

Onsite generation of Electrolyzed Water

Application Manual for Aquaox Technologies

About the manual

The Aquaox Technologies Application Manual is task-oriented and presents common target industries identified by Aquaox and users of Hypochlorous Acid (HOCL) solutions. The knowledge about HOCL is based on Aquaox' 25-year experience, scientific and practical research.

Due to the fact that different practices are used in different life stock sectors, guidelines given in the manual are subject to continuous adaptation during forthcoming years. Therefore situations may differ per specific farm. Each user of Aquaox' technologies has possibly a specific application for using HOCL.

We welcome comments on each guideline if you find something that needs amendments. This will help us continually improve our products and services in the future. Or if you have a general comment about the manual, please do not hesitate to let us know.

Kind regards,

Michel van Schaik
President.

Aquaox LLC.
17355, Hamlin Boulevard
Loxahatchee
FL 33470, USA
Cell : +1 561 427-9495
michel@aquaox.net

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I. GENERAL

The usage of the Aquaox onsite Electrolyzed Water generator, HOCL solutions and related applications differ in dairy, pig and poultry farms. The difference is related with the possibility to use Mixed Oxidant Water (MOW), Neutral Electrolyzed water (NEW) and Alkaline Water (AW). These products have specific functions at the animal production facility.

Product: MOW (Mixed Oxidant Water)

Active ingredient	:	OCL ⁻ / HOCL
Free available Chlorine (FAC)	:	4000-5000ppm
pH	:	8-9
ORP mV (redox-potential)	:	600 - 800
Electrical Conductivity (mS)	:	50-70
Equipment	:	MOW-1 (25gph)

Product: NEW (Neutral Electrolyzed Water)

Active ingredient	:	HOCL / OCL ⁻
Free Available Chlorine (FAC)	:	460-500
pH	:	6.3-7.2
ORP mV (redox-potential)	:	800-900
Electrical Conductivity (mS)	:	3-9
Equipment	:	EAW-1(24gph)

Product: AW (Alkaline Water)

Active ingredient	:	NAOH
Free Active Chlorine (FAC)	:	0
pH	:	11 - 13
ORP mV (redox-potential)	:	-/-800 - 900 (acts as a powerful anti-oxidant)
Electrical Conductivity (mS)	:	3-9
Equipment	:	EAW-1(2-3gph)

Note:

- MOW and NEW both consist of HOCL as main active ingredient at usage strength and pH.
- The strength of HOCL is measured as ppm FAC.
- Diluting MOW and NEW in water result in different ppm HOCL solutions.

Caution for MOW (undiluted):

- Can cause minor skin irritation
- Avoid contact with eyes. If contact with the eyes or skin is made rinse the eye or skin directly with clean water
- Avoid contact with clothing

Warning:

Do not add MOW or NEW together with medicines or nutrition in the water supply for animals at the same time. Disinfect water so that it contains 1-5 ppm FAC. When dosing MOW and allow 5-10 minutes flush time before dosing any medicines or nutrition.

I. Pig Farms.

Stable disinfection

Disinfecting a department or a barn is always difficult due to the infection level of “barn-tied” micro-organisms. When a barn is disinfected regularly the chance of returning “barn-tied” contagions are reduced to a minimum.

Application:

- Spray disinfected water having 1-5ppm FAC to the area to be cleaned. After cleaning, (electrostatic) fog a 500ppm HOCL solution (3 litres per 100m³ or 1 gallon per 4000 sq. ft) and turn off the ventilation. The department should be closed for 2,5 hours for the best results.
- In case the infection reappears, fog additionally 3 litres a 500ppm HOCL solution per 100m³ (1 gallon per 4000 sq.ft)
- The temperature of the disinfecting solution must be lower than 30 degrees Celcius. (less than 86F)
- Make the fog as thin as possible. (3-5micron)
- MOW as well NEW can be used to dilute solution to required 1-5ppm concentration.

Hogs, drinking water

Pipe systems are frequently covered on the inside with a film of organic material that the living environment is for bacteria and moulds (germinate or micro-organisms). Especially long and older pipe systems are vulnerable to pathogens and pollution. At the same time contagion of the water can be rooted to the source of water; for example from the usage of source water with a germ number.

Application:

- Inject MOW or NEW in the drinking water system to obtain a 0.1- 0.5ppm residual FAC measured at the end of the drinking water system. Initial usage dosage of MOW or NEW to drinking water is 5ppm, which is gradually reduced to 1ppm.

Note:

Clean water is a basic condition for good production results without stress due to infections. With 1 – 5ppm FAC into the water, the piping remains clean and the water is free of bacteria, moulds etc.

