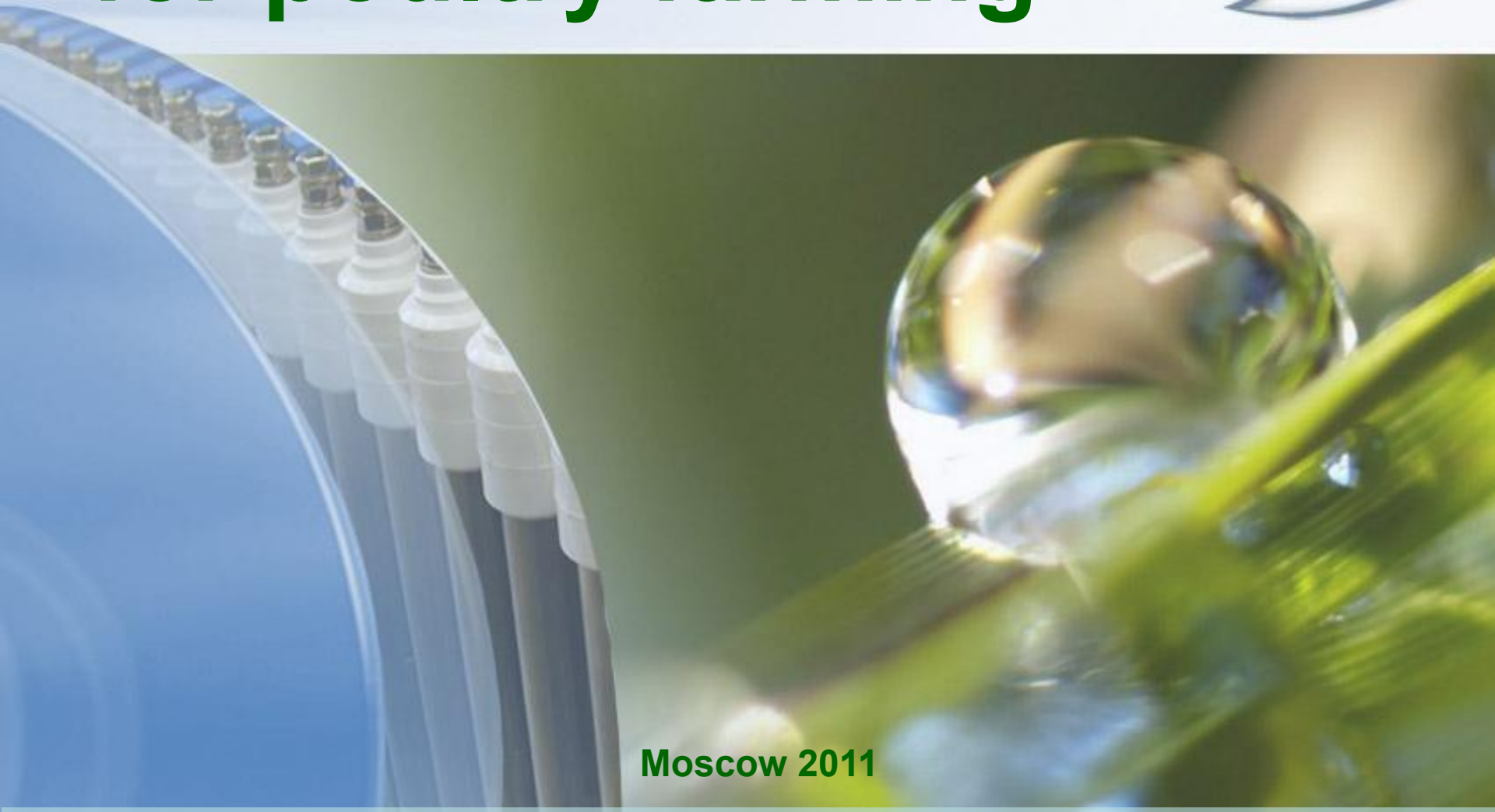
ECA solutions
for poultry farming

Vitold Bakhir Institute



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JSC «Vitold Bakhir Electrochemical Systems and Technologies Institute»

creates new technologies with ECA solutions application, realizes development and production of technical electrochemical systems (devices) for new effective technological and environmentally appropriate processes in medicine, industry, agriculture and other areas under the scientific and technical direction of Vitold M. Bakhir, the author of Electrochemical Activation Technology.

The essence of Electrochemical Activation Technology

Electrochemical activation is a technology to produce metastable substances using unipolar (anodic or cathodic) electrochemical influence for further usage of these substances in various technological processes while they still maintain physical-chemical and catalytic overactivity.

Electrochemical Activation as new scientific and technical direction was officially accepted in the conclusion of academic council by the defence of V.M. Bakhir Ph.D. thesis of the 25.06.1985.

As a physico-chemical process, electrochemical activation is a combination of electrochemical and electrophysical actions (performed in conditions of minimal heat evolution) on liquid (mostly on water) containing ions and molecules of substances dissolved in it, in the area of spatial charge near the electrochemical system electrode (either anode or cathode) surface during non-equilibribrium transfer of charge by electrons through the border "electrode - electrolyte".

The essence of Electrochemical Activation Technology

As a result of *electrochemical activation*, water becomes metastable (activated) demonstrating for a few dozen hours an increased reactivity in various physical and chemical processes. Water activated by cathode (catholyte) gets such characteristic as superactivity of electrons and an evident reductant quality. Correspondingly, water activated by anode (anolyte) is characterized by inhibited electron activity and manifests qualities as an oxidant.

Electrochemical activation makes it possible to purposefully change dissolved gases composition, acid-base and oxidative-reductive properties of water in wider limits than under equivalent chemical regulation, allows to synthesize metastable chemical reagents (oxidants or reductants) from water and substances dissolved in it. It is used in processes of water purification and decontamination, as well as for transforming water or diluted electrolyte solutions into environmentally friendly anti-microbial, washing, extractive and other functionally useful solutions, including therapeutic ones.

Electrochemical devices

More than 500 patents and applications for utility model in the field of technique and technology of *electrochemical activation* proved their efficacy and economy and are widely adopted in various branches of industry, agriculture and medicine.

STEL, EMERALD, AQUACHLOR, ENDOSTERIL and many others devices have successfully been working for ten years at many factories, hospitals, sanatoriums, treatment plants in Russia, in foreign countries and in the former Soviet republics.

