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MEASURING AND MANAGING LIVESTOCK WATER QUALITY

Dr. David Kolb, DVM and Dr. Ryan Leiterman, DVM

Dr. Kolb and Dr. Leiterman have created a "water quality management system" – "Water Trough Scorecard" that makes it easy to measure and monitor key water quality factors for livestock health.

Water has frequently been referred to as **the most essential nutrient consumed by livestock.** Water affects all the critical elements of an animal's growth, development, and production. Yet, as important as water is, it can also be the most overlooked resource. It is commonly thought that if the water is available, then the job is over, with little consideration given to the quality of the water.

Odds are that you've checked out your water troughs and wondered whether the water would be considered drinkable or undrinkable, but you didn't have any way of measuring the water quality. So, **what is "good / poor water quality," and how can it be measured?** That is the question that was tackled by Dr. Ryan Leiterman, DVM, Crystal Creek Natural, LLC and Dr. David Kolb, DVM, Lodi Veterinary Care, Lodi, Wisconsin.

Dr. Kolb and Dr. Leiterman have created a "Water Trough Scorecard" that makes it easy to measure and monitor key water quality factors, using the following tools:

- A Hygiena ATP Meter / AquaSnap™ Total Tests
- A HANNA® Combo pH / ORP Meter

An Introduction to ATP Testing

Adenosine Triphosphate, or ATP, is the energy molecule found in all living things, making it a perfect indicator when trying to determine whether a water source is clean or contaminated. Companies use ATP systems as a rapid test to verify surfaces have been cleaned thoroughly in food manufacturing, healthcare facilities, and to ensure that biofilms are not developing on surfaces that could affect water quality. When residues are left on a surface, or within a water system, they house disease-causing pathogens within the biofilm that they create, causing problems that can affect water quality and compromise the health of the animals. Water troughs can be measured with an ATP meter and provide an immediate indication of a water trough's relative hygiene level.

Dr. Leiterman has been using the ATP bioluminescence testing technology for several years to evaluate the hygiene of dairy calf housing and calf feeding equipment and has incorporated water quality testing into Crystal Creek's monthly "Hygiene Management Audit." He feels that proper water hygiene monitoring is critical to the health and welfare of the animals and the health of the farm labor.

The developers of the water ATP test, Hygiena, have provided a chart that equates the ATP meter RLU results with Colony Forming Units (CFU).

CFU : RLU Conversion

CFU / ml or swab*	*E.coli*	Coliform	Enterobacterioceae**	Total
<10	<2	<2	NA	<10
<20	<4	<4	NA	<20
<50	<7	<7	<10	<50
<100	<12	<12	<20	<100
<200	<20	<20	<40	<200
<500	<35	<35	<100	<500
<1,000	<60	<60	<200	<1,000
<5,000	<180	<180	<1,000	<5,000
<10,000	<300	<300	TNTC	TNTC

*Direct sample e.g., 1 ml liquid or surface swab. Dilution factors must be accounted for with product samples.
**Data reflects dynamic range after 6-hour incubation. See product instructions for more details.
Hygiena MicroSnap™, Rapid Microorganism Detection. www.hygiena.com.

ORP: Measuring Disinfection Power

ORP (Oxidation Reduction Potential) measures the oxidizing power of a solution, providing the actual sanitizing strength of the solution being tested. Simply counting the PPM (parts per million) of a disinfectant present is misleading due to the changes of chemistry when a solution is diluted with water, or the hydrolysis of the disinfectant when mixed in water. An ORP meter measures a dilution strength in millivolts (mV). The higher the ORP value the greater the oxidizing action and the shorter the microbial kill time in water.

ORP offers many advantages to "real-time" monitoring and recording of water disinfection potential, a critical water quality parameter. Hand-held devices are affordable and are an essential backup for cross-referencing the operation of an inline ORP sensor, as are the more traditional dose-related test kits.

