expensive
 - Systems not very farm friendly
 - No sanitizing residual (only lasts 5-10 minutes)
 - Water should be filtered after ozone treatment
 - Otherwise water can become re-contaminated
- Beneficial to inject chlorine or H_2O_2 downstream

Hydrogen Peroxide

- Effective oxidizer
- Target- 25-50 ppm residual in drinking water
- Good for sanitizing pond or river water because it controls taste issues and no chlorine by-products
- Can be dangerous to store and handle, flammable
- Effectiveness deteriorates with storage
- Not as good at oxidizing iron and manganese
- Stabilized products like Proxy Clean last for weeks in stock solutions

Successful Water Sanitation Requires a Clean System



If water looks like this,
there is room for improvement

Dirty Systems Need Effective Cleaning



Water line cleaned
with acid-pH only 6.8



Same barn but this line
cleaned with 3% Proxy Clean

Line Cleaning: The Crucial Step

- Clean water systems are essential
 - Improve daily water sanitation program
 - Reduce opportunity for disease to recur
- Ideal line cleaning products should:
 - Reduce microbial growth
 - Remove biofilm
 - Dissolve scale
 - Not damage equipment
- Do you have proper injection system?
 - Medicators only inject 1:128 at best a 0.78% solution
 - Medicators not suited for strong chemicals
 - Small submersible pumps ideal for injecting stronger solution
- Clean lines in 400 foot house-need 60 gallons

Water Line Cleaning

- After birds are gone, flush lines
 - Power flush is best, but any flush is good
 - Removes sediment, loosen bacteria, slime, etc.
- Make sure stand pipes are working
- Mix in trash can or 100 gal stock tank
 - 3 %- 35 % H_2O_2 or Proxy Clean
 - 2% CID 2000
 - 2.5% Sterilex
- Fill lines using 1/12th hp submersible pump
- Sweep drinkers to charge drinker wells
- Leave 3% solutions in lines for 24 hours
- Leave 2% CID 4 hours

Line Cleaning

- Flush cleaner from lines
- De-scale lines with acid if water supply contains minerals:
 - Calcium or magnesium (> 80 ppm)
 - Iron or manganese (>0.5 ppm)
 - Sulfur (>80 ppm)
 - pH must be 5 or less to dissolve scale
 - Leave in lines 24 hours
- Flush acid from lines
- Follow acid with sanitizer such as bleach
 - 4-6 ounces/gallon stock solution
 - 1 ounce stock/gallon water
 - Proxy Clean stock solution- 4 ounces/gallon then 1:128
 - This last step can help keep biofilm from returning
 - May even prevent drinkers from “sticking” after cleaning





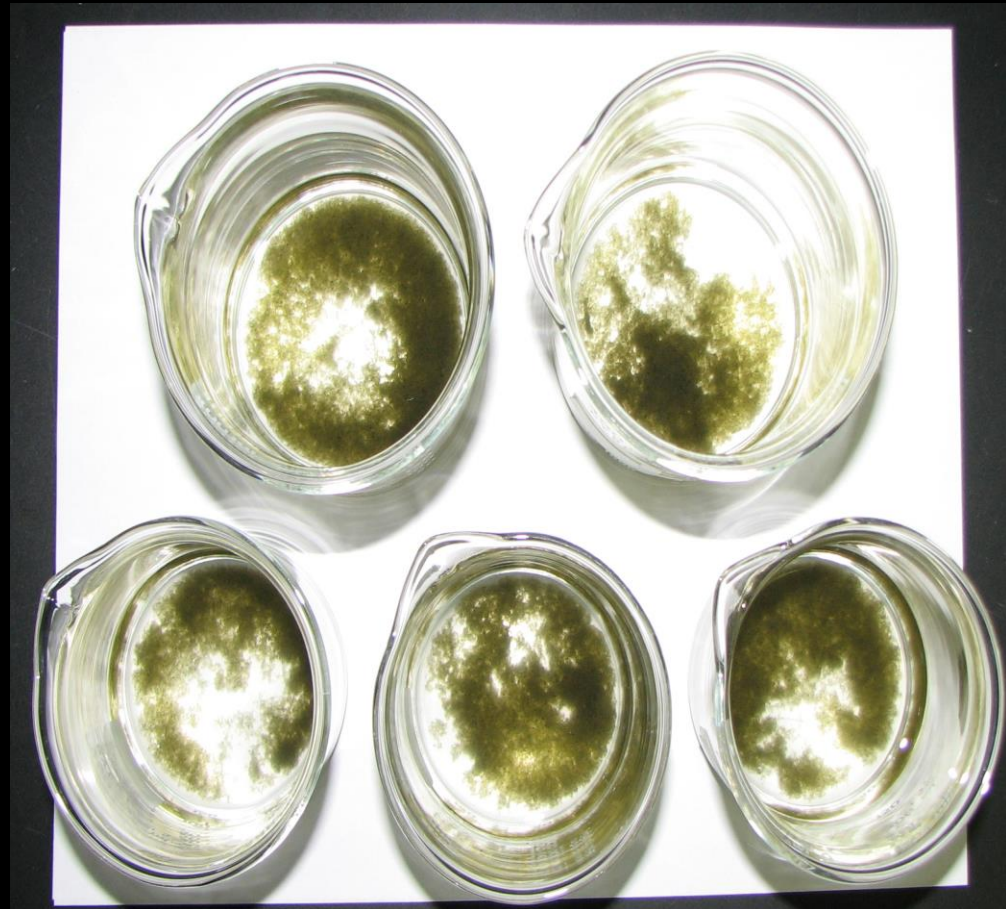




Thorough cleaning essential
but if harsh cleaners are damaging
what are our choices??

