INTRODUCTION OF **Neukocyte**

NeuKocyte®

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Table of Contents

1. What is “Slightly Acidic Electrolyzed Water (=Neukocyte bactericide)”?

Name of our device : NeuKocyte (**Neu**trophilic + Leu**kocyte**)

NeuKocyte is a strong bactericide that can be used like tap water. NeuKocyte can be used in many ways because it has no bad influence on the environment. When use in the food industry, hospitals, nursing facilities, schools, public facilities and residences, NeuKocyte is effective for disinfection, sanitation and odor diminution. Besides washing tools, machines or hands, NeuKocyte is the only disinfectant that can be used as mist for disinfection and odor diminution in places where people live.

(1) Manufacturing of NeuKocyte bactericide

Dilute hydrochloric acid (HCLO) is electrolyzed when placed in the non-diaphragm electrolytic cell and then NeuKocyte bactericide can be produced by adding water to it. The electrolytic cell is composed with corrosion resistant electrodes. Direct electric current is loaded in the electrolytic cell to carry out electrolysis. The electrolysis reaction formula is as follows:

$$2Cl^- \longrightarrow Cl_2 + 2e^-$$

With anode, chlorine ion is electrolyzed to become chlorine. Then, chlorine reacts with water under proper condition to produce hypochlorous acid. Hypochlorous acid is a bactericidal substance.

$$H_2O + Cl_2 \longrightarrow \mathbf{HClO} + H^+ + Cl^-$$

To avoid forming by-products, the proper electrolyzing condition must be selected. On the other hand, with cathode, hydrogen gas is generated and discharged.

$$2H^+ + 2e^- \longrightarrow H_2$$

The generated hydrogen gas is in small amount, but it is dangerous if the gas accumulates. So, the generating unit should be set up in a well ventilated room. If NeuKocyte bactericide is stored in a tank a gas discharge pipe or a gas discharge device should be attached to the tank.

(2) Food additive regulations

Slightly Acidic Electrolyzed Water (=Neukocyte bactericide) was specified as bactericide that can be used as indirect food additive by the Ministry of Health, Labor and Welfare of Japan in June 2002. Regulated specifications of Slightly Acidic Electrolyzed Water are as follows:

- Drinkable water should be used as raw water.
- The electrolyte used should be food additive grade hydrochloric acid.
- The pH of Slightly Acidic Electrolyzed Water should range from 5.0 to 7.0.
- Hypochlorous acid (HClO) should range from 10ppm to 30ppm.
- The official name is “Slightly Acidic Hypochlorous acid Water”.

(3) The relation between bactericidal effect and pH value

The difference of bactericidal effect between Slightly Acidic Electrolyzed Water and sodium hypochlorite depends on the pH as described in Table 1. When the pH varies, the existing ratio of chemicals in chlorine solution changes as illustrated in Fig.1.

