Super Oxidised Water / Super Alkalised Water

Technical Data & Report

AOI ENGINEERING INC.

Contents

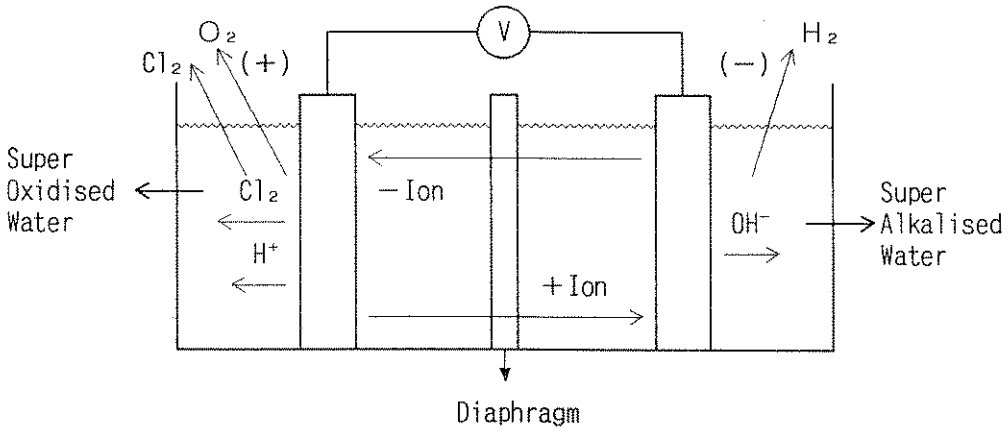
1. The principle behind the formation of Super Oxidised Water and Super Alkalised Water

Both Super Oxidised and Super Alkalised Water are produced simultaneously by the electrolysis of water within the apparatus.

They are formed as a result of the movement of positive and negative ions passing through the diaphragm and which appear as a result of the application of DC current through the positive and negative electrodes which are submersed in a mild electrolytic solution consisting of a little salt dissolved in normal water.

On the positive electrode side of the diaphragm O_2(oxygen gas) is produced and a concentration builds up of H^+(Hydrogen ions) so forming Super Oxidised water.

At the same time on the other side of the diaphragm and around the negative electrode H_2(Hydrogen gas) is produced with a concentration build up of OH^-(Hydrate ions) so forming Super Alkalised water.



The reaction which occurs at the positive electrode is as follows:

H_2O(Water) → $1/2O_2$(Oxygen) + $2H^+$(Hydrogen ions) + $2e^-$(Electron)

The concentration of H^+(Hydrogen ions) increases and pH value decreases and the fluid becomes acidic.

Also another reaction occurs where salt has been used as an electrolyte:

$2Cl^-$(Chlorine ions) → Cl_2(Chlorine) + $2e^-$(Electron)
Cl_2(Chlorine) + H_2O → HOCl(Hypochlorous acid) + H^+ + Cl^-

The reaction which occurs at the negative electrode is as follows:

$2H^+$(Hydrogen ion) + $2e^-$(Electron) → H_2(Hydrogen)

The concentration of H^+(Hydrogen ions) decreases and that of OH^-(Hydration ions) increases and pH value rises and the solution becomes alkaline.

2. What is Super Oxidised Water ?

Acidic and alkaline waters are formed on the positive and negative sides of the diaphragm respectively.

The water formed on the positive electrode side is named Super Oxidised water and has a pH of less than 3 and an Oxidisation Reduction Potential (ORP) of more than +1000mV.

The water formed on the negative electrode side of the diaphragm is named Super Alkalised water with a pH of more than 11 and an ORP of less than-700mV.

Both these produced waters have a variety of functions which normal water does not possess.

3. Features of Super Oxidised Water

(1) The differances between Super Oxidised and Super Alkalised waters and typical chemicals such as Hydrochloric acid, Sodium Hydroxide and others.

a. First difference.

Super Oxidised Water has a much higher ORP compared to these typical chemicals.

Super Alkalised Water has a much lower ORP compared to these same chemicals.

This indicate that Super Oxidised and Super Alkalised waters are very different to chemicals in respect of their electrical characteristics.

A typical comparison table follows:

· Super Oxidised water ·····	pH 2.45	ORP 1156mV
· 0.013% hydrochloric ·····	pH 2.45	ORP 627mV
· 10% acetic acid ·····	pH 2.42	ORP 616mV
· Super Alkalised water ····	pH 11.67	ORP -889mV
· 0.8% sodium hydroxide ····	pH 11.64	ORP 215mV
· 3% ammonia ·····	pH 11.72	ORP 552mV

b. Second difference.