Observation:

Generally, if the drinking water has an ORP of above 650mV, a pH around 6.5-7.0 and 0.1-0.3ppm residual FAC measured at the end of the waterlines, it will contribute to the hogs health. In the first 3-5 weeks water measurements may vary, as biofilm will be gradually removed from the water lines. Filters may be needed to be rinsed, as biofilm and algae may be trapped in the filters. Once biofilm has been removed, lines and filter will remain free of biofilm and algae as long as MOW or NEW is dosed into the drinking water system at a 1-5 ppm FAC dosage rate. It is beneficial to dose more MOW or NEW in the first and last week of the cycle.

Air disinfection

Application:

- Fog departments with weaner or fattening pigs, 1 - 3 times per week with a 250ppm HOCL solution while the pigs are present. Dosage rate is 2 litres per 100 m³. (1 gallon per 2000 sq. ft). If an automated fog installation is present, fog the departments several times a day for 3-5 minutes.
- Make the fog as thin as possible. (3-5micron)
- MOW as well NEW can be used to dilute solution to create mentioned 250ppm HOCL solution.

Aim of fogging:

- a) In the barn there are a lot of particles in the air. These particles form a substrate for germinates of bacteria, moulds, viruses etc. By fogging a 250ppm HOCL solution these germinates of bacteria, moulds, viruses etc. are reduced to a minimum level.
- b) By introducing a fog in the barn separately airborne germinates will be eradicated.
- c) If the number of micro-organisms is reduced, there are no longer metabolites formed from the “food” in the air. Already after the first treatment the atmosphere improves considerably. The air that animals breathe will become cleaner.
- d) When there is a lower number of germinates, the current level of animal-to-animal contagions decreases. (Recognizable phenomenon is related for example with cough symptoms. It starts in one area of the department and after a day the whole department is infected. A day later it can affect the other part of the barn.)
- e) When animals are infected with a cough infection, daily fogging treatment is advisable. Cough will disappear because the animals clean/disinfect their lungs.

Observation:

After the fogging application stable air becomes substantially cleaner. This is possible due to the cleaner air with the micro-organisms reduced to a minimum. This results in less production of gaseous fatty acids and other metabolites. Fog must be preferable an electrostatic fog (3-5micron), as standard foggers (more than 15 micron) may unnecessary wet the hogs and equipment.

Weaners

- 1) Clean/disinfect the department as mentioned above.
- 2) Disinfect water by adding 1-5ppm FAC into the water system as mentioned above.
- 3) Disinfect air using (electrostatic) fogging as mentioned above.

Extra recommendation:

- 1) If possible, add MOW or NEW during the first 2 days after to obtain 50ppm FAC in the water tray. Especially when pigs are already sensitive before weaning or when pigs are located in a department where diarrhoea is common. This treatment will help to improve the start of the weaners considerably. The diarrhoea problems (mainly an E-coli infection) will be reduced to a minimum or disappear.
- 2) Separate sick or weak animals from the group and give them 500ppm HOCL solution next to the drinking water. Allow weaners to have free choice what to drink
- 3) All skin infections can be treated by applying 50-500ppm HOCL solution with a towel or spraying

Warning: Do not allow weaners to drink 500ppm HOCL solution for more than 7 days, unless weaners are sick.

II. Dairy and Beef Farms.

We recommend to start with only limited number of applications. To start all applications at the same time requires a lot of attention. There are several guidelines that should be followed, for example how to make different HOCL solutions with the onsite Electrolyzed Water generator.

Drinking water

Milk contains over 80% water. It is therefore no surprise that improving the water quality result in improving the milk quality.

Application:

1) Standard: Add MOW or NEW to drinking water at 1 to 5ppm FAC dosage rate. This should result in 0.1-0.3ppm residual FAC at the end of the water distribution system.

2) If the health condition of the cows is not optimal: Add 1 to 5 ppm AW to drinking water instead of adding MOW or NEW for one day. Continue alternate dosage for maximum one week.

Specific application:

1) Cows with ruminant acidification: Give undiluted AW from drinking tray or bottle for 2 or 3 days, 3 litres each time.

2) Calves with diarrhoea: Give 500ppm HOCL solution one day followed by one day neat AW.

Observation:

- The appetite of the cows improves if 1 – 5ppm FAC has been added to water. The intake of raw fodder will increase.
- Algae in the drinking places will disappear when 1 -5ppm FAC is diluted to the water.
- Somatic cell count in the milk will decrease.

Cleaning and Sanitation

The 2011 PMO recognizes and allows usage of 50-200ppm HOCL for sanitation of milk equipment, CIP systems and other milk contact surfaces. NAOH as a cleaning agent is not regulated as it has not efficacy claims. EPA allows onsite usage of 50-200ppm HOCL for surface sanitation.