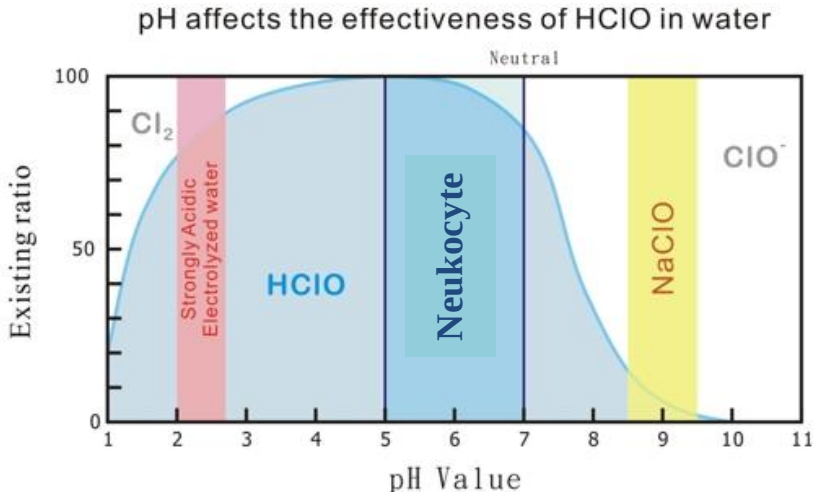

Fig. 1

If pH value becomes higher than 7, the volume of hypochlorous acid decreases but hypochlorite ion increases. Hypochlorite ion has only a slight bactericidal effect, so the pH value becomes higher but the bactericidal effect becomes lower. On the other hand, if the pH value becomes lower than 3, the existing ratio of chlorine molecule becomes higher. Chlorine gasification causes the odor of chlorine and instability of bactericidal effect. The purpose of slightly acidic pH value of Slightly Acidic Electrolyzed Water is to keep the stability of hypochlorous acid (bactericidal substance) in high existing ratio. When Slightly

Acidic Electrolyzed Water is used in food, the pH value should be between 5.0 and 7.0, and the hypochlorous acid (HClO) should be between 10ppm and 30ppm. This concentration is selected to ensure enough bactericidal effect, which does not cause foreign flavor, color and texture damage. For applications other than food, Slightly Acidic Electrolyzed Water can be used with concentration beyond this range.

(4) Comparison with other bactericides

Table 1

Items	Neukocyte	Strongly acidic Electrolyzed water	Sodium Hypochlorite (SHC)	Ethanol
Raw material	HCI	NaC1	NaC1	Ethanol
pH Value	5.0-6.5	2.7>	7.5<	
Bactericidal effect	Strong	Strong	**Weak to the spore and virus**	**Weak to the mold and spore**
Anti virus	Effective	Effective	**Weak**	**Weak**
Stable	Practically stable	**Unstable**	Moderately stable	Volatile
Food additive	Specified	Specified	Available at pH7.5<	Specified
Chloroform	No	No	Yes	Yes
Chlorine gas generation	No	**Yes**	No	
Mass manufacturing	Available	**No**	Available	
Useless water	Not generated	**Generated**	Not generated	
Salt residue	No	**Formed**	**Formed**	**No**
Spraying	Possible	**Impossible**	**Impossible**	**Explosive**
Qualification person	Unnecessary	Unnecessary	Necessary	Necessary
Fire hazard	No	No	No	**Existing**
Cost	Low	Low	Low	**High**
Flavor damage	No	Weak	**Strong at high concentration**	**Strong**
Hand roughness	Slightly	Weakly	**Strongly**	**Strongly**
Washing use	Available	Available	Available	No

(White cell – excellent property, Light grey cell – problem, Dark grey cell – serious problem)

2. Characteristics

(1) Safety

All safety tests carried out for food additive specification requests have produced good results. Therefore, Slightly Acidic Electrolyzed Water (=Neukocyte bactericide) was evaluated as being harmless to human health by the ministry of Health, Labor and Welfare in Japan.

Table 2

Ames test using bacteria
Oral single administration toxicity test using rats (Available chlorine concentration was 7.5 ppm)
Oral single administration toxicity test using rats (Available chlorine concentration was 50ppm)
5 days accumulative skin stimulation test using rabbits
Eye stimulation test using rabbits
90 days repetitive dosing toxicity test using rats (Available chlorine concentration was 40ppm)
Quality evaluation test by water service law / Quality evaluation test by food sanitation law

So Neukocyte bactericide can be used to disinfect food directly, and is safe even if it is swallowed by mistake, or enters eyes by accident.

(2) Absence of taste, smell and color

Neukocyte bactericide only contains slight amount of hypochlorous acid and a small amount of minerals from raw water, and its pH value is within slightly acidic range. Therefore Neukocyte bactericide has almost no taste, no smell and no color. So, when used for disinfection in food, it does not ruin taste, damage texture, spoil color and nutrients.

(3) Bactericidal ability

As shown in table 3, Neukocyte bactericide has a wide range of disinfection effects. It disinfects as quickly as within tens of seconds or a few seconds. But in the case bacterial spores and some mold spores, more time may be needed for their elimination.