Anolyte types

Depending on pH value and catalytic activity dependent on production technology, anodic treated solutions subdivide at present into:

1. **Anolyte A – acidic anolyte with pH < 5, Cox ≤ 100 мг/л, mineralization C ≤ 1 g/l. It has high corrosiveness and foxy of chlorine.**
2. **Anolyte ANK neutral with pH = 6,5÷7,5, Cox ≤ 500 мг/л, mineralization C = 4 ÷ 5 g/l. Corrosiveness is less, slight smell of oxidants presents.**
3. **Anolyte ANK neutral with pH = 6,5÷7,5, Cox ≥ 500 мг/л, mineralization C ≤ 1 g/l. Corrosiveness almost absents, slight smell of oxidants presents.**
4. **Anolyte Perox with pH= 6,0÷7,0, Cox ≤ 50 мг/л, mineralization C = 0,5 ÷ 0,6 g/l. Corrosiveness and smell completely absent.**

Catholyte types

Depending on pH value and catalytic activity dependent on production technology, cathodic treated solutions subdivide at present into :

1. **Catholyte K – alkaline catholyte with pH > 9.**
2. **Catholyte KN neutral with pH = 5,5÷9,0.**

Ways of ECA solutions application

- Liquid
- Aerosol (fog)
- Ice
- Emulsion
- Suspension
- Gel
- Cold plasma

STEL devices

The name for STEL devices was given in 1989 by Vitold Bakhir combining two words together - *STerility* and *ELectrochemistry*.

The name was assigned to all types of electrochemical devices, which produce electrochemically activated detergent, disinfectant and sterilizing solutions – anolyte and catholyte from sodium chloride and water and have inside electrochemical reactor of flow-through electrochemical module elements MB-11 (Bakhir Module) – FEM elements of new generation.

Anolyte ANK neutral is one of the most effective universal solution with wide spectrum of antimicrobial activity.

Anolyte ANK

Anolyte ANK is low mineralized (fresh) water with pH=7 in which small amount (not exceeding 0.05 %) of active oxygen and chlorine (oxidants) compounds synthesized in STEL device are dissolved. The oxygen and chlorine compounds are in metastable (activated) state during 5 days for anolyte with mineralization C= 4 ÷ 5 g/L and up to 30 days for anolyte with mineralization C=1÷2 g/L. Anolyte ANK is nontoxic.

Due to special technology of synthesis and design features of electrochemical reactors consisting of the flow through electrochemical module elements MB-11 Anolyte ANK has much higher antimicrobial activity than 10 times more concentrated known disinfecting solutions – chloramine, sodium hypochlorite, quartenary ammonium compounds, dichlorisocyanurats, aldehydes, heavy metals salts. Anolyte ANK has as well cleansing properties unlike the above solutions.
Production of 1 L of anolyte ANK requires 1 L of drinking water, 1.5÷2.5 g of table white salt and 2-3 kWt·h/L of electric power.

Anolyte ANK: active components

Active oxygen components

OH^- – hydroxyl anion
$HO^\bullet$ – free hydroxyl radical
HO_2^- – peroxide anion
$HO_2^\bullet$ – free peroxide radical
H^+ - hydrogen ion (oxonium ion)
$H^\bullet$ – free hydrogen radical
HO_2 – hydrogen superoxide
HO_2^- - hydroperoxide anion
$^1O_2$ – singlet molecular oxygen
e_{aq}^- – aqua-electron
O_2^- – molecular oxygen ion-radical (superoxide anion or hyperoxide-anion)
O_2^+ – dioxygenil cation, contains one unpaired electron
O^{2-} – oxygen anion
O_2^{2-} – peroxide anion
O_3 – ozone
O_3^- – molecular ozone anion-radical
H_2O^- – molecular aqua anion
$H_3O_2^+$ – peroxonium cation
$O^\bullet$ – atomic oxygen
H_3O^+ – hydroxonium ion (hydronium cation)

Active chlorine components

$HClO$ – hypochlorous acid
ClO^- – hypochlorite anion
$ClO^\bullet$ – free hypochlorite radical
$Cl^\bullet$ – free chlorine radical (atomic chlorine)
ClO_2 – chlorine dioxide
$ClO_2^\bullet$ – free chlorite radical
ClO_2^- – chlorite anion

ECA-solutions application in poultry farming

Poultry farming requires application of Anolyte ANK at all stages starting from disinfecting treatment of eggs before incubation to general disinfection and treatment of facilities, fodder, watering of poultry for preventive and treatment purposes.

<u>Poultry farming:</u>

1. Treatment of eggs.

2. Watering of young poultry, broilers and hens for prevention and cure of gastrointestinal infections.

3. Treatment and disinfection of facilities, equipment by way of wipe, soak, irrigation and spraying.

4. Grain sprouting for feed.

<u>Slaughter floor:</u>

5. Watering of poultry before slaughter.

6. Treatment and disinfection of carcass by anolyte for shelf life increase.

7. Treatment and disinfection of facilities by way of wipe, soak, irrigation and spraying.

Application of ECA solutions in poultry farming allows

- to increase growth of live weight of birds by 6,7-13,7 %%;
- to save 7-10 %% of feed due to its better assimilation of bird organism;
- to provide effective cleaning and disinfection of rooms and equipment without application of special chemical disinfectants;
- to provide effective cleaning and disinfection of eggs before incubation and to increase hatch of incubating eggs;
- to improve quality of birds carcasses by more total and less laborious and power-consuming feather removing as well as carcasses washing and disinfection;
- to improve quality and rise shelf life of cooled and frozen production – carcasses, by-product, force-meat, sausages etc.
- to provide effective air disinfection of poultry rooms and incubators.

Catholyte has great influence upon growth and maturity, egg-laying qualities and vitality of bird, has high cleaning properties and is used for washing of eggs, bird carcasses, air of poultry rooms and equipment.

Birds growing

Birds watering by catholyte

In living organism catholyte stimulates biological processes. Being metastable and having surplus of potential energy, catholyte improves metabolism in bird organism. Interacting with feed being in alimentary tract catholyte rises digestion and assimilability due to use of water energy received during electrochemical treatment. Therefore organism can spend for digestion its own energy less.
Concentration of dissolved oxigen in catholyte reduces, and it means a lot for optimal value of ORP potential in cells and tissues and have an influence at rate of passing of biochemical reactions.

Birds growing

Broilers watering by catholyte

Watering of chicken and hens by catholyte of tap water with ORP=-300:-600 mV increases haemoglobin and erythrocytes in blood, at that leucocyte content reduces in blood. Consuming of catholyte results in protein content increase in pectoral (chest) muscles and femoral muscles; usage of nitrogen, fat, calcium and phosphorus is also increased.

Watering of broilers by catholyte during 1.5 hours after every 1.5 hours increases live weight, reduces feed and water consumption for growth, at that carcass production increases compared to chicken watered by tap water. Usage by poultry of nitrogen, fats, calcium and phosphorus, assimilation of A and B_2 vitamins, erythrocytes quantity and haemoglobin in blood increase, which proves an improvement of metabolism. If poultry is watered by catholyte, once per day supply of anolyte into drinking bowls during breaks between watering allows to eliminate microflora in drinking water.