Application:

- Rinse with HOT disinfected water (1-5ppm FAC).
- Apply NAOH solution or other detergent
- Rinse with HOT disinfected water (1-5ppm FAC)
- Sanitize with 50-200ppm HOCL solution
- Rinse with COLD disinfected water (1-5ppm)

Footbath

A 500ppm HOCL solution proves as effective against foot warts as currently used chemicals when HOCL is freshly generated.

Application:

- 1) Use 500ppm HOCL solution with (ideally) pH 5.5.
- 2) There is some evidence that the application frequency using a 500ppm HOCL solution needs to be higher compared to the use of for example formaldehyde. However, this can greatly differ per farm.
- 3) Add 50ml of MOW or 500ml of NEW per cow when the cows run through the bath, so the ORP (Oxidation-Reduction Potential) will stay above 650. This can be automated easily. Dosing MOW or NEW keeps footbath longer effective and in most times it remained effective for the whole day.
- 4) Best results are obtained with at least one treatment per week
- 5) Footbath become contaminated, oxidant consumption increases and efficacy of the footbath reduces; drain footbath after approximately 300 to 500 cows, flush and fill with fresh HOCL solution prior to usage.

Footspray

Spraying the hoofs with a 500ppm HOCL solution from the ground upwards using conical sprayers prior to milking proved most effective. When spraying hoofs prior to milking the HOCL has sufficient contact time and the run-off water helps to disinfect the milking parlor

Application:

Gather cows in parlor.
Flush cold water on floors (to stimulate dumping)
Force cows to walk through a “foot shower” whereas

Mastitis:

If mastitis is caused by a *Non Staphylococcus Aureus* then a HOCL solution made of NEW (not MOW) proved to be effective.

- 1) Treat cows with 250ppm HOCL (NEW)
- 2) Application with injector **at (not in)** the opening of the tit.
- 3) Quantity: 100 á 150 ml.
- 4) Treat until animals are healthy.

Warning: Don not exceed this dose.

Important notice:

- a) A 250ppm HOCL solution (250ppm NEW) is injected by putting the injector **at the tit (not in)** so there will be no damage inside. In this way the treatment is more pleasant for cows.
Bring the 250ppm NEW just like antibiotics higher in the udder by stretching.
- b) Treat the chronic and latent mastitis cases directly with 250ppm NEW. Dead or infectious tissue of the latent infected quarter will be eradicated; this will come out of the utter. The udder becomes gentler and the cows that have repeated case of mastitis

repeat less rapidly. Therefore treat these cows at that moment when they do not show mastitis, but always have a too high cell count and the one or more quarters are not feeling smooth.

- c) In 90% of the cases antibiotics (by means of the injector) used for curing the udder can be replaced by 250ppm NEW. This does not apply for antibiotics that are applied in the neck of the cow. The vet or farmer must examine to what extent antibiotics in the neck are currently significant.
- d) When a shot of 250ppm NEW is replacing the antibiotics for mastitis treatment, milk can be delivered to the milk factory.
- e) Cows with E-coli show very acute mastitis accompanied by high fever. The quarter becomes rapid hard and milk is like water. Use in this case directly antibiotics. Oral application of 3 litres AW will help the cow to recover from the infection. Treat the infected quarter 5 days with 250ppm NEW after the recovery. The udder will recover significantly better by removing in this way dead and infected tissue.

Pre Teat-dip

Prepare a 500ppm HOCL solution and dip or spray teat prior to milking.

De-souring milk

Milk may be de-soured and its heat resistance increased by adding 5-15ppm of AW to the sour milk with acidity 21-36 degrees (according to Turner).

Introduction of 5-15ppm AW into sour milk is aimed at reducing its acidity to 18 degrees according to Turner and maintaining this level for a considerable time without cooling. The technological effect of this procedure is as follows: characteristics of milk fresh from the cow are restored in the de-soured milk, and it acquires additional heat resistance.

The amount of AW required can be more precisely calculated on the basis of this table and depends on amount of acid according to Turner. In the table you see the time during which the level of milk sourness remains stable, and how the amount of added AW influences decreasing the level of sourness.

Amount of AW relative to the amount of milk (ppm)	1	2.5	5	10	20
Time of 18°level remaining stable(hours)	1	2	6	12	22
Time of 20°level remaining stable(hours)	2	4	8	16	26
Decreasing level of acidity according to Turner(degrees)	0.5	1.7	2.5	4.5	6.5

Note:

Heat-resisting qualities that milk gains as a side effect of de-souring allows boiling milk without curdling. Milk tastes and smells fresh. It can be used for making milk products without any restrictions and its heat resistance is increased.