There are NO residues.

Super Oxidised water returns to normal water by means of external factors as follows.

○ When it is in contact with some organic matter such as fat, protein etc.

○ When it is diluted by normal water.

○ When it is left for a period unprotected from light and air.

○ When it is in contact with deoxidating agent.

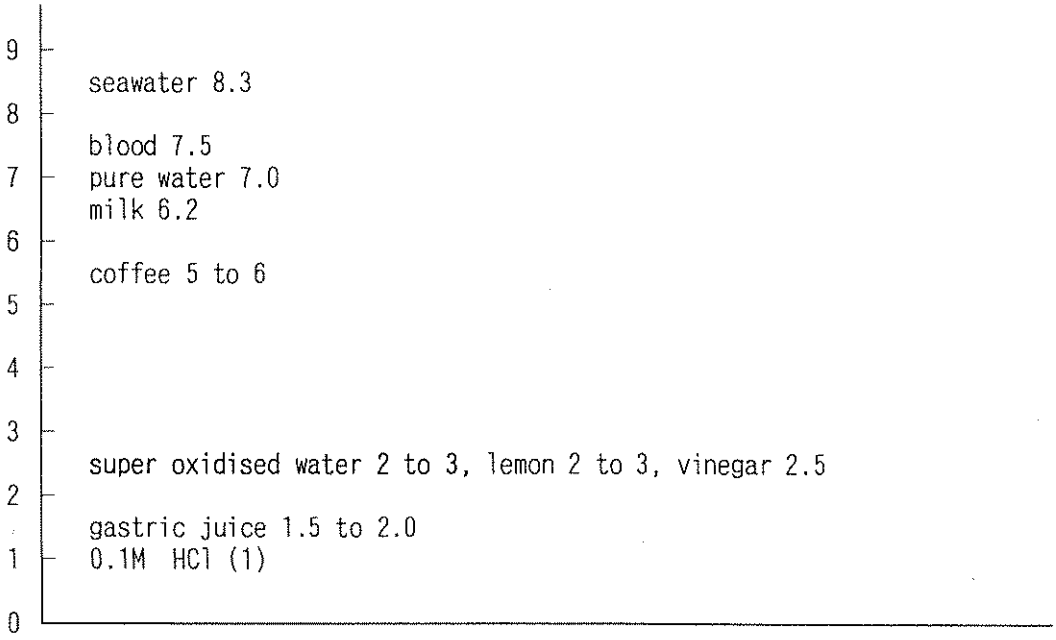
Hence Super Oxidised water becomes normal water immediately when it comes into contact with the natural world.

As an example the following table shows the experimental effect of adding 1% yeast extract to two test samples of Super Oxidised water.

	Test sample 1		Test sample 2	
	Before	After	Before	After
pH	2.27	4.64	2.54	5.07
ORP (mV)	1170	520	1110	199
Remaining Chlorine (ppm)	37.2	0	29.0	0

(2) The pH of Super Oxidised Water.

The pH of Super Oxidised water is 2 to 3 but there are many things which a similar value all around us:



(3) The comparison between Super Oxidised water and Acid Rain.

Acid rain consists of rain water contaminated by exhaust fumes, gas(smoke) emitted from chemical plants etc. and the main pollutants are Hydrochloric Acid, Sulphuric Acid, Nitric Acid and others.

Super Oxidised water is completely different inasmuch as it is formed by the electrolysis of water and results in water where the concentration of Hydrogen ions is very high.

(4) Preservability.

Super Oxidised water unlike other germicidal agents is influenced by the conditions in which it is kept.
Under normal room temperature conditions the preservation period will be approximately as follows:

Hermetically sealed container shaded from direct light ····· 50 days.

Hermetically sealed container subject to scattered light ··· 30 days.

Open container ····· 1 days.