Birds growing

Positive results of broilers watered by catholyte

For broilers watering catholyte was used with ORP = - 200 ÷ - 600 mV. Catholyte was given every 1,5 hours during 1,5 hours.

This watering regimen provide with:

- **increase of live weight of broilers by 6-10 %%,**
- **reduction of feed consumption to growth by 4-16 %%,**
- **reduction of water consumption to growth by 4-5 %%,**
- **increase of carcasses production of first category by 6-12 %%.**

Under continuous access to catholyte and tap water during all the period of broilers growing one cannot mark a reliable difference on live weight and vitality of birds.

Birds growing

Feed consumption to 1 kg of growth under broilers watering by catholyte

Advantages of birds using catholyte according to feed consumption to 1 kg of growth.

	Feed consumption to 1 kg of growth, % *
Growing in cells	less by 3,7
Growing on bedding	less by 12,1

*** as compared to birds watered by tap water**

Birds growing

Assimilability of nutritive materials under broilers watering by catholyte

Periodical watering by catholyte in regimen every 1,5 hours during 1,5 hours greatly increases use of nitrogen, fat, calcium, phosphorus by bird.

8-week-old broilers	Use of nitrogen of digestible protein, % *	Protein content in chest and femoral muscles, % *
Roosters	More by 7,4	21,3 (more by 1,6 *)
Chickens	More by 7,7	21,0 (more by 3,6 *)

*** as compared to birds watered by tap water**

Birds growing

Assimilability of vitamins under broilers watering by catholyte

Catholyte increases assimilability of A и B_2 vitamins by birds.

4-week-old broilers	Content in 1 gram of liver, % *
A vitamin	more by 30,9
B_2 vitamin	more by 33,4

*** as compared to birds watered by tap water**

Catholyte influence on blood indices under broilers watering

Catholyte improves haematological indices of blood, that confirms by increase of erythrocytes quantity and haemoglobin in blood and indicates improvement of metabolism in organism of bird.

4-week-old broilers	Percentage, % *
Haemoglobin	more by 9,2
Erythrocytes	more by 12,1

*** as compared to birds watered by tap water**

Bird growing

Catholyte influence on safety and live weight of broilers

Birds watering by catholyte allows to increase its safety and live weight.

Turkey-poult broilers	Percentage, % *
Safety (1st week)	more by 10,3
Live weight (1÷4 weeks)	more by 7,6

*** as compared to birds watered by tap water**

Birds growing

Broilers watering by catholyte and anolyte

Birds watering by catholyte is used with anolyte for drinking bowls disinfection and cleaning. Supply of anolyte into drinking bowls once per day during the breaks between watering by catholyte allows to eliminate microflora in drinking water and bowls.

Under this regime of watering there were no microflora and mucus at drinking bowls walls, so there were no need to wash it. In the control group where tap water was used it was spend about 3,4 man-hours for 1000 broilers during all the period of broilers growing,

Watering of remount young poultry and mature birds by catholyte and anolyte

Remount young poultry and mature birds are watered by ECA solutions for increase of productivity due to improvement of metabolism and feed assimilability.

It is desirable to water remount young poultry during pubescence by ECA solutions to prevent forming follicles from pathogen microflora infection. Broilers mature birds one should water with ECA solutions for stabilization of microflora of alimentary tract.

Regimen of watering by catholyte is 3 hours before feeding and 2 hours after feeding, that allows to reduce feed consumption by 6,4 % for one layer.

Watering of remount young poultry by catholyte and anolyte

Watering of remount young poultry by catholyte with ORP no less than - 400 mV in the period of limited feeding reduces feed consumption by 13 % (13,2 kg of feed for 1 bird) as compared to control group watered by tap water.

From 18 to 26 week poultry should be watered by catholyte and anolyte. It allows to reduce quantity of salmonella in small intestine of pullets in 24 times. Pullets watered by catholyte and anolyte also have no salmonella in ovary follicles, while there were 4 % pullets in control group with ovaries infected by salmonella.

Mature birds watering by anolyte

In productive period of mature birds pathogens of infectious diseases penetrate into egg both during its formation in oviduct and during its coming through uterus, vagina and sink. Mature birds watering by anolyte reduces contamination of egg shell by microflora of alimentary tract under laying.

Under birds watering by anolyte total bacterial contamination of contents both rectum and egg shell surface was 19,4 times less than in control group. The same tendency was of contamination by bacteria of colibacillus group. Experimental group has no salmonella at egg shell surface, while hens of control group have 9,1 microbial bodies/cm^2 of salmonella at surface of egg shell.

Pre-slaughtering broilers watering by anolyte

Poultry meet represents sanitary danger compared to meet of other domestic animals because starvation of poultry is necessary for purposes of slaughtering and processing technology, which leads to general weakening of organism and may result in penetration of microflora, especially salmonellosis, from gastro-intestinal tract to the surfaces and internal of carcass.

During the period of pre-slaughter fasting before giving anolyte to poultry it is necessary to have break in watering for the period of not less than 3 hours which is connected with difference in gustatory qualities of anolyte and water. Duration of watering by anolyte before fasting should make 8-16 hours. Watering of poultry according to the above conditions practically fully eliminates bacterial contamination of digestive system as well as contamination of meet.

Birds growing

Data of bacteriological tests

Birds watering by anolyte allows totally eliminate microflora in contents both of craw and large intestine.

	Contamination under watering by tap water			Contamination under watering by anolyte		
	Quantity of microbial bodies in 1 ml of craw contents	Quantity of microbial bodies in 1 ml of large intestine contents	Quantity of microbial bodies at 1 cm^2 of carcass	Quantity of microbial bodies in 1 ml of craw contents	Quantity of microbial bodies in 1 ml of large intestine contents	Quantity of microbial bodies at 1 cm^2 of carcass
TMN*	$581*10^3$	$1792*10^3$	$23,6*10^3$	0	0	0
ECBG**	$377*10^3$	$1634 * 10^3$	$21,3*10^3$	0	0	0
Salmonella ***	$8*10^3$	$19*10^3$	$2,3*I0^3$	0	0	0

* - total microbial number,

** - Escherichia coli bacterial group,

*** - nonpathogenic culture of salmonella - S.Shottinilleri

Ways of eggs contamination

Sanitation allows to prevent contagion and raise hatchability.
At shell one can find up to 40 kinds of microorganisms, and it is mostly Escherichia coli, staphylococcus, salmonella.

