INTERNATIONAL

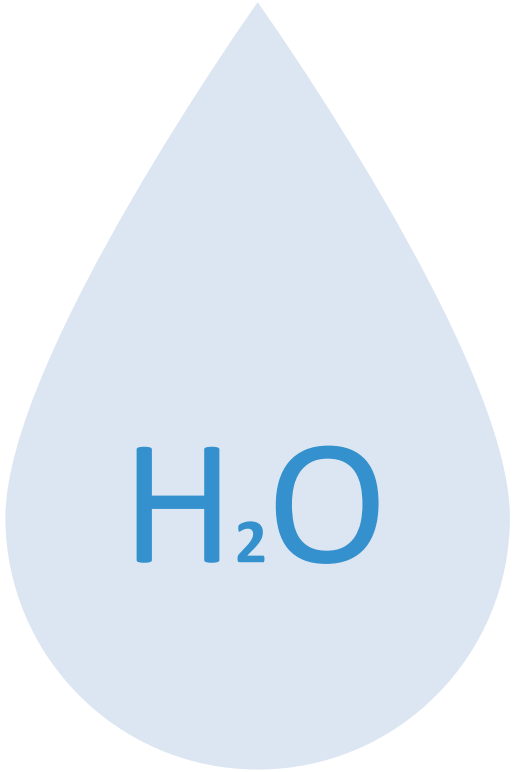
The key to your profit!

Improving the performance by strategic water usage

HMaurice Raccoursier DVM MSc
Global Technical Team

Water is …

The most underestimated nutrient – and how to use it well to spike performance



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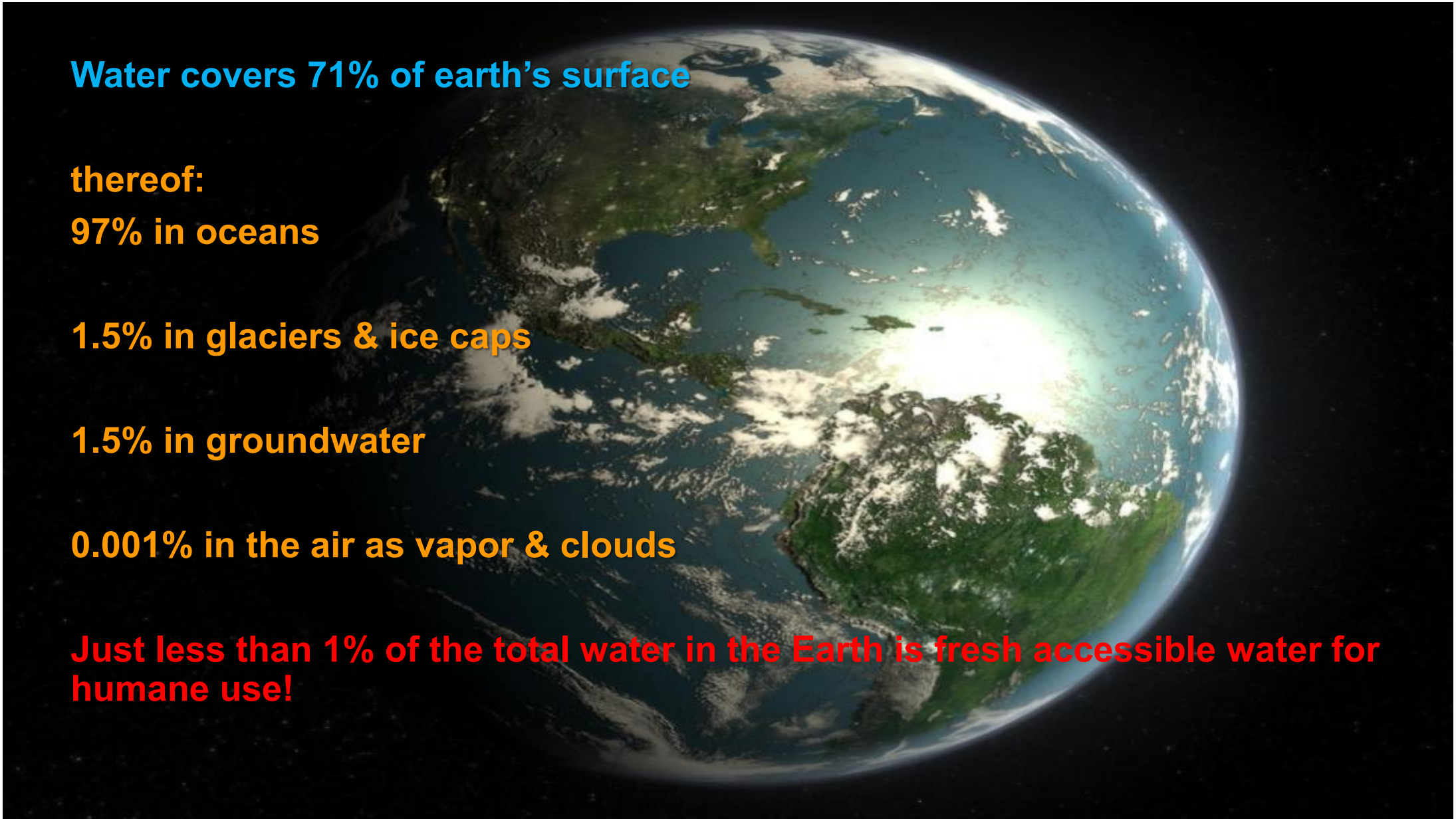
Water covers 71% of earth's surface
thereof:
97% in oceans
1.5% in glaciers & ice caps
1.5% in groundwater
0.001% in the air as vapor & clouds
Just less than 1% of the total water in the Earth is fresh accessible water for humane use!

Importance of water

- Water plays an important role in the world economy
- Approximately **70%** of the fresh water used by humans goes to agriculture.

A chemical substance **VITAL** for all known forms of life!