A primary advantage of using ORP for water system monitoring is that it provides the operator with a rapid and single-value assessment of the disinfection potential of water. Research has shown that at an ORP value of 650 to 700 mV, free-floating decay, and spoilage bacteria, as well as pathogenic bacteria such as *E. coli* O157:H7 or Salmonella species, are killed within 30 seconds.**

Measurement of Oxidizing Agent ORP Values In Pathogen Disinfection*

OXIDIZING AGENT	OXIDIZING AGENT ORP VALUE RANGE (mV)
CHLORINE DIOXIDE (CLO_2)	600 ⇢ 1000 MV
OZONE* (O_2)	700 ⇢ 1000 MV
IODOPHORS (I_2)	400 ⇢ 600 MV
HYDROGEN PEROXIDE	300 ⇢ 500 MV
SODIUM HYPOCHLORITE	250 ⇢ 500 MV

ORP Values In Pathogen Disinfection**

Pathogens	<500 ORP (mV)	500 - 600	600 - 700	700+
CORONAVIRUS	> 300 S	< 60 S	< 10 S	< 1 S
E. COLI (0157:H7)	> 300 S	< 60 S	< 10 S	< 1 S
SALMONELLA SPP.	> 300 S	> 300 S	< 20 S	< 1 S
LISTERIA MONOCYTOGENES	> 300 S	> 300 S	< 30 S	< 1 S
THERMO-TOLERANT COLIFORM	> 48 H	> 48 H	< 30 S	< 1 S

*Ozone is greatly influenced by the water quality and ozonation system.
**Oxidation Reduction Potential (ORP) for Disinfection Monitoring, Control and Documentation; University of California, Trevor Suslow, Department of Vegetable Crops, University of California - Davis

Chlorine Dioxide

Chlorine dioxide is a powerful oxidizing agent, and oxidizing agents are the most prominent disinfectants used in the animal agriculture hygiene processes (chlorine, sodium hypochlorite, iodophors (iodines), hydrogen peroxide, peracetic acid and ozone). Chlorine dioxide is a gas, that when created is more soluble and much more efficient in water than chlorine / sodium hypochlorite. Chlorine dioxide does not hydrolyze (break apart) in water like hydrogen peroxide and sodium hypochlorite and operates at a high ORP level (600 -⏵ 800+ mV) across a wide pH range (2 – 12 pH).

The above tables show the comparative ORP strength of oxidizing treatments, and their effectiveness with pathogen survival.

Putting It All Together: The Water Trough Scorecard

Unfortunately, livestock water systems are rarely measured for water quality. The CDC reports that water may act as an important source of many infectious and non-infectious diseases in both animals and humans. Each test device provides an indication of a livestock system's water quality level, but by themselves, cannot tell the total story. To that point, Dr. Kolb and Dr. Leiterman constructed a "Water Trough Scorecard" that enabled their teams to evaluate all the important components that make up the categories within the scorecard. Improved water hygiene has been proven to increase water consumption, production, and animal wellness.

Each veterinary practice conducts a monthly **Water Trough Scorecard audit** to make sure their clients are continuing to manage this critical animal health category. Both practices are also using the Acepsis™ – AquaSoar™ Water Treatment – Chlorine Dioxide systems.

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Water Trough Scorecard

	Water Valve Entry Area	Trough Water	Organics on Bottom	Biofilm	ORP (mV)	ATP (RLU) (AquaSnap)
Score 1	Clean / Clear	Clean / Clear	Minimal	None on sides or bottom	>600	<100
Score 2	Clean / Clear	Slight Haze	Some	None on sides or bottom	>500	<200
Score 3	Hazy	Hazy	Covers the Base	Slight on sides or bottom	>400	<500
Score 4	Cloudy	Cloudy	Buildups	High Level on sides or bottom	>300	<1000
Score 5	Opaque	Opaque	High Level of Buildups	On Sidewalls and bottom	<300	>1000

SCORE 1

SCORE 5

For more information contact: rcavanagh@acepsis.com.

ACEPSIS™, LLC is an animal health based company that is focused on the development of state-of-the-art animal hygiene technologies. Our Company's mission is to apply innovative animal hygiene technologies into the agricultural and veterinary market sectors. Visit us at www.acepsis.com or info@acepsis.com.

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