Endogenous way of eggs contamination:
- **under eggs formation from infected follicles,**
- **during coming through oviduct and sink.**

Exogenous way of eggs contamination:
- **through air,**
- **through dust of poultry-farm,**
- **under contact with bedding.**

Pre-incubational eggs treatment

Bacterial contamination of incubational eggs' shells can reach considerable values especially during storage, since membranes are no more intact, the activity of immune factors decreases and eggs are subject to microbiological spoilage.

Active microbial forms (coli bacilli, salmonellas, staphylococci) quickly penetrate inside the egg into white and yolk, and from there into the embryo causing the most common pathological conditions in birds.

It is practically impossible to prevent exogenous contamination of shell with various microbes at different industrial stages, so pre-incubational treatment of eggs should be mandatory. Such treatment is to secure complete liquidation of relatively pathogenic and pathogenic microflora both on shell surface and between shell and sub-shell membranes.

Criteria of disinfectant choice for eggs disinfection

Criteria of disinfectant choice for pre-incubational eggs treatment is:

- **action spectrum,**
- **absence of harm for man and bird, ecological compatibility,**
- **penetrative ability and cleaning effect,**
- **influence on technology of production,**
- **increase of hatch of 1-day nestling from eggs after treatment,**
- **absence of toxicity and harmful influence upon incubatory quality of eggs and on embryo,**
- **total moving of organic and inorganic contamination off shell,**
- **total destruction of pathogenic microflora at shell surface, in its pores and under shell covering.**

Under usage of acid anolyte disinfecting effect is based on reaction of partial dissolving of shell and formation of calcium, sodium and potassium hypochlorite at its surface and in pores. It protects eggs against penetration of microorganisms into eggs under its storage and transportation. Eggs treatment by catholyte and anolyte does not affect its normal gas exchange with the environment.

Treatment and disinfection of eggs by submersion

The most common way of eggs treatment is submersion into catholyte with repeated vertical moving during 3 minutes.
After eggs treatment by catholyte it is disinfected by repeated submersion of eggs into anolyte during 3 minutes.
Consumption of anolyte and catholyte per 1 egg is 30-50 ml.

After treatment trays with eggs are set on transport cart and place into cold store or cabinet incubator.

Treatment and disinfection of eggs by irrigation

Under eggs treatment by irrigation for 1 egg it is used 10-20 ml of catholyte.

Irrigation one make in special irrigation chamber by water-air sprayers making high-dispersed aerosol (80-100 mkm) or by water-jet nozzles (water sprayers) with productivity no more than 1 l/min under pressure of 5 kilogram-force/cm^2.

For eggs treatment by irrigation special transport carts are used. The cart is charged by trays with eggs for 50 %, that improves quality of eggs aerosol treatment.

Indices of hen's eggs hatch

Washing and disinfection	Increase of hatch of nestling from clean eggs, %	Increase of hatch of nestling from dirty eggs, %
By submersion	by 2,9	by 3,1
By irrigation	by 1,6	by 3,5

Indices of duck eggs hatch

Eggs of duck are washed during 5 minutes by catholyte, which fully eliminates contamination of shell, then are washed during 5 minutes by anolyte ANK, which leads to egg's complete disinfection.

Washing and disinfection	Increase of hatch of nestling from clean eggs, %	Increase of hatch of nestling from dirty eggs, %
By submersion	by 2,2	by 2,2

Indices of turkey eggs hatch

Washing of turkey eggs in catholyte allows during 5 minutes totally remove contamination off shell surface, and following disinfection in anolyte during 5 minutes eliminates all the pathogenic microflora.

Washing and disinfection	Increase of hatch of nestling from clean eggs, %	Increase of hatch of nestling from dirty eggs, %
By submersion	by 6,3	by 6,3

Pre-incubational eggs treatment

Eggs of duck and turkey are washed during 5 minutes by catholyte which fully eliminates contamination of shell, then are washed during 5 minutes by anolyte ANK which leads to egg's complete disinfection.
Such treatment provides positive prolonged effect and prevents penetration of microflora into the egg's content during incubation period. This allows as well to increase poultry growth.

Surface treatment of eggs does not provide elimination of microflora which penetrated through shell before anolyte treatment. Deep treatment of eggs by anolyte according to the set mode allows to eliminate microflora both on the shell's surface and the penetrated one. Application of this method allows to increase chicken hatch by 3-5 %.
About 8 % of egg surface are pores through which one can inject inside 0,7-1,0 ml of liquid, in particular, anolyte. Egg is put into liquid, than vacuumize so plugs rush out. Than liquid (anolyte) under pressure goes into egg, which provides with deep treatment/disinfection of eggs.

Procedure of dirty commodity eggs washing

Washing of dirty commodity eggs (chicken, duck) in eggs storage at poultry-farms make by soak it in tanks with catholyte and following washing by water jet in an eggs-washing device or by water irrigation.

Consecution of action	Моющее средство	Treatment time, min	Way of treatment
1. Soaking in catholyte	Catholyte pH 10-11	3-5	Eggs in polyethylene packing are put in tank with catholyte
2. Hydrofining	Tap water (warm)		In eggs washing device or by water jet irrigation

Procedure of dirty commodity eggs washing and disinfection

Before treatment eggs are put in incubation trays. After eggs removing from tank with anolyte eggs are dried with warm air by drier and put into cabinet incubator.

Consecution of action	Temperature, °C	Time of treatment, min	Way of treatment
1. Soaking in catholyte with pH=10-11	25-30	1-2	submersion
2. Washing in catholyte with pH=10-11	25-30	0,5-1	irrigation
3. Disinfection in anolyte with pH=3-4 concentration of active chlorine 200-300 mg/l		1-2	submersion

Disinfection procedure of eggs under salmonellosis

Dirty eggs are washed preliminary by catholyte.

Disinfectant	Parameters			Time of treatment, min	Way of treatment
	pH	temperature	Active chlorine concentration, mg/l		
Anolyte neutral	6-7	20-25	300	2	Submersion into tank with anolyte
Anolyte acid	2-3				

Pre-incubational eggs treatment

Experiments on eggs disinfection by anolyte Perox are carrying out. There are some preliminary results.

	u/i	f/i	b/r	m/l	gasp	w	fi	br	ha
Clean egg	8,0	1,1	1,1	3,4	3,4			83,0	90,1
Clean egg treated with anolyte Perox	8,0		2,3		3,4		1,1	84,0	91,4
Clean egg treated with anolyte Perox + treated with anolyte Perox under moving to hatch	7,4		1,7	0,6	6,3	2,3	0,6	81,3	87,7
Dirty egg	4,6	1,1	2,3	2,3	6,8		3,4	79,6	83,3
Dirty egg treated with anolyte Perox	6,8	0,6	1,1	1,7	5,1	0,6	2,3	81,8	87,8
Dirty egg treated with anolyte Perox + treated with anolyte Perox under moving to hatch	8,0			1,1	4,6	1,1		85,2	92,6

u/i – unimpregnated,
f/i – false impregnated,
b/r – blood ring,
m/l – motionless,
gasp – gasped

w – weak,
fi – infected with fungus,
br – brooding,
ha – hatchability

Perspectives of anolyte Perox application

According to carried out experiments on can make a conclusion that anolyte Perox:

- Increase hatchability of nestling,
- decrease quantity of false impregnated eggs,
- decrease quantity of nestling with stoppage of embryo development and growth at various development stages.