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Water in poultry

- Birds typically drink 1.6 to two times the equivalent weight of feed, and, if water intake is limited, then feed intake declines.
- Poor water means less than expected results from even the best quality feed.
- 90% of the egg is water
- Several factors impact on water consumption.
- **Water requirements = feed requirements**

Water in poultry

- Water Consumption Various factors (ambient temperature, humidity and air velocity, feed intake, dietary formulation, drinking water presentation, age and sex, genetics) drive the amount of daily water intake.
- Properties of water like water temperature and levels of minerals and contaminants also affect the consumption of water and the overall performance of birds.
- High water consumption is correlated with optimal feed to gain ratio.
- Genetic research in the poultry industry, especially in the breeding sector, is an ongoing process with the goal of better performance by improving the breed lines through intense selection. Improved selection strategies result in enhanced production traits in birds such as 4 growth rate, feed efficiency and yield. These production attributes are not obvious unless the physiology of the birds is altered and are sometimes accompanied by negative complications or undesired traits as well. To avoid the negative complications from selection pressures and to capture the full genetic potential, existing husbandry practices need to be reviewed accordingly. Energy requirements and therefore the water requirements should be reconsidered for every cross bred progeny.
- The significant increase in water consumption today compared to past: In 2010-2011 birds drank 5.5 gallons more on day 7 and 13 gallons more on day 42 per 1000 birds as compared to birds that were reared a decade earlier.

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What requirements are important

- Must know the water quality of your farms
- Taste the water!

a) Filtration

b) Sanitation

- Monitoring: quality and supply

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Minerals: standard values

Parameter	Recommended Range for Poultry	German Human Drinking water ordinance
Calcium	60 - 75 mg/L	No limit
Copper	0.6 - 1 mg/L	2 mg/L
Iron	0.2 - 0.3 mg/L	0.2 mg/L
Magnesium	50 - 75 mg/L	-
Manganese	0.1 mg/L	0.05mg/L
Nitrate	15 mg/L	50 mg/L
pH	6 – 8	6.5 – 9.5
Phosphorus	0.1 mg/L	-
Potassium	250 - 500 mg/L	-
Sodium	50 mg/L	200 mg/L
Sulfate	100 – 200 mg/L	240 mg/L
Alkalinity	100 mg/L	
Hardness	60 – 180 mg/L	-

Maharjan, 2018

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Possible impacts of exceedance of the standard values **(Depending on age and body size)**

- **Nitrites & Nitrate:** Decrease of oxygen absorption in blood (Lazy & sluggish birds, Blue Comb & Wattle); Low Fertility; Respiratory Infections, low feed Intake, lower weight gain and performance
- **Iron:** **Gastrointestinal Disorders, negative impacts on vaccines and medication efficiency; clogs the water pipes up, bad odor or taste, encourage the bacteria growth**
- **Sulfate:** Laxative effect, fishy egg smell, negative impacts on nervous system, bitter taste, reduced water intake
- **Calcium & Magnesium (Water Hardness):** **Lime Deposit in the water system, high magnesium levels (50 ppm) can have laxative effect esp**. when the Sulfate or Chloride levels are high
- **Chloride:** Detrimental effect on Metabolism
- **Sodium:** **Laxative effect**
- **Lead, Zinc:** Toxic
- **Copper, Manganese:** bitter taste
- **pH:** **Low values harms Vaccines and medications**

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Water Alkalinity

- Associated with bicarbonate, sulphates and calcium carbonate
- Can give water a bitter taste which makes it undesirable to the birds.
- High levels can make it difficult to lower the pH
- Can be corrosive to evaporative cool cell pads.
- Control it by **water acidification.**
- **We must know this value** (< 100 mg/l)

Also dependent on bicarbonate, (HCO_3), and sulfate (SO_4)
Alkalinity is an index **of** the capacity **of** water to neutralize acidity that is usually expressed in milligrams per liter **of** equivalent calcium carbonate. **Hardness**, the sum**of** the calcium and magnesium concentrations, also is usually expressed the same way

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Water Total Hardness

Classification	Total hardness mg/ml of CaCO2
Soft	0 - 75
Somewhat hard	76 - 150
Hard	151 - 300
Very Hard	> 300

Maharjan, 2018

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

- Produce scale that reduces pipe volume and nipples are hard to trigger or leak.
- Calcium and Magnesium
- How to deal with hard water:

a) Water acidification < 6.5 pH
b) Conditioning agents (sequestering Ca).
c) Water softener (evaluate first the Na level in the water).

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Filtration options

- Wound filters (polypropylene string).
- Sand filters
- Carbon filters
- Reverse Osmosis
- Parker Hannifin – Farm guard series (polyester).

➢ Washable “Pre-filters” to remove big particles.

- The best option depends on the water analysis.

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Filtration options

Sand filter

- – Good for oxidized minerals, some turbidity
- – Back flush necessary
- • Automatic back flush
- • Pressure back flush
- – Not adequate to remove bacteria, viruses,etc.
- – >$2,000 for 100,000 bird capacity

Carbon filters

- – Removes Chlorine- that can be good or bad
- – Sulfur < 20 ppm
- – Hydrocarbons
- – Pesticides and PCBs
- – Volatile organic chemicals-benzene

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
20 micron @ > 95% efficiency

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Water pH

- Must know the water pH
- Ideal pH: 6.0 to 6.8 but can tolerate between 4.8 to 8.0
- > 8.0 impacts on water intake (bitter taste), feed intake, GI disorders, bacteria growth, sanitizer efficiency (chlorine activity – best pH 4.0-6.5).* Organic or mineral acids
- < 4.0 harms vaccines, medications, water intake and performance. * Baking soda.

$NaHSO^{-}_{4}$ Soiduim Hydrogen sulfate

Measures how acidic or basic

- Change of one indicates ten fold change
- Less than 6.5, corrosive water
- pH < 5.9, poor performance?
- pH > 8.0