Objective

- Evaluate products using water that simulates worse case scenario in drinker systems



Materials and Methods

Products

- Pro Clean
 - 50% stabilized hydrogen peroxide
 - 3 % solution tested
- ProxyClean
 - 50 % stabilized hydrogen peroxide
 - 3 % solution tested
- Sodium hypochlorite
 - 6 % product-household bleach
 - 1 ounce bleach/gallon of water
 - 12 ounces/gallons stock
 - 1 ounce/gallon water

Materials and Methods

Products

- CID 2000
 - 20% stabilized hydrogen peroxide
 - 2 % solution tested
- Citric acid
 - 2 packs used to prepare a gallon of stock solution
 - 1 ounce stock added to gallon of water or 1:128
- Hydrogen Peroxide
 - 35 %, not stabilized
 - 3 % solution tested

Materials and Methods

Products

- Pro Clean
 - 50% stabilized hydrogen peroxide
 - 3 % solution tested
- ProxyClean
 - 50 % stabilized hydrogen peroxide
 - 3 % solution tested
- Sodium hypochlorite-Bleach
 - 6 % product-household bleach
 - 0.78% solution tested
 - 12 ounces added to gallon water served as the stock solution
 - 1 ounce to gallon water or 1:128

Bacteria Results

Treatment	Pre (Log 10)	Post 4 H (Log 10)	Post 24 H (Log 10)
Control	7.017	7.10	7.38
Bleach 12	6.88	5.05	5.90
Bleach .78 %	6.98	5.03	5.14
Citric Acid	7.56	7.52	7.33
CID 2000	6.90	2.00	<1
H ₂ O ₂ 3%	6.74	5.45	1.97

Bacteria Results

Treatment	Pre (Log 10)	Post 4 H (Log 10)	Post 24 H (Log 10)
Control	7.017	7.10	7.38
PRC 3%	6.88	4.91	<1
PRC .78 %	7.38	5.69	4.62
PXC 3%	6.32	5.15	<1

Product Testing Conclusion

- Even strong bleach solution not effective on heavy microbial load
- Citric acid did not reduce bacteria
- 2 % CID 2000 most effective in 4 hours
- 3% ProxyClean, Hydrogen Peroxide needed 24 hours to effectively reduce bacteria
- Summary-To get the most out of line cleaning, use right concentration and leave in long enough to do the job

What mixes?

- Basic products- Add ammonia
 - Sulfa drugs
 - Penicillin
- Acidic products- Add citric acid
 - Tetracycline
 - Erythromycin
 - Vitamins
 - Amprolium

My birds have a slight snick . .

- I want to run some iodine as an expectorant, should I stop chlorinating?

My birds have a slight snick . .

- I want to run some iodine as an expectorant, should I stop chlorinating?
- Chlorine and iodine work well together
 - If chlorinating use second pump to inject iodine
 - May not get a chlorine reading when running both



Alkalinity

- Refers to the amount and types of chemicals that can shift $\text{pH} > 7$
- Usually expressed as calcium carbonate (CaCO_3)
- Also dependent on bicarbonate, (HCO_3), and sulfate (SO_4)
- Poisons in nature usually alkaloid so high alkaline, content may back birds off water





What to do about Hardness

- Acidify drinking water
 - helps keep Ca in solution
 - Masks alkalinity taste concerns
- Klear Flo- Sequestering agent
 - Keeps Ca in solution
- Phosphate products also prevent scaling
- Water softener
 - Exchanges sodium for calcium

Alkaline Hydrolysis

- pH of >7.5 can impact insecticides
- pH range of 4 to 6 best for most insecticides
- Carbaryl (Sevin)

	pH	Half-life
–	6	100-150 days
–	7	24-30 days
–	8	2-3 days
–	9	1 day

- To lower pH add citric acid or PWT to spray water

Oxidation-Reduction Potential

- Measures the energy in water
- Free chlorine present- energy will be high
 - (> 600)
- Water dirty or no free chlorine, energy is low
 - Can even be a negative number
- Optimum ORP level- 650 to 750
 - Free chlorine levels of .5 to 1 ppm may be adequate



ORP

Orion 108

723

power

QuiK

ORP

764

Goys

T

pH, ORP, Total and Free CL

pH	ORP	T Cl	Free Cl	APC
6.86	20	0	0	1,250,000
6.47	425	5	2.5	>10
5.85	540	5	2.5	>10
5.17	615	5	2.5	>10
3.91 Bleach 8 oz/gallon stock	705	5 then 1:128	2.5	>10

PWT used to adjust pH

Food for Thought

- Chicken is ultimate opportunistic eater,
“Eat fast before you are eaten!!”
- Nature made chicken’s crop to hold seeds before digestion
- Commercial production has changed the diet
 - Easily digested full of fat, sugars, protein
 - Seeds are ground to enhance digestion
 - Partially cooked
 - Often contains animal by-products with questionable microbial quality- (Clostridium, etc.)
- Microbial quality of feed and environment ????
- Adding poor quality water to a full crop of feed could be inviting disaster

Conclusion

- Good water quality is essential for good bird performance
- Unfortunately it is rarely a given
- Water quality impacted by many factors such as products used and natural contaminants
- Understanding how factors impact each other can help one to make right decisions on water treatments
- Water system sanitation is essential for a healthy bird



Do you know what your birds are drinking?

Questions?

IMPORTANT
CHECK CHLORINE LEVELS
AT LEAST
2 TIMES PER WEEK
3-5 PPM