Indices are not reliable so it is required to check experiment and carrying out conditions and analyze some negative results and its reasons.

STEL-PEROX

STEL-PEROX devices are developed and produced as pilot batch. STEL-PEROX are used for synthesis of electrochemically activated antimicrobial solution – Anolyte Perox, active substances of which are mixture of percarbonic acids and hydroperoxide substances, as well as detergent and extractive solution – catholyte K.

Thanks to work universality and absence of corrosive activity Anolyte Perox has wide perspectives in food and pharmaceutical industry as well as any other industries, where disinfection and washing of objects nonresistant to corrosion and aggressive chemicals are needed.

Birds watering for prevention of eggs contamination

Infectious agents penetrate into the egg during the period of formation in oviduct as well as during passing through uterus, vagina and sink. Watering of poultry (from 18 to 26 weeks) by catholyte was conducted during all the period of feeding and 2 following hours, and during fasting in the period of pubescence birds were watered by anolyte (Cox=300 mg/l). Such watering regimen provides absence of salmonella in follicles. Bacterial contamination of rectum is decreased, so risk of infecting of egg's shell is reduced too.

Disinfection of hatchery air

Poultry-farm air contaminated with microorganisms exceeding the permissible degree, may become a stress factor causing lower productivity of birds and aggravation of respiratory diseases.

Special attention should be focused on the condition of air in hatcheries, because in case of latent infection development in embryo in the process of hatching and the further period of drying chickens in hatching cases of incubators there occurs massive pollution of the air. This not only leads to re-contamination of chickens in the hatching lot, but may cause the risk of a still wider spread of the causative agent of the infection. That is why thorough treatment of the air in poultry-farms and hatcheries is of crucial importance.

Aerogenic cross-contamination of nestling at hatching

Re-contamination of chickens through air during hatching is one of the major ways of spread of infections diseases.

Infection from a brooding-shop spreads via air, polluted with down and dust. The buildings where hatchers and brooders are located are not completely isolated, and polluted air fills the whole hatchery and is sucked into hatchers. Polluted air ejected by exhaust ventilation, is partially re-sucked with incoming air because of inadequate purification and enters hatching and brooding cases. Consequently, there is a real danger of spreading the infection. Decontamination of hatcheries` air in the period of incubation and brooding younger chickens is one of the main stages in reducing a number of contagious diseases.

Disinfection of incubatory rooms by anolyte aerosol

Air atmosphere of hatchery spaces is disinfected by high dispersed aerosol of anolyte; small dispersed anolyte aerosol provides with lower level of disinfection of air in hatchery.
Aerosol of anolyte was made by ejector of directed action: productivity up to 500 ml/min., aerial pressure in pipe-line up to 4-5 kg/cm, length of spray cone up to 3 m; spray-cone angle to 15 degree.

Exposition of treatment is 10-20 minutes depending on space volume. Anolyte aerosol has excellent sanitary action and promotes a 2-5 times decrease of specific (E. coli) and non-specific microflora content in the air of hatcheries.

Disinfection of hatchery by anolyte aerosol

Bacteriological studies of the sanitary efficiency of anolyte have demonstrated:

- **low level of E.coli keeps up to 72 hours after treatment in an incubational shop, in a shop of grading younger chickens and brooding, and do not return to the initial level.**
- **TMN (total microbial number) increases in egg storehouse after 24 hours after treatment, after 48 hours - in an incubational shop; and it keep low level in a brooding shop during 72 hours.**

Based on studies data it has been established that treatment of air one should make every other day.

Air treatment of hatchery

Disinfection of air in hatchers and brooders during egg incubation and brooding younger poultry was carried out with anolyte having definite parameters, which was used in the system of moistening hatchers and brooders instead of tap water.

Microflora of air of hatchers during incubation

	Moistening by anolyte	Moistening by tap water
TMN	Reduction from 5 day and its stabilization up to 18 day	Increase from 1st day, 4-fold increase up to 18 day
E.Coli	Reduction from 5 day and its stabilization up to 18 day	Increase from 1st day, up to 18 day it multiply more than by 5

Increase of Total Microbial Number and E. coli levels was reported in brooding cases during mass scale pecking and brooding of younger poultry. In the control group, these values were by far higher than in the group where anolyte was used for moistening.

Air treatment of hatching and brooding cases

Application of anolyte in the system of hatchers cooling allows not only to reduce microflora population and keep it unchanged but also to improve incubational parameters of eggs. Use of anolyte for disinfection of air in hatching and brooding cases allows to increase brooding and hatchability by 2-4%, and lower incubational wastes by 1-1.5%.

Use of anolyte in cooling systems of hatching and brooding cases does not involve great expense, since anolyte is pumped into spare capacities belonging to hatcheries, from which it goes into cooling system.

Disinfection of poultry-farm air in presence of bird

Disinfection of poultry-farm air by anolyte in the presence of birds during 30 minutes allows to reduce greatly bacterial contamination. It also provides bacteriostatic activity as per air microflora up to 3 days for poultry of 3 weeks old, 2 days – for poultry of up to 6 weeks old, 1 day – for birds older than 6 weeks. Usage of anolyte aerosol allows to reduce microflora level (6-10 times) at vertical and horizontal surfaces of facilities and equipment.

Everyday disinfection under colibacteriosis and salmonellosis of birds

Everyday disinfection of rooms and equipment under colibacteriosis and salmonellosis is carried out in presence and absence of bird.
Implements and equipment of unfavourable poultry-farms with colibacteriosis minutes are wiped twice with anolyte for 1 hour.
Surfaces are cleaned off dirt before disinfection.

Disinfection	Concentration of active chlorine, mg/l	Disinfectants consumption, ml/m^2	Time of disinfection, hours	Way of disinfection
Anolyte neutral	250-300	200-250	1-2	Large drop irrigation of surfaces

Preventive disinfection of rooms and equipment

Disinfection	Concentration of active chlorine, mg/l	Disinfectant consumption, ml/m^2	Time of disinfection, min	Way of disinfection
Anolyte neutral	200-300	150-200	60	Large drop irrigation

Floor and walls are covered with slab.