– Impacts chlorine activity

- Chlorine most effective in pH 4.0 - 6.5

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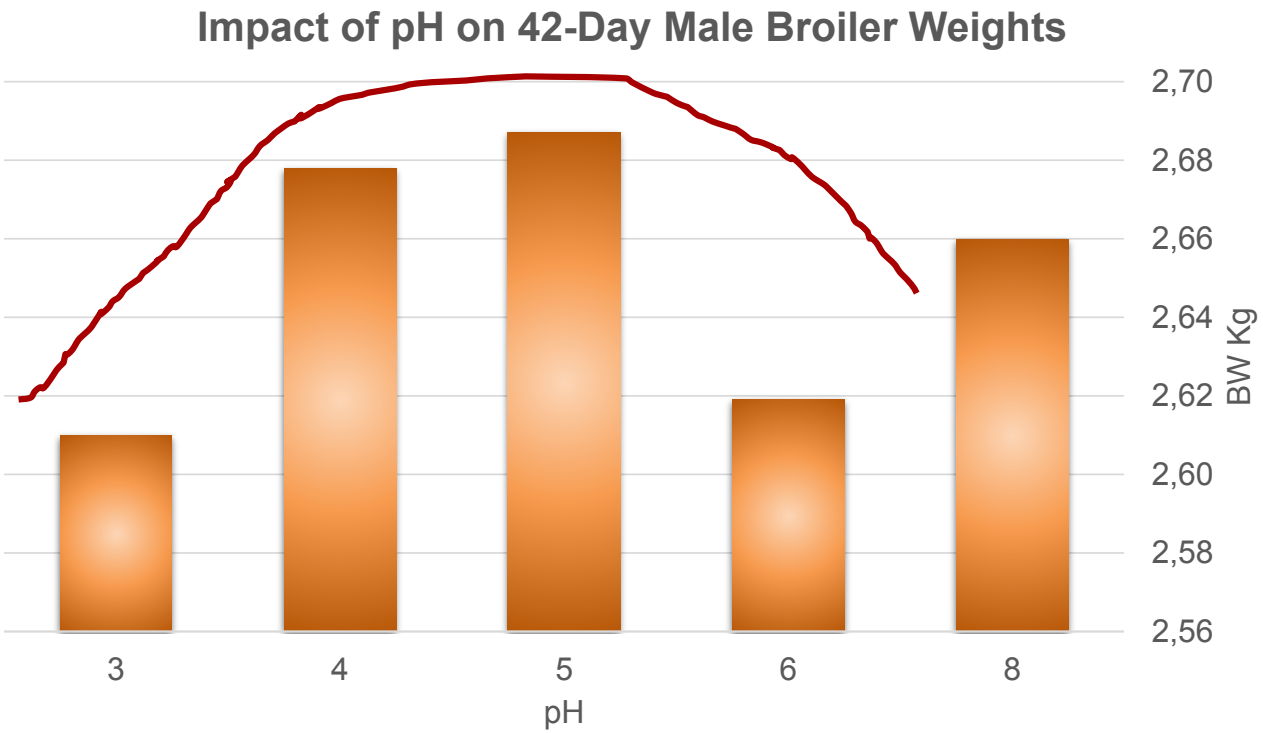
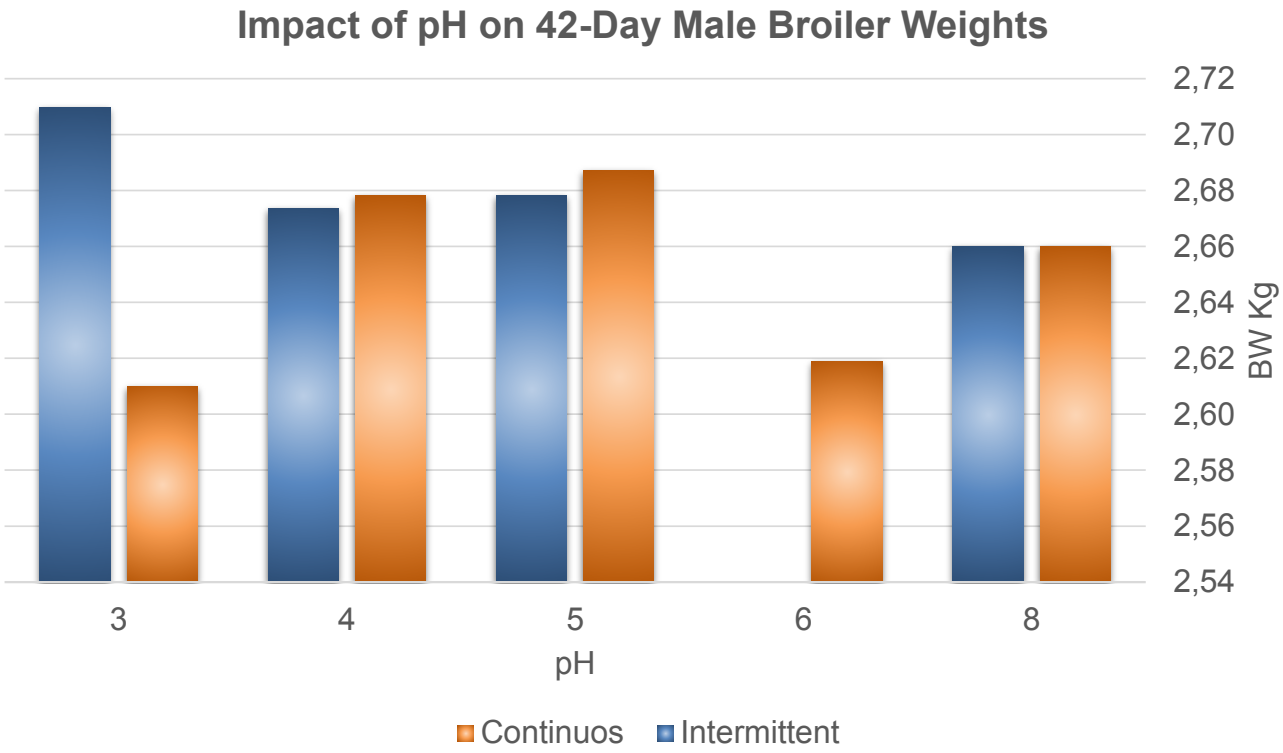
Water pH and Body weight



Watkins, 2008. PWT used to adjust pH

Water pH and Body weight



Target pH of 3.5-4.0 at bi level
- Continuous delivery for first 7-10 days after placement
- 48-72 hrs before and after each feed change
- 72 hrs continuous each week
- 48 hrs continuous prior catch

Watkins, 2008. PWT used to adjust pH

Water pH

- Waters with high pH need to be acidified but:

1. Acidifiers are not sanitizers
2. Most acidifiers need lots of contact time to damage or kill bacteria
3. During high water usage, contact time is minimal
4. Some bacteria may be resistant even thrive on it
5. Doses and products varies depending on water pH and water alkalinity (organic vs mineral).

Raise pH with soda ash (Na_2CO_3), lime $Ca(OH)_2$ or sodium hydroxide (NaOH)
Lower pH-phosphoric acid, sulphuric acid and hydrochloric acid for strong alkalinity, citric acid and vinegar for weak alkalinity
Sodium hydrogen sulfate

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Effect of drinking water Ph on Broiler Digestive Tract

pH	3	4	5	6	Control
Crop	4.33c	3.34c	4.62b	4.95b	5.57a
Gizzard	3.62	3.72	3.70	3.95	4.16

Watkins, 2008. PWT used to adjust water pH

- No difference in Gizzard pH

Water acidification as sanitizer

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

Watkins, 2008. 5 minutes exposure

Product	pH	APC Count CFU/ml
Control	8	8.2 mil
PWT	7	4.9 mil
PWT	6	2.8 mil
PWT	5	2.7 mil
PWT	4	2.9 mil

Watkins, 2008. 5 minutes exposure

- Water acidification could be not enough to clean water lines.
- Laying birds refuse to drink water at low pH levels

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Water is Perfect Carrier of Health Challenges

- Water supplies can harbor many health challenges
  - Bacteria
  - Viruses
  - Protozoa
  - Worms..