Table 3

General	Food poisoning	Pathogenic	Virus
E. coli	Salmonella	0-157	Influenza
B. subtilis spore	Vibrio parahaemoriticus	Shigella dysenteriae	SARS
B. cereus spore	Staphyrococcus aureus	Vibrio Cholerae	Noro
Saccharomyses	Listeria	Micobacterium (cow)	
Cladosporium	Yersinia	MRSA	
Candida	Campylobacter		
	Serratia		
	Pseudomonas aeruginosa		

The disinfection effects can become higher or lower depending on temperature. Preferably, application at 40C is best.

(4) Stability

To maintain its stability, Neukocyte bactericide must be kept away from sunlight, fluorescent and mercury light. After preserving in an ordinary shaded tank for one week, Neukocyte bactericide retains 80% of its hypochlorous acid (HCLO). If kept under 15C in a perfectly sealed and shaded tank, Neukocyte bactericide remains functionable even after 6 months. Before using preserved Neukocyte bactericide , the presence of hypochlorous acid (HCLO) has to be checked for with paper testers.

(5) No residue

Test results revealed the fact that the Neukocyte bactericide remaining on the surfaces of foods would lose function soon after disinfection because no residue of hypochlorous acid was detected.

On the other hand, the Neukocyte bactericide used on surfaces of inorganic materials was found comparatively stable. But it disappeared easily through drying or light irradiation. The above findings prove that Neukocyte bactericide leaves no residue after disinfection and therefore the risk of recontamination exists. So, careful handling after disinfection would be necessary. Furthermore, upon contact with organic materials, Neukocyte bactericide would lose its bactericidal effect. Therefore, soaking foods or dirty things in Neukocyte bactericide or reusing should be avoided.

(6) Generating of THMs (Trihalomethane)

THMs, or trihalomethanes, are chemical compounds that are formed as a result of a reaction between organic materials in drinking water and chlorine added as a disinfectant in 200ppm or above. THMs are one of the many by-products of water chlorination. When ingested in drinking water, THMs can cause a host of physical problems. THMs are known carcinogens and leading causes of bladder and rectal cancer. THMs can adversely affect nervous system functioning, as well as trigger liver and kidney malfunctions. Ingestion of THMs in drinking water has also been linked to spontaneous abortion, or miscarriage, in pregnancy. However, it is realized that Neukocyte bactericide , apart from its known ability to kill bacteria and virus, is so harmless that it would never induce the above health hazards.

(7) The influence on waste water treatment

The treatment of organic waste water by microbes is widely adopted. If disinfectant or pH-changing materials flow into the processing tank of a waste water processing plant the function of the microbes grown inside weakens greatly and plant operation if forced to stop. To avoid such situation, waste SHC (bleaching water) must be neutralized or diluted before discharging. However, as described in paragraph (5) “No residue” Neukocyte bactericide is inactivated easily by mixing with small amount of organic materials. Therefore, when Neukocyte bactericide is mixed with organic waste water its bactericidal effect disappears. Then, harmless waste Neukocyte bactericide can be discharged freely.

(8) No chlorine pollution when used for spraying purpose

As described in paragraph (3) “The relation between bactericidal effect and pH value”, the low pH value limit was selected to avoid chlorine gas generation. Therefore, when being used in large quantities in the room with Neukocyte bactericide being stirred or aerated, chlorine gas would not be generated to foul up the air. Therefore, if need be, Neukocyte bactericide can be sprayed in the room with people present.

(9) No crystallization on surfaces of matters

If Neukocyte bactericide is generated by using hydrochloric acid only, crystallization does not occur after drying. Therefore, Neukocyte bactericide can be sprayed or scattered repeatedly without causing rust in any metals nearby.

(10) Influence on metals

It is impossible to completely avoid the influence of Neukocyte bactericide on metals because it contains hypochlorous acid. Repeated use in iron, copper, aluminum and brass should be stopped. Also, the droplets on surfaces of metal should be washed away within short time. The metals, nobler than SUS304, are moderately stable. But, soaking them for long time in Neukocyte bactericide or using Neukocyte bactericide at high temperature (higher than 30℃) in metals should be avoided. Furthermore, the seamed parts and welded parts of metals tend to be corroded, so soaking them in Neukocyte bactericide for long time is not preferable. Plastic is recommended for the making of level sensors, pipes, tanks and pumps, which are in contact with Neukocyte bactericide continuously. However, using Neukocyte bactericide temporarily for disinfection of durable metals such as SUS304 creates no problems.