Washing and disinfection of hatchery equipment

Treatment and disinfection of incubational trays and cases for nestling transportation make in special tanks by submersion in catholyte with following hydrofining and disinfection by anolyte.

Regimen	Operation consecution	Substance		Time of treatment, min.	Way of treatment
		Catholyte, pH	Anolyte, active chlorine concentration, mg/l		
I	1. Soak of surfaces	11		3-5	Submersion into tank with catholyte
	2. Hydrofining by hot water				Jet under ressure
	3. Disinfection by anolyte		200-300	60	Large drop irrigation
II	1. Soak with neutral or acid anolyte		200-300	3-5	Submersion into tank with anolyte
	2. Hydrofining by hot water (40-60°C)				Jet under pressure

Washing and disinfection of equipment

Hatching cases are disinfected with neutral anolyte.

Operation conseqution	Substance		Time of treatment, min	Substance consumption, ml/m^2	Way of treatment
	Catholyte, pH	Anolyte: pH, active chlorine concentration, mg/l			
1. Mechanical treatment of inner and outer surfaces	11	6-7, 200-250			Cleaning with any means
2. Surface treatment by catholyte			10-20	100-150	2-3fold wiping by sponge with catholyte
3. Surface treatment by anolyte			60	200-250	2-3fold wiping by sponge with anolyte

Summary

The most important is reduction of total microbial contamination of big objects, which is reached by disinfection of large volume of air, water and big surfaces. Disinfection of air and surfaces should be made by dispersion of anolyte fog or by use anolyte in systems of air cooling and moistening.
Water disinfection by anolyte provides with safe sanitary conditions of water and water-supply, at that it do not influence upon inactivated vaccine.

Under disinfection one should keep consecution of disinfection from total to particular in order to avoid cross-contamination objects. So using everyday disinfection of room/shop/poultry-farm one goes to everyday disinfection of equipment and implements and than – to disinfection of biological objects.

Example: disinfection of incubational shop, than disinfection of incubator, equipment and implements, than disinfection of eggs.

Factors determinative for carcasses category

Carcasses category is determined according to following:

- **fatness,**
- **subcutaneous fat deposits,**
- **good muscle development,**
- **relevant cleanliness of the skin's surface (no feather or down remnants, no stumps).**

Qualitative indices of poultry carcasses are strongly affected by precise realization of all technological operations during slaughter and processing of poultry-meat.

During processing poultry-meat special attention should be given to the sectors of slaughter-shops, most commonly connected with deterioration of meat quality:

- **sector of heat treatment and removal of feathering;**
- **sector of drawing and dressing the carcasses;**
- **sector of cooling**.

Scalding poultry carcasses with catholyte

Depending on ways of cooling the carcasses conditions of heat exposure may be mild and rigid.

Mild conditions are used when further cooling of unpacked carcasses occurs in the air; the temperature of water in a heat-treatment device should be 53-54 degree C for chicken carcasses, 56-58 degree C for hen carcasses under time of treatment 120 sec.

Rigid conditions are used when further cooling of disemboweled carcasses of chickens and hens takes place in ice-cold water. Water temperature during scalding under these conditions is 60 degree C, the time of treatment is 90-120 sec.

Scalding at temperatures lower than indicated by the norms worsens feathering removal and is usually followed by skin lacerations.

Heat treatment with higher temperatures as compared with recommended ones improves removal of feathering, but destroys skin epidermis, causing a poorer marketable state and skin darkening during subsequent storage.

Catholyte use for heat treatment of carcasses definitely raises the quality of cleansing of birds' carcasses from surface impurities and from feathers within one treatment cycle.

Birds processing

Carcasses scalding by catholyte

Catholyte is characterized with the presence of H_3O_2 hydroxyl groups and complexes, which, being adsorbed along the boundary of phases' division "feather quill - feather follicle" induce an abrupt fall of resistance between feather quill and skin. It results in easier and more complete feathering removal and the absence of defects on skin surface.

Application of catholyte in heat treatment of carcasses leads to decline of skin damage by 12-20 % and improves the quality of carcasses' treatment by increase of feather removal degree by 10-12 %. Feathers and down, which are highly valued in the poultry industry, are cleansed with catholyte from impurities and fatty layers. The period of heat treatment with catholyte is shortened from 120 to 60-90 sec. as compared with common water.

Under action of catholyte, fecal soilings on the carcasses' surface swell, partially exfoliate, and are practically completely removed while passing through beating machines.

Birds processing

Washing and disinfection of poultry carcasses

Poultry meat can be sanitary dangerous as compared with meat of other animals as, to facilitate processing, birds are starved before slaughter, that leads to general weakening of the birds' organisms, which can cause microflora (esp. salmonellas) penetration from gastro-intestinal tract to the surface and into the internal organs of birds. Also, methods of technological treatment applied in slaughter shops favor contamination of meat with various types of microflora and, most often, salmonellosis.

Birds processing

Washing and disinfection of poultry carcasses

In the course of drawing the birds there occur cases of intestine rupture and subsequent contamination of both internal and external surfaces of a carcass with feces. Because of that, after drawing there exists on the conveyor an operation of irrigation of carcasses, for this purpose catholyte is used which possesses complete removal of after-drawing soilings both on inner and outer surfaces of a carcass.

Irrigation with heated catholyte can proceed with more effective cleaning of carcasses.

After drawing carcasses should be disinfected with anolyte.

After carcasses have been removed to the conveyor to pass through a cooling vat, they are again treated with anolyte from spray washers.