De-soured milk becomes heat resistant immediately after no less than 1% of AW has been introduced. The time and the amount of AW required to reach the desired level of acidity depends on its initial acidity level and is achieved in 15-25 minutes after introducing AW. Depending on the storage time and qualities of the milk the acidity will gradually increase again, but if needed it may be de-soured again. The only limitation is that its fattiness will decrease with introduction of more AW.

Cleaning milking equipment

Practice case:

- 1) Equipment with 16 milk couples. Approximately 18 meters piping.
- 2) For rinsing the milking machine both NAOH solution and 250ppm HOCL solution are used.
- 3) Application
 - In the morning only rinse with 250ppm HOCL solution
 - In the evening the complete programme
 - a) 12 litres cold water in one time – pre-washing
 - b) 40 litres of 80 degrees C water + 6 litres NAOH solution during 5 minutes.
 - c) Disinfect afterwards with 250ppm HOCL solution

III. Broilers and Egg Production

Stable disinfection

Disinfecting a department or barn is always difficult due to the infection level of “barn-tied” micro-organisms. When a barn is disinfected regularly the changes of returning “barn-tied” contagions are reduced to a minimum.

Application of HOCL:

1. Spray 5ppm HOCL for flushing / cleaning.
2. After cleaning, fog 500ppm HOCL (temperature of HOCL must be lower than 30 degrees). Make the fog as thin as possible.
3. In case the infection returns, fog next time 3 litres of 500ppm HOCL per 100m³ additionally and turn off the ventilation while fogging.

Animals, general use

Application of HOCL:

- 1) - Dose 1-5ppm HOCL in the drinking water system.
 - Broilers the first 5 days 5-8ppm.
 - Layers start as recommended with 1-2ppm

Pipe systems are frequently covered on the inside with a film of organic material that the living environment is for bacteria and moulds (germinate or micro-organisms). Especially long and older pipe systems are vulnerable to pathogens and pollution. At the same time contagion of the water can be rooted to the source of water; for example from the usage of source water with a germ number.

Clean water is a basic condition for good production results without stress of infections. With 1-5ppm HOCL dosed into the water, the piping remains clean and the water is free of bacteria, moulds etc.

- 2) Fog department's broilers or layers twice per week with 2 litres 500ppm HOCL per 100 m³.
If an automated fog installation is present, fog the departments several times a day for 3 minutes.

Aim of fogging:

- a) In the barn there are a lot of particles in the air. These particles form a substrate for germinates of bacteria, moulds, viruses etc. By fogging 500ppm NEW these germinates of bacteria, moulds, viruses etc. are reduced to a minimum level.
- b) By introducing a fog in the barn separately airborne germinates will be eradicated.
- c) If the number of micro-organisms is reduced, there are no longer metabolites formed from the “food” in the air. You will see already after the first treatment that the quality of the atmosphere improves considerably. The air that animals breathe will become cleaner.
- d) When there is a lower number of germinates, the current level of animal-to-animal contagions decreases. (Recognizable phenomenon is related for example with cough symptoms. It starts in one area of the department and after a day the whole department is infected. A day later it can affect the other part of the barn.)
- e) When animals are infected with a cough infection, fogging treatments is advisable. Cough will disappear because the animals clean/disinfect their lungs.

Broilers and layers

- 1) Clean/disinfect departments as mentioned above.
- 2) Dose HOCL on water as mentioned above.
- 3) Fog as mentioned above.

IV. Treatment of Wounds

In life stock production, wounds can be caused mechanically, by parasites or through infections. HOCL is suitable for treating these wounds. Animals can be treated with neat fluid by means of spraying, rinsing or cleaning with a soaked cloth with 250ppm HOCL (made from NEW). If higher parasites such as maggots e.g. are present, first remove these on the normal procedure. 250ppm HOCL is not a cure for these parasites.

Examples of disorders where 250ppm HOCL is effective:

- Bacterial damage.
- Damage caused by viral infection.
- Fungi infections.
- Leases on the skin, food or hoof.

Usage in and at wounds is possibly by injecting 250ppm NEW in deeper wound areas. After some treatments the wound will stay clean, the colour of the tissue will change to a light-colour in when granulation will start. The treatment with 250ppm NEW must be continued until the wound is entirely healed.

Scientific Research

250ppm NEW accelerated the healing of full-thickness coetaneous wounds in rats.

Hypochlorous acid (HOCl), also produced by chlorination (as a by-product of electrolysis of NaOCl or gaseous chlorine), was ineffective, suggesting that this type of electrolyzed water enhances wound healing by a mechanism unrelated to the well-known antibacterial action of HOCl. One possibility is that reactive oxygen species, shown to be electron spin resonance spectra present in anode chamber water, might trigger early wound healing through fibroblast migration and proliferation.