- Poultry drinking systems easily contaminated
  - Water is slow moving/ warmed during brooding
  - Water systems/lines have many hiding places-pinch points
  - Water often contains food the organisms need
  - We add food

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Water quality: bacteriology

- Drinking water standard for poultry

Parameter	Unit	good	Maximum acceptable
Total aerobic plate counts	In 1 mL	0	< 1000
Total coliforms	In 1 mL	0	< 50
Fecal coliforms	In 1 mL	0	0
Escherchia Coli	In 1 mL	0	0
Pseudomonas	In 1 mL	0	0

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Total Bacteria Inexpensive Test for Quality Assurance >1,000 cfu/ml-potential problem

Farm	Source	End of line in poutry barn
	Colony forming units of bacteria/ml	
A	2.700	26.600
B	203.000	2.340.000
C	0	4.775.000
D	0	0

Watkins, 2008

Water analysis must be performed frequently (every month). Especially if the source is well water

Microorganisms

Same Farm, different well waters!

Take samples from all parts of the house!

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How to sample?

- Take the samples from **different parts of the water system** e.g. dead ends
- **Clean and disinfect the openings and nipples** thoroughly **before** taking samples
- Water should be **first run for some minutes** to get a representative sample

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How to sample?

Microorganisms

- For bacteria count tests the sample should arrive the laboratory **within 24 hours** otherwise the water sample should be frozen!
- **Glass bottles** are more preferred than plastic ones
- What about the **Biofilm**?

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Biofilm

Microorganisms

Biofilm is a mixture of Fungi, Algae and Bacteria and organic contaminants e.g. sugar bound together stuck on the inner surface of the pipelines and water system!

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What Promotes Bio-film?

- Natural contaminants
  - Iron, manganese, sulfur
- Vitamins
- Electrolytes
- Organic acids
- Products with nutrients like carbohydrates
- Vaccines and vaccine stabilizers
- Probiotics and Antibiotics
- Are lines cleaned after the use of these products?
- Is water sanitation sacrificed so water can be delivery route for products?

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Negative impacts caused because of Biofilm

- Reduce flow
- Increase pressure
- Negative impacts on Medications & Vaccines applied through drinking water
- An optimum medium for pathogenic germs (Salmonella + Campylobacter …). Protection and food.
- Negative impact on production parameters
- Increased mortality
- Negative impact on drinking system specially nipple drinkers

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Look For the Source of Problems:

Line Swab Procedure

Microorganisms

Source: S. Watkins

1. Insert sponge into line approximately 8-10 cm

Source: S. Watkins

2. Return sponge to 25 ml BPD or sterile water

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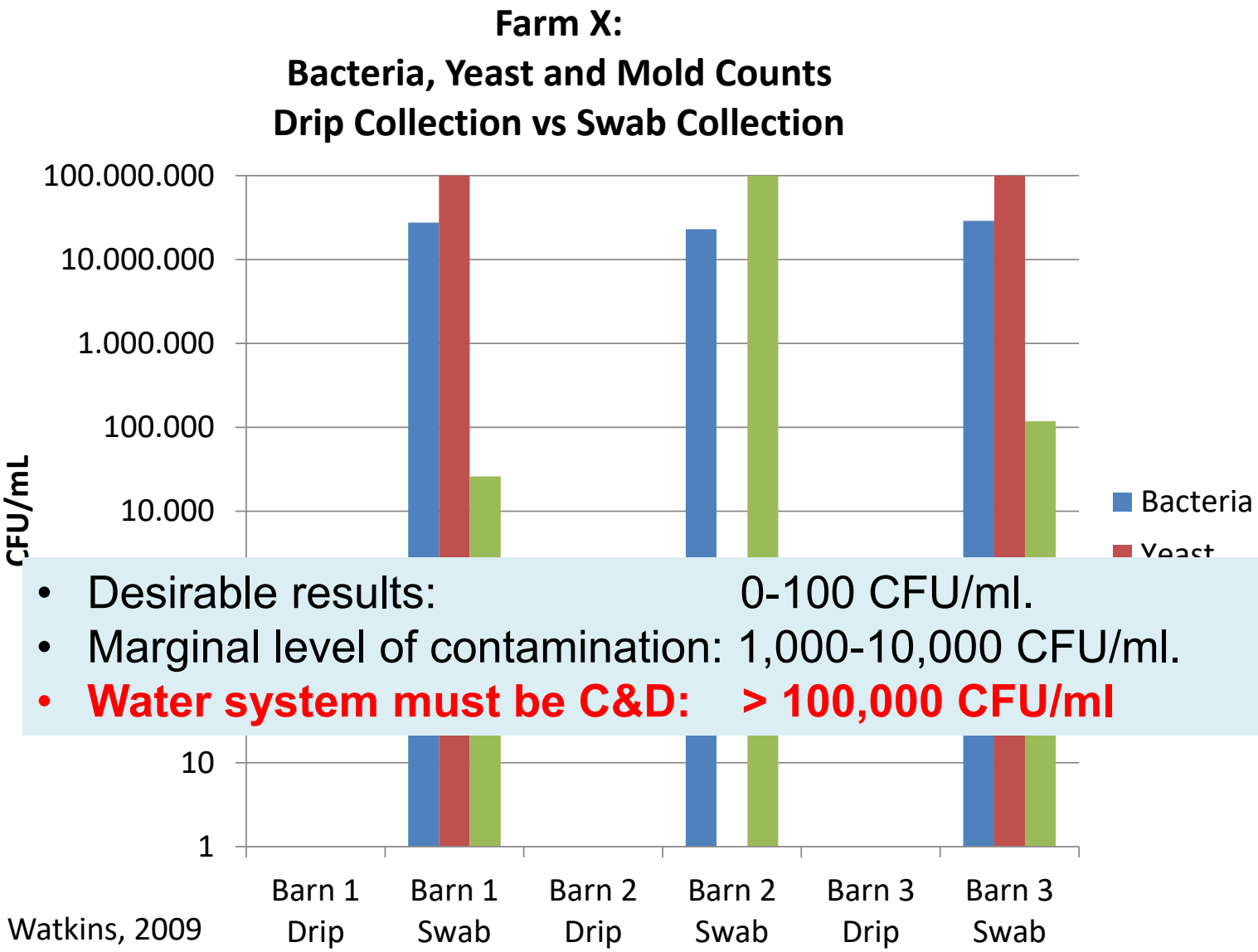
Microorganisms



- Desirable results: 0-100 CFU/ml.
- Marginal level of contamination: 1,000-10,000 CFU/ml.
- **Water system must be C&D: > 100,000 CFU/ml**

Watkins, 2009

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Treatments to eliminate or reduce impurities, scale and lime build-ups, biofilm and bacteria count.