3. Usages of Neukocyte bactericide

(1) Food industry

a) Daily food makers, raw food makers, food retailers
Cleaning of raw foods, hands, uniforms, cooking utensils, cooking tables, floors and walls, air cleaning, transportation apparatus and rest rooms, etc.

b) Breweries, wineries, rice-wineries, milk industry
Cleaning of machines and utensils, transportation apparatus, containers, air cleaning, floors and walls, raw ingredients, external surfaces of ingredient packages, hands and rest rooms, etc.

c) Miso and soy sauce makers
Cleaning of machines and utensils, transportation apparatus, air cleaning, floors and walls, raw ingredients, external surfaces ingredient packages, hands, rest rooms and uniforms, etc.

d) Fishery
Cleaning of machines and utensils, transportation wares, air cleaning, floors and alls, raw ingredients, hands, rest rooms and uniform, etc.

(2) Agriculture

a) Facilities gardening
Pesticide, bactericide, humidifying, watering, air cleaning, disinfection of seeds and young plants, disinfection of soil, post harvest, air cooling.

b) Garden farming
Pesticide, bactericide, humidifying, watering, disinfection of seeds and young plants, disinfection of soil, post harvest.

c) Dairy farming, livestock industry
Cleaning of livestock, cleaning of wounds, sanitation of milking, cleaning of livestock barns, cooling of barns, drinking water of livestock, prevention of transmission.

d) Circulation
Machines and utensils, post harvest, humidifying, cooling of air.

(3) Fishery

a) Cultivation
Machines and utensils, environment

b) Circulation
Disinfection of seafood, ice for cooling, cleaning of transportation equipments, cleaning of handling places.

(4) Medical care

Disinfection of operating rooms, cleaning of patients' bodies, sanitation of kitchens, cleaning of passages, air purification, humidifying, disinfection of utensils, cleaning of bath and rest rooms, deodorization of rooms, cleaning of diseased parts

(5) Servicing industry

a) Restaurants, hotels, inns
Foods, cooking utensils, tablewares, floors and walls of kitchens, cleaning and deodorization of guest rooms, cleaning of bath and rest rooms, hands

b) Recreational facilities
Disinfection of swimming pools, cleaning of utensils, air purification, cleaning of rest rooms, sanitation of kitchens.

c) Traveler transportation
Interior cleaning of station wagons or estate cars, air purification in vehicles, fogging at passages of border control.

(6) Schools

Disinfection and humidifying of rooms, cleaning hands, sanitation of kitchens and cleaning of rest rooms in schools.

4. Caution

(1) Rinsing by Neukocyte bactericide

- In case of food disinfection, Neukocyte bactericide must be supplied continuously. Vegetables, fruits, meat and fish do not need rinsing with water after disinfection. Remaining Neukocyte bactericide disappears promptly. It is necessary to alert for recontamination.

- If Neukocyte bactericide is used to wash out the grime from utensils, washing and disinfection can be done at the same time.

- Soaking dirty things in Neukocyte bactericide pool is ineffective. Washing dirty things in Neukocyte bactericide pool is not effective either. Cleanly washed utensils can be soaked. Appropriate soaking is suitable for spore disinfection.

- Cloudy Neukocyte bactericide cannot be used.

- Neukocyte bactericide cannot be mixed with other disinfectant or detergent for use. Neukocyte bactericide sometimes loses bactericidal effect when mixing with other chemicals.

(2) Right types of containers must be used

- Storing of Neukocyte bactericide in metal equipments for long time must be avoided. Especially at a temperature higher than 30℃ almost all metals are subject to influence at different levels.

- Supplying equipments such as tanks, pipe-lines, pumps, nozzles, etc, should be made of PVC or fluorine plastic. The part of any article continuously soaked in Neukocyte bactericide should be made of corrosion resistant material such as fluorine plastic.

(3) Influence on the human skin

Neukocyte bactericide influences the human skin very little and very few people suffer skin allergy caused by contact with chlorine. People who feel uncomfortable with chlorine water should wear water-proof plastic gloves.