Data of bacteriological studies

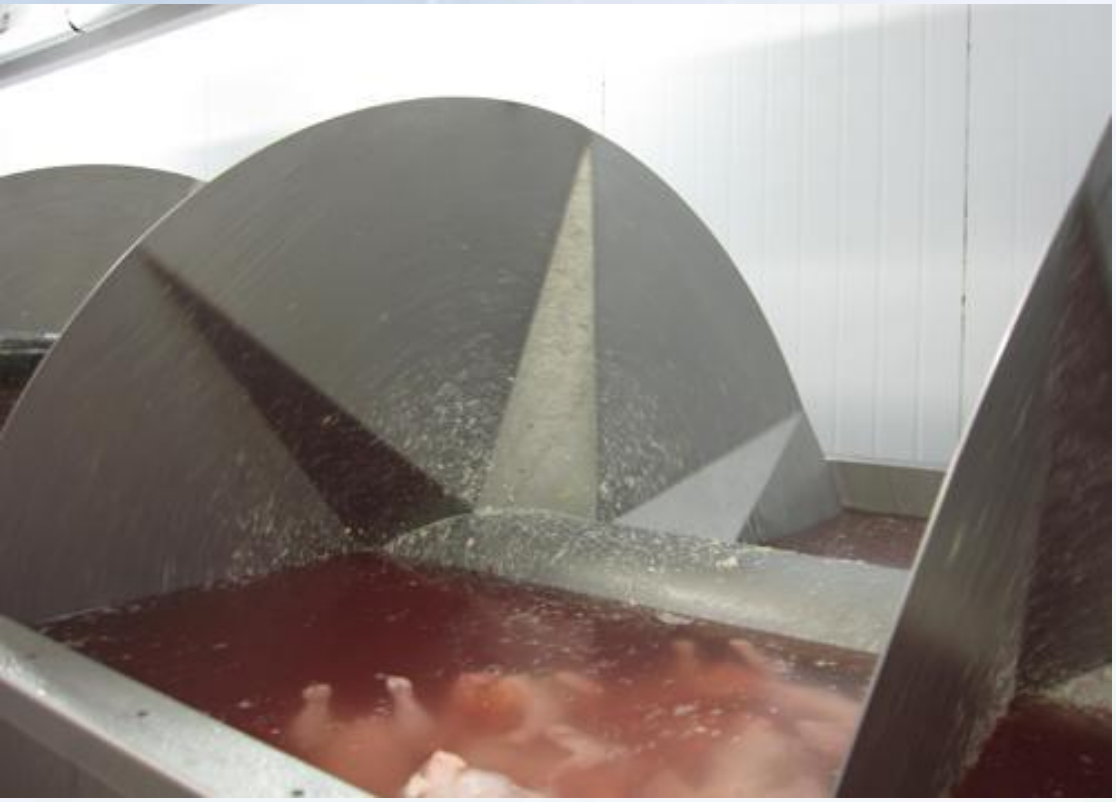
Bacteriological studies have proved that consecutive treatment of carcasses with catholyte and anolyte makes it possible to reduce microflora content on carcasses surface by 43 times, in lungs - 8.1 times, and in meat - 18.1 times.

In the process of 3-day storage of meat at the temperature of -12 — -18 degree C it was shown an increase of bacteriostatic effect of ECA solutions on saprophytic microflora, E-coli and ECBG (Escherichia coli bacterial group) was observed.
Storage of carcasses during 3 days at the temperature of 0 degree C has demonstrated that bacterial contamination of carcass surfaces is minimal and meat is practically sterile.

Birds processing

Carcasses disinfection under submersion

Another variant of disinfection of poultry carcasses is their cooling by submersion into anolyte. It gives reduction of carcasses contamination in few times as compared to their treatment by irrigation.



This method of cooling is characterized with high technical and economical indices, but it can occur possibility of cross infection of a large number of carcasses from a diseased bird not rejected for some reasons during sanitary veterinary examination.

Application of anolyte in a cooling vat provide with good sanitary quality of carcasses which positively affects on its storage.

Birds processing

Carcasses disinfection under submersion

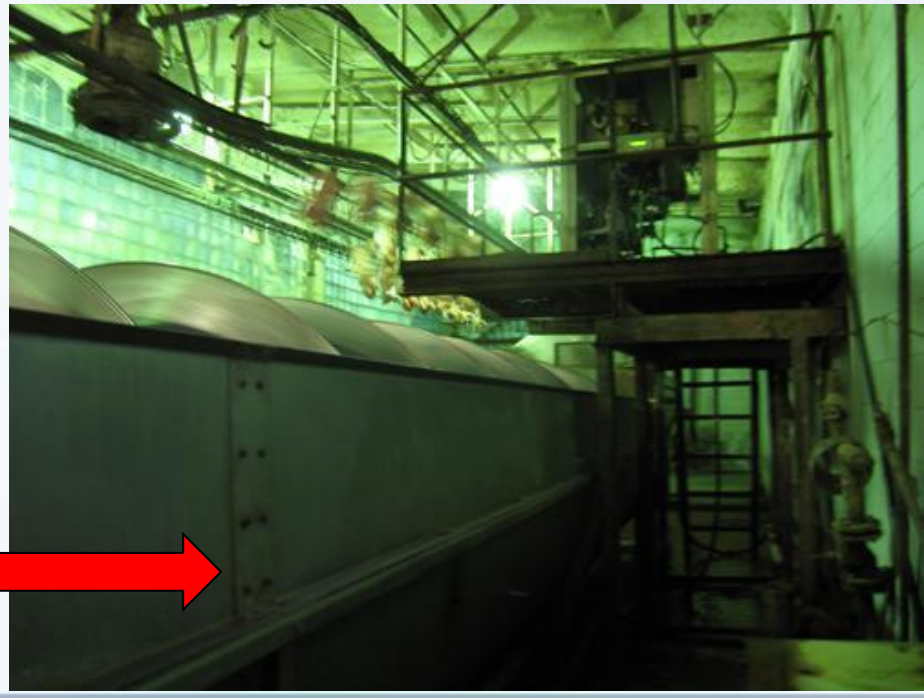
Use of anolyte in cooling vat for carcasses disinfection almost totally disinfect carcasses surface and provide with complete elimination of E. coli and Salmonellas, reduces of TMN by 93.3% with simultaneous saving of commodity quality of carcasses.

In the process of storage, intensity of microflora growth was very low on the surface of carcasses treated with anolyte, whereas on the carcasses treated with tap water this index increased by two orders.

Birds processing

Examples of carcasses disinfection under submersion

c. Sergiev Posad. Volum of cooling vat is 20 m^3 with water replacement 17 m^3/h. Ideal sanitary conditions and karge water replacement do not give reliable data of positive effect of anolyte in cooling vat. Oxidants concentration in cooling vat is 1,2 – 2,0 mg/l.



c. Ryazan. Under bad sanitary conditions and small volume of cooling vat 5 m^3 result of anolyte application is evident, contamination of carcasses decreases in few times. Oxidants concentration in cooling vat is 10 – 15 mg/l

Summary

Quality of poultry carcass cleaning from contamination and feathers improves significantly with catholyte application (at temperature of 50 degrees) after one cycle of treatment. Feathers removal increases by 10-12 %, number of faulty damage reduces by 20%. Time of thermal treatment by catholyte is two times less compared to thermal treatment by water.

Application of anolyte ANK in technological cycle of carcass processing – immersion of carcass into cooled anolyte – provides complete sanation of carcass and allows to reduce TMN by 96% preserving commercial quality. At that growth of microflora on carcass surface reduces considerably in the process of storing (100 times less than the usual method of carcass treatment).