Chemical Treatments

a) Chlorination (unsafe, bad smell, not completely effective)

b) Hydrogen Peroxide

c) Polyphosphate Compounds

d) Organic Acids (not completely effective)

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Treatments to eliminate or reduce impurities, scale and lime build-ups, biofilm and bacteria count.

Physical Treatments

a) Electromagnetic Methods
b) Ultraviolet light, Ozone Treatment (Limited effect on bio-film)
c) Laser (Only effective at point of use)
d) Softener Equipment
e) Pressure impulse methods

- *Only a very few treatments can be used during the production cycle.
- Other effective treatments must be applied during service period!

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Water Treatment - Chemicals

	Desinfection under hard conditions*	Lime sclae Elimination	Biofilm Elimination	Acidification	Stability	Toxicological Properties
Peracetic Acid						
Hydrogen Peroxide						
Organic Acids						
Chlorine Compound						
Chlorine Dioxide						
Chloramine T						

Lohmann Animal Health, 2010

Excellent | Good | Satisfactory | Acceptable | Poor

*PH, Water Hardness, Temperature

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Water Line Cleaning Essentials

- Right concentration of an effective cleaner left the proper amount of time is the key to success
- Cleaning the whole system is essential
- There are lots of great products, DOCUMENT which one is best for your operation(s)
- **Flush system after cleaning with sanitizer and/or applying medications.**

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Water Line Cleaning Essentials

- Right concentration of an effective cleaner left the proper amount of time is the key to success
  - Improper cleaner concentration or not leaving long enough are both failures
- Cleaning the whole system is essential
  - Water lines
  - Standpipes
  - Regulator
  - Distribution pipes
- There are lots of great products, DOCUMENT which one is best for your operation(s)
  - Collect swabs pre and post cleaning
- **Flush system after cleaning with sanitizer**
  - Stabilized products ideal since they keep working for days
  - This helps kill any bugs that survived line cleaning
  - 1 minute per every 30 meters of water line.

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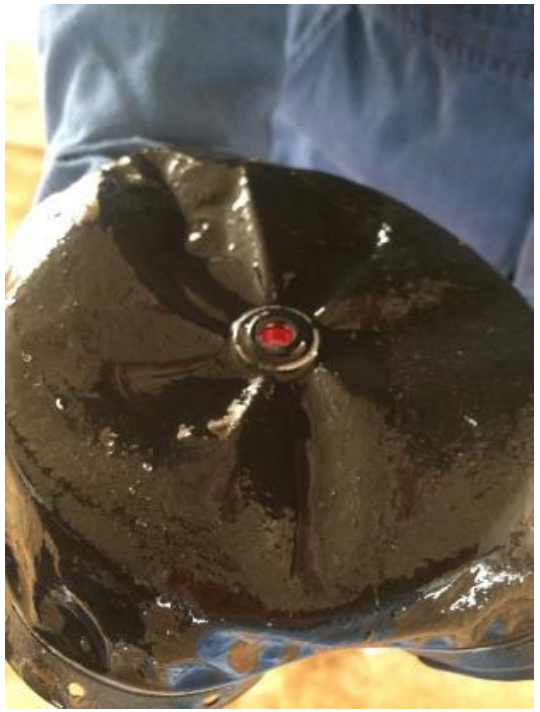
Regulators can harbor challenges

Before cleaning regulators

Source: S. Watkins

After cleaning regulators



Source: S. Watkins

Source: H&N International

Cleaning regulators and standpipes are key for success
Make sure regulators are not in flush mode
Make sure stand pipes are working

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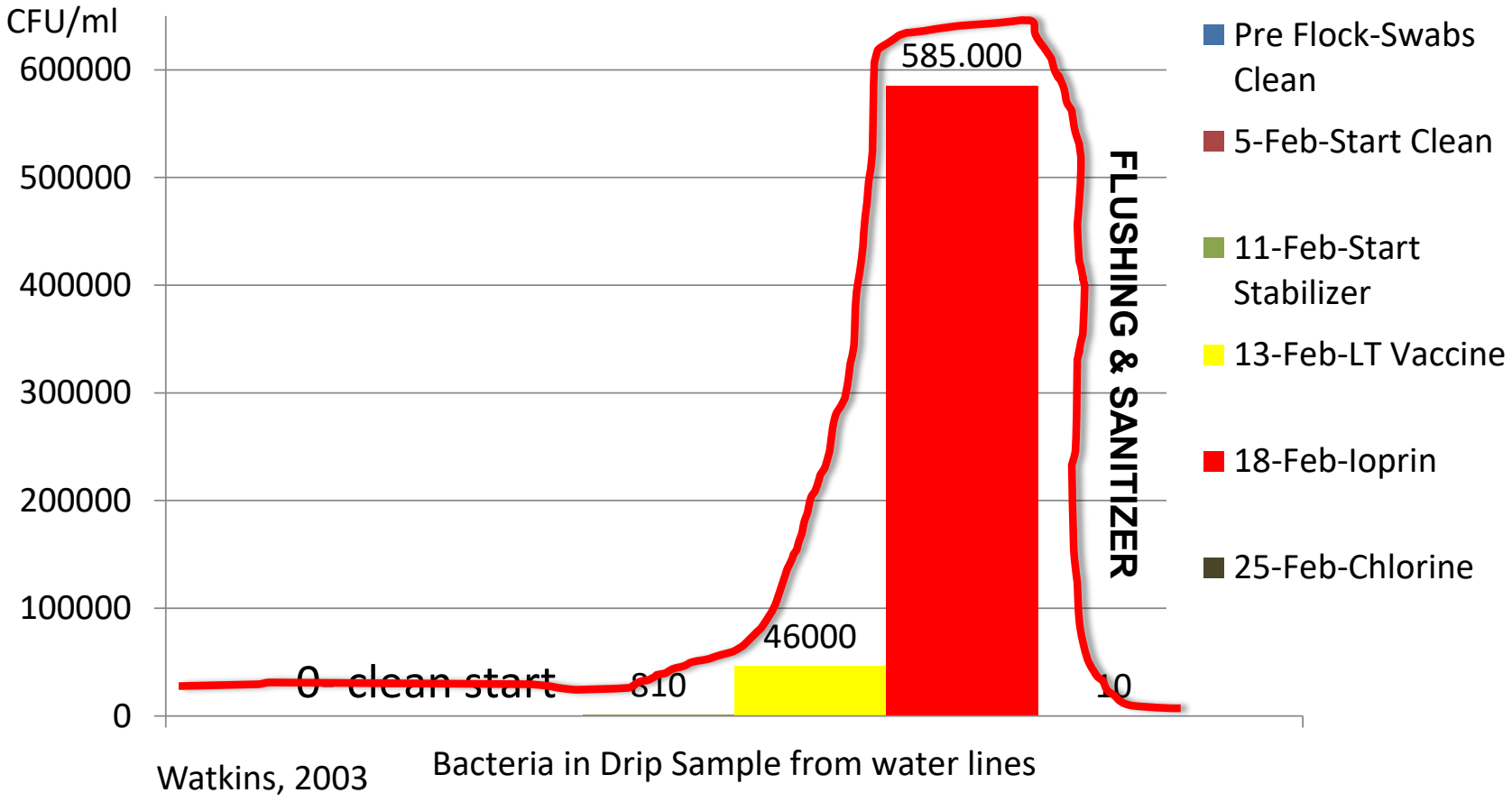
What happens to water quality when the sanitizer is shut off or barn is empty?

Microorganisms



Watkins, 2003

Bacteria in Drip Sample from water lines

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Water Sanitation

- Chlorine great sanitizer but not perfect
- Affected by:
  - pH, best pH is 4.0 to 7.0
  - Low concentration bacteria will live
  - Water temperature, >18.9 C loses effectiveness
  - Turbidity (dirty water)
  - Short exposure time, will not work
  - Age/ storage conditions of bleach

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What Form is Your Chlorine?

- Hypochlorus acid is 80-300 times more effective as a sanitizer than chloric ion
- Free chlorine not considered effective unless it is 85 % Hypochlorus acid (<7 pH)
- Goal: 2-4 ppm of free Chlorine

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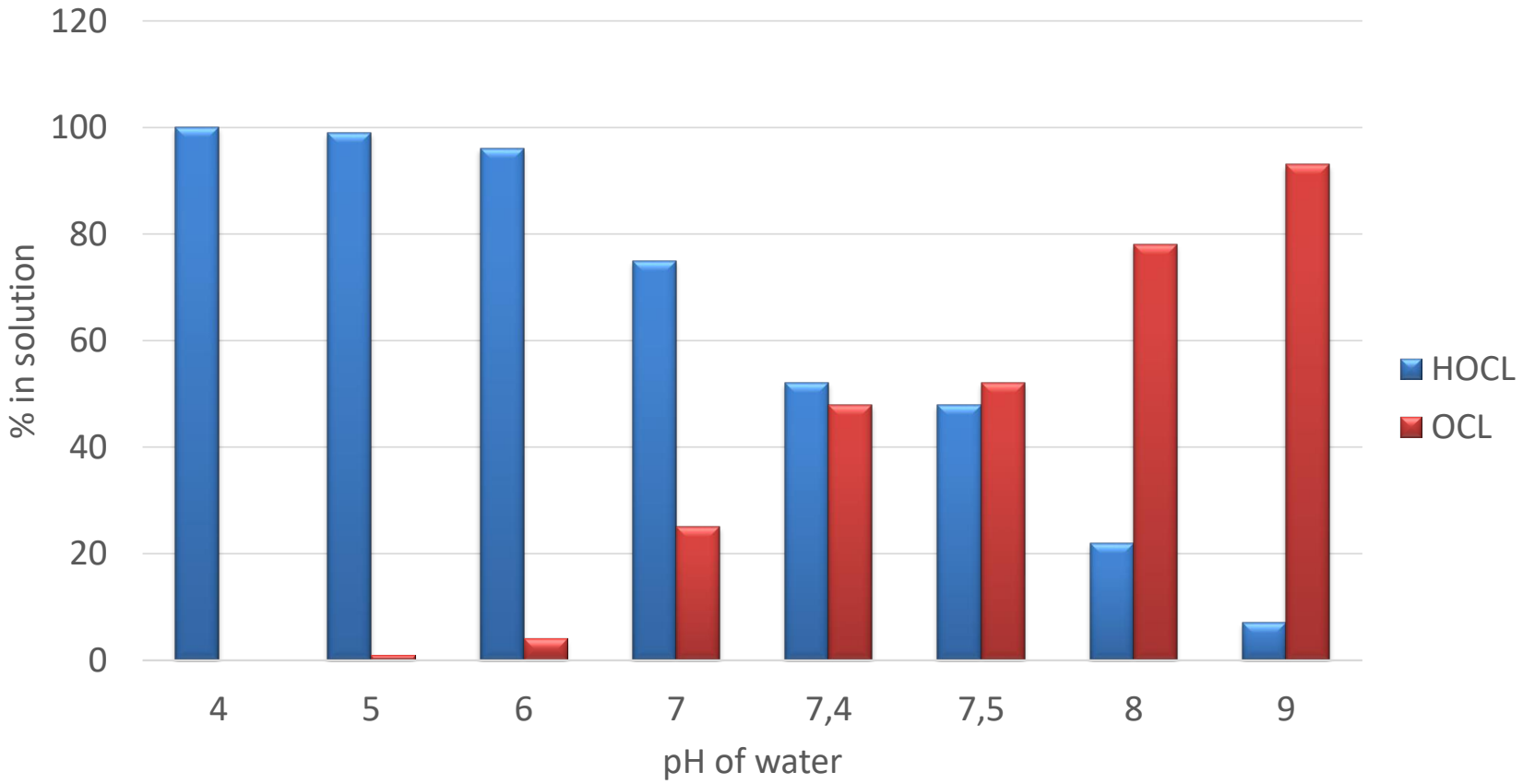
How pH Affects Chlorine
Ratio of Hypochlorous Acid to Chloric Ion