Conservation of slaughtering products in anolyte

For the purpose of slaughtering products saving (traumatized parts of carcasses, legs, head, neck etc.) without cold store it is possible to treat slaughtering products with anolyte with pH 6-7 and active chlorine concentration of 200 – 300 mg/l for its concentration for period of 5 days.
Conservation is made in plastic tank with cover.
First slaughtering products are washed (rinsed) by anolyte 2-3 times, than anolyte is poured into tank up to level 5-100 cm less of the upper level of conservation material.

STEL-UNIVERSAL device

STEL-UNIVERSAL device is used for water disinfection of birds processing shop and for anolyte fillup of cooling vat.

Device is installed in the water treatment room.

Neutral anolyte is supplied directly into treated water (after mechanical treatment etc.).

For carcasses disinfection anolyte is supplied into cooling vat.

Catholyte from the device is used in carcasses scalding vat.

STEL-UNIVERSAL device

Productivity of STEL-UNIVERSAL device is 500 l/h of catholyte with pH 8-11 and 500 l/h of anolyte ANK neutral with parameters: concentration of active chlorine Cox is no less than 100 mg/l, mineralization C is 0,3 – 0,5 g/l, pH from 3 to 5.

For carcasses disinfection in cooling vat anolyte is supplied in ratio 1 l of anolyte to 50 l of water, so the end concentration of anolyte in cooling vat was 1,5 – 2 mg/l.

STEL-UNIVERSAL models

STEL-UNIVERSAL devices are developed and produced as pilot batch for synthesis of electrochemically activated solutions with such active substances as percarbonic, perphosphoric, peracetic acids and mixture of electrochemically activated metastable organic and nonorganic compounds with total mineralization of anolytes no more than 1 g/l, i.e. similar of fresh water mineralization.

The most perspective fields of application of such solutions are food and pharmaceutical industry, public health service, veterinary, biochemical manufactures, transport, plant growing, poultry farming, fish industry and some others.

STEL-UNIVERSAL-20-01 **STEL-UNIVERSAL-500-01**

STEL-UNIVERSAL models

Initial solition main components are: water, chlorides, carbonates, phosphates or sodium acetate. Types of produced metastable solutions: Anolytes A, PEROX, ANPHOS, ALOX-M, catholyte K.

Mainactive substances are oxide-chlorine and hydro-peroxide oxidants, percar-bonic, perphosphoric, per-acetic acids, reduced forms of soluble substances and water.

Total content of soluble substances both in anolytes and catholyte is no more than 1 g/l.

Preventive disinfection of rooms and equipment of slaughter floor

Rooms and equipment of slaughter floor (walls, floor, trough for blood collection, bunkers, preparation line, machines, shelves, tables) are cleaned off blood, fat, feathers and other dirty by soaking it in catholyte with following washing by hot water; cleaned surfaces are disinfected by anolyte.

Consecution of treatment	Substance		Consumption of substance, ml/m^2	Time of treatment, min.	Way of treatment
	Catholyte, pH	Anolyte, active chlorine concentration, mg/l			
Soaking of surfaces	10-11		150-200	20	Large drop irrigation
Hydrofining by hot water					Jet under pressure
disinfection		200-300	200-250	60	Large drop irrigation

Birds processing

Preventive disinfection of implements of slaughter floor

Consecution of treatment	Substance		Time of treatment, min.	Way of treatment
	Catholyte, pH	Anolyte, Active chlorine concentration, mg/l		
1. Saoking of surfaces	10-11		10-20	Submersion with following wiping
2. Disinfection		200-300	50	Submersion

Treatment of birdseed

Seed sprouting applying catholyte and anolyte

Treatment of barley seeds by ECA solutions demonstrated quicker going out of seed from the state of rest and activation of growth without using special substances, besides time of soaking reduces by 30%. In order to get high percent of germination it is necessary to soak seeds in anolyte and catholyte during 12-24 hours. After soaking seed may be moistened by catholyte or usual tap water. In the process of soaking anolyte is irreplaceable as a disinfecting and loosening seed coat solution which results in earlier penetration of solution into the seed promoting as well acidation of endosperm and initiation enzyme synthesis. Catholyte provides stimulating effect on the processes of seed growth at the stage of soaking at the expense of increase of penetrability of seed coat, acceleration of transfer of moisture and nutrients of endosperm. Catholyte's alkalinity has negative impact on the root and stalk growth as pH optimum of the majority of growth enzyme is in subacid and neutral area. That is why at certain stages of seed soaking and growth it is necessary to apply anolyte and catholyte with strictly observed parameters and in the requested succession. This allows to disinfect seed by anolyte without usage of special solutions as well as to increase germination and growth energy of seed by 30% compared to seed soaked in usual water.

Ostrich farm in Vietnam

At ostrich growing farms anolyte ANK use at all stages from disinfection treatment of eggs before incubation to general disin-fection treatment of rooms and birdseed.

Anolyte ANK one use also for wate-ring of osrtich nestlings for preven-tion and cure of gastrointestinal in-fections.

SUMMARY

ECA solutions application for birds growing

Anolyte and catholyte from STEL devices of various modification depending of need of plant can be successfully and effectively used in technological processes at poultry-farms:

1. Hatchery:

- pre-hatchery eggs irrigation by anolyte to increase hatchability and quality of nestling;
- washing of hatching and brooding cases, another equipment and package with catholyte and disinfection with anolyte;
- everyday aerosol disinfection of air in an incubational shop by anolyte to eliminate pathogenic microflora.

2. Farm of broiler growing:

- washing of poultry-yard and equipment by catholyte and following disinfection after every grown group;
- air disinfection of poultry-yard by anolyte in presence of bird for reduction of total bacterial contamination and precautions of colibacteriosis;
- birds watering by catholyte during broiler growing to increase growth and feed economy;
- pre-slaughter birds watering by anolyte to eliminate pathogenic microflora in contents of digestive system.

SUMMARY

ECA solutions application at birds processing

Anolyte and catholyte from STEL devices of various modification depending on needs of poultry-farm can be successfully and effectively used in technological processes:

3. Plants on slaughter and processing:

- carcasses scalding in catholyte for better feathering removal;
- carcasses cleaning by catholyte after gutting and separation various parts of carcasses for wash-out of fat, parts of muscles etc.;
- disinfection by anolyte of carcasses and its parts in the period of cooling and before packing;
- washing of rooms and equipment by catholyte and disinfection by anolyte;
- air disinfection by anolyte at farms.

ABOUT US

The Institute's objective is to coordinate and promote research, design, manufacture and practical application of technical electrochemical systems and electrochemical technologies protected by patents of V.M. Bakhir and his colleagues, as well as development of ECA technology created by V.M. Bakhir as the most ecological technology allowing to achieve effective and economically feasible results with no pollution of the environment at all fields and spheres of human activities.

Please refer to the following sites for extended information on electrochemical activation, electrochemical technologies and devices, application areas and experience:

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