Microorganisms

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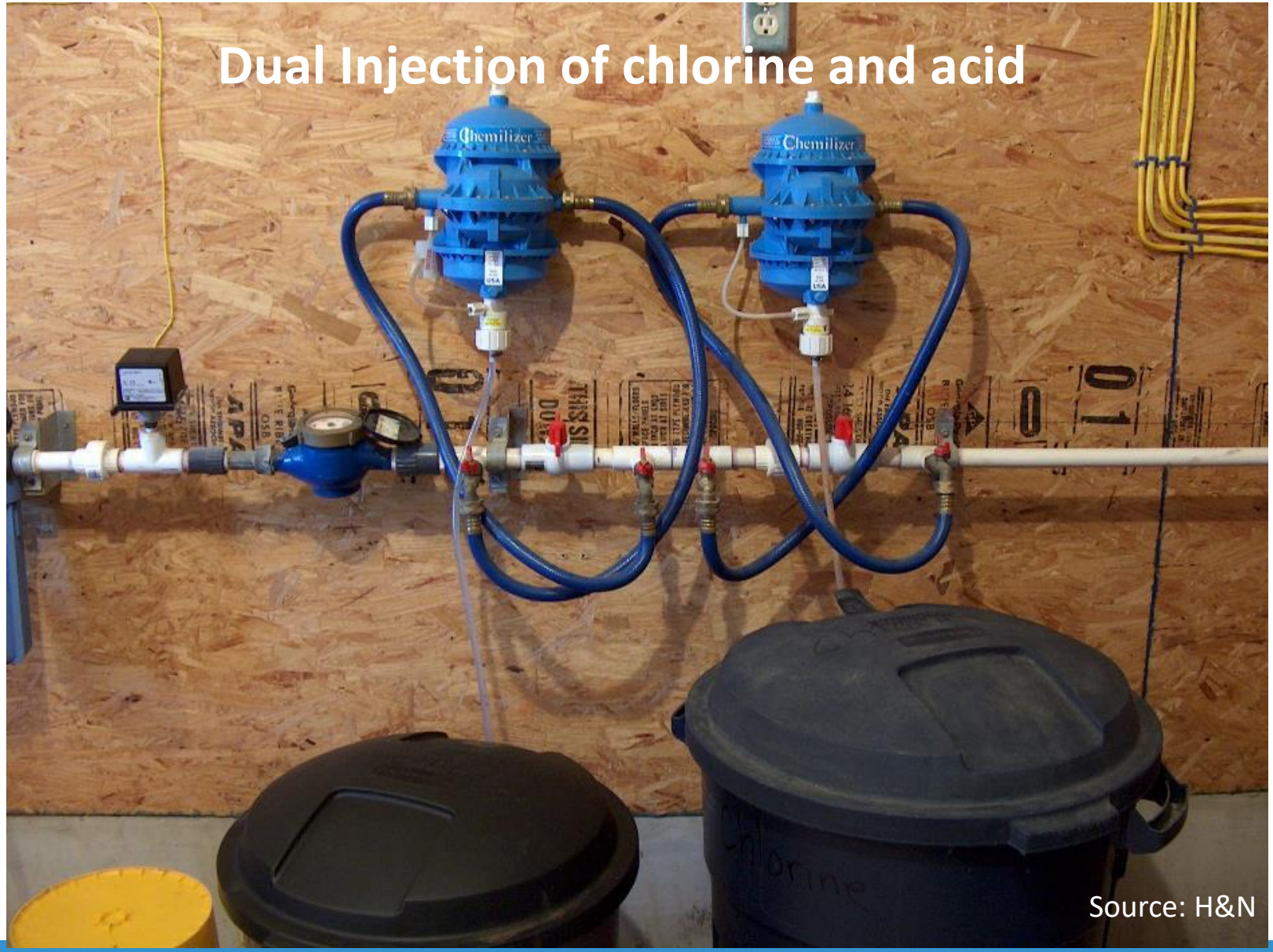
Dual Injection of chlorine and acid



Source: H&N

Hydrogen Peroxide

- Target- **25-50 ppm** residual in drinking water
- Good for sanitizing pond or river water- controls taste issues/no chlorine by-products
- **Can be dangerous to store and handle**, flammable
- Effectiveness deteriorates with **storage**
- **Stabilized products** like Proxy Clean/CID last longer

Physical Treatments: APIRE ®

- The APIRE drinking line cleaning equipment
- **A new method based on pulsed Water & Air pressure produced in specific intervals in pipelines**
- A chemical-free method
- Suitable for empty houses
  (in the service period) and occupied houses
- Complete elimination of Biofilm
- Easy and fast application
- Does not cause any corrosion in the system.
  It can be used in the long term and at any frequency.
- Works under lower pressure,
  thus does not overload the water mains network.

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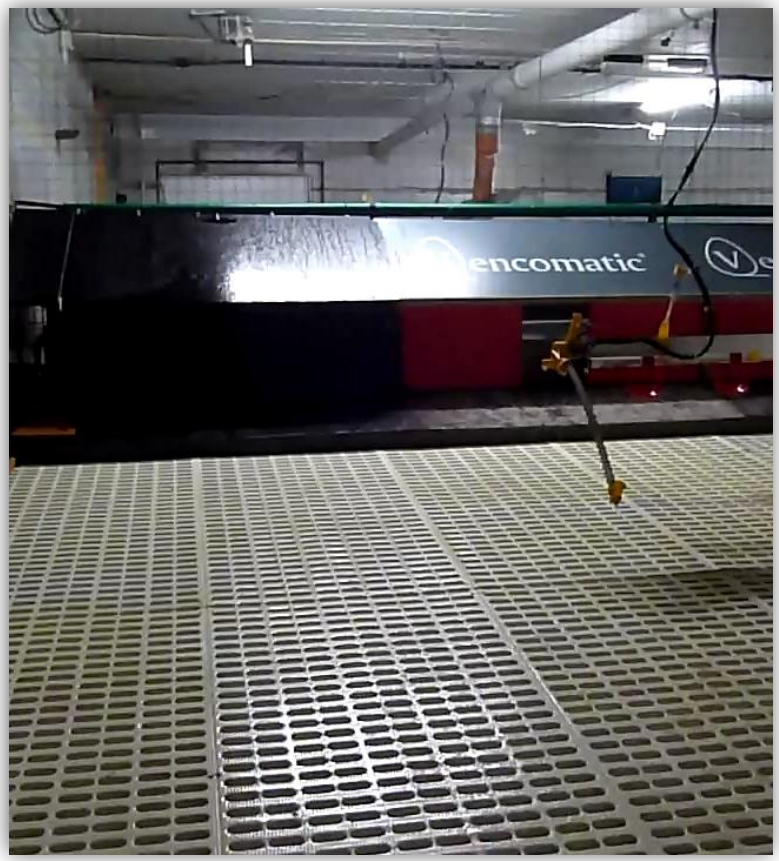
APIRE ® (LAH GmbH)

Microorganisms



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Microorganisms

Simple Pipeline Flushing without APIRE®

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Microorganisms

First Flushing with APIRE®

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Third Flushing with APIRE®

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Microorganisms

Fifth Flushing **VS** **Third Flushing**

with APIRE®

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Monitoring sanitizer

Microorganisms

- Free chlorine tests strips
- Chlorine Dioxide tests strips
- Hydrogen peroxide test strips
- ORP

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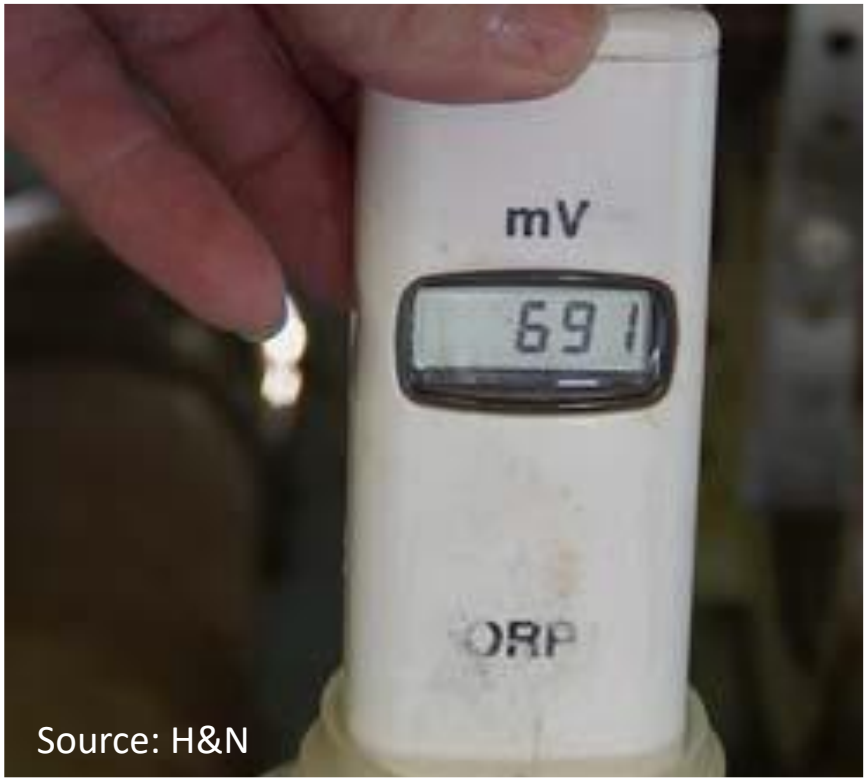
Oxidation-Reduction Potential (ORP)



Source: H&N

- Measures the energy in water
- Free chlorine present- oxidizing 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 2 to 4 ppm adequate

pH, ORP, Free Cl and APC

pH	ORP	Total Cl	Free Cl	APC CFU/ml
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	705	5	2.5	< 10

Bleach 8 oz/gallon stock then 1:128
PWT used to adjust pH

- The lower the pH the higher the ORP
- Goal > 650

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Always use medicators

Supply

Source: H&N

- Always use a specify recipient for medications
- Always label the recipients.
- Must be covered all the time.
- Frequently mix the solution
- Do not undersize the medicator.

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Medicators


Source: Brian Fairchild


Source: Brian Fairchild

Always monitor water intake

- Daily check the presence of water.
- Water meters are a must in every poultry house.
- Best is to have a water meter per each water line.
- Record the daily water consumption.
- Record the Water : Feed ratio.
- Follow the guide & manufacturer space recommendations (birds/nipple).

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Flow Rate

35-40 up to 90 to 110 cc/min

Supply

- Periodically measure the flow rate (cc/min)
- Adjust it depending on flock age, BW, temperature, ventilation, among others.
- Keep an eye on ball height.
- Pay attention to the litter/manure belt condition (wet or not).
- The flow rate **MUST FOLLOW the** manufacturer recommendation.
- Keep in mind: Water Usage = Consumption + Spillage.

Source: Aviagen

Always check the litter conditions!

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Key points for an adequate water supply

- Right water pressure coming into the house water system.
- Install the right water meter size – depends on the water demand
- Calculate the plumbing line size for a max water demand (summer + cool pad; lights on and off)
- Water filters replacement and/or cleaning – water pressure gauges on both sides of the filter.
- Maintenance of water regulator.
- Always check the drinker supply hoses. Use good quality ones.

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Key points for an adequate water supply

- Nipple drinkers. Activating all of them before placement is a MUST. Chose the right type.
- Sloped water lines results in an uneven water supply and can create air locks. Always keep the water lines straight. If necessary, install slope regulators.
- Air locks: prevent them by keeping your water line straight. Critical in young birds.

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Check list

Have the profile of you water

- ☐ Minerals
- ☐ pH
- ☐ Micoorganism

- ☐ **Create procedures to optimize your water**

Daily:

- ☐ Check/adjust line height and levelness
- ☐ Check/adjust regulator pressure
- ☐ Check that incomin/outgoing pressure is steady
- ☐ Check water presence in water lines (end)
- ☐ Check drinker supply hoses
- ☐ Monitor water consumption

Weekly:

- ☐ Backflush water filters
- ☐ High pressure flush water lines
- ☐ Remove dust from site tubes
- ☐ Monitor the sanitizer concentration
- ☐ Monitor the water quality (fast test: pH, total hardness, etc)
- ☐ Check the water tanks

Monthly:

- ☐ Check flow rates (every 2-3 weeks during rearing)
- ☐ Samples for bacteriology

Quarterly:

- ☐ Clean and disinfect the whole system
- ☐ Check presence of bacteria

Yearly:

- ☐ Check water quality (complete analysis)

- Flush water lines after the application of any products through the water system

Valco, water line maintenance

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The key to your profit!

Conclusion

Conclusion

- The importance of good quality drinking water is often underestimated!
- So Pay Attention to it! Follow a checklist.
- Easy access to fresh clean water must be always ensured!
- Flush the water line periodically and after the application of vaccines, medications, etc.

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Would you drink the water?

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Keep in mind …

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Keep in mind …

- More than **one in 6 people in the world don't have access to clean drinking water!**
- About 1.8 Mio. People die yearly of diarrheal diseases like cholera as a result of drinking polluted water
- By 2025, half of the world's population will be living in water-stressed areas.

https://www.deccanchronicle.com/world/neighbours/080317/84-per-cent-people-lack-access-to-clean-drinking-water-in-pakistan.html

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“Thousands have lived without love, not one without water.”
–W.H. Auden

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Thank you for your attention!