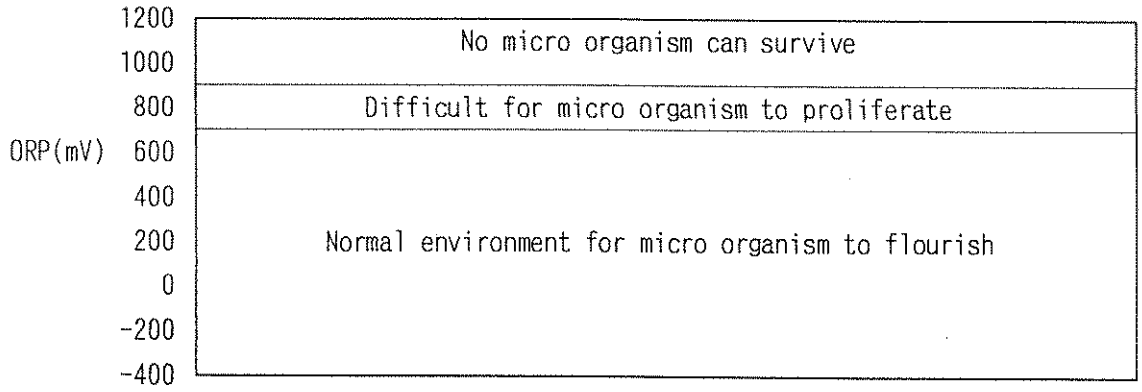
NOTE: This period of preservation is taken as the time in days before the ORP falls to less than 1000mV and clearly the judgement of this datum is dependent on the use to which the Super Oxidised water is to be put.

4. Sterilising effect of Super Oxidised Water

(1) Mechanism of sterilisation.

a. Super Oxidised water has high ORP of more than 1000mV and the membrane potential of the cell of small micro organisms is exceeded by this high exidisation potential and hence no micro organism can survive when exposed to it.

The environment in which micro organisms can survive depends on the ORP present

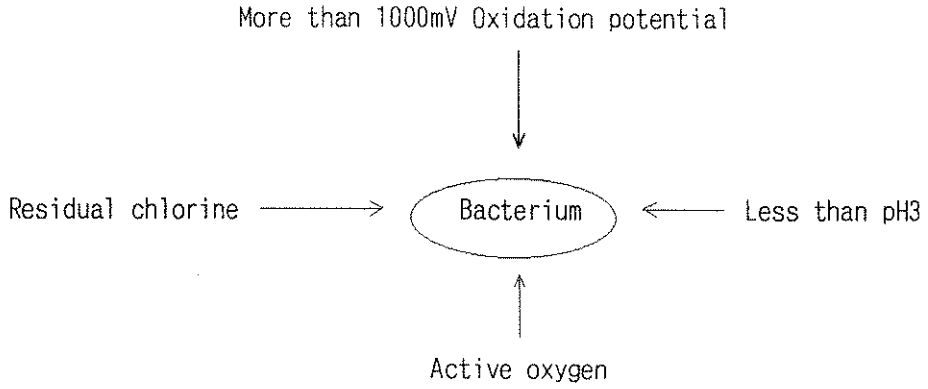


b. The pH of Super Oxidised water is less than 3 and it is very hard for any micro organism to proliferate in this situation as the hydrogen ions is capable of penetrating the cell cytoplasmic membrane so hydrolysing the protein.

c. There may still be present in the Super Oxidised water some residual chlorine from a few ppm to several ppm.

This has an oxidising function and it denatures the fungus protein of the micro organism and kills it off in a short space of time.

d. There exists in the Super Oxidised water the hydroxy radical OH which is a type of active oxygen and this has the strongest sterilizing power of all.



(2) Sterilising test

a. Name of test facilities : Foundational juridical person

Kitasato Research Center of Environmental Science

b. Method of test

Add the testing bacterium into Super Oxidised water and make it act for a stated time and neutralize the residual chlorine by adding 3% thiosodium sulfate liquid immediately after the action is completed and then inoculate it into the culture medium and culture it.
Found the number of living bacterium by counting the number of colony after the cultivation.

c. The sort of germs to be used

[Bacterium]

· Staphylococcus aureus	IFO 12732	(A)
· Mithicillin Resistant Staphylococcus Aureus	ATCC 43300	(B)
· Escherichia coli	ETEC:08	(C)
· Pseudomonas aeruginosa	IFO 3445	(D)
· Bacillus subtills	IFO 13721	(E)

[Fungus]

· Trichophyton rubrum		(F)
· Candida albicans		(G)

[Virus]

· Herpes virus	type 1 H.F.	(H)
· Polio virus	type 1 Lsc2ab	(I)
· Coxsackie virus	type B6 Schmitt	(J)

d. Specification of Super Oxidised water

· pH : 2.50 ～ 2.52, ORP : 1120 ～ 1131 mV, Residual chlorine : 40 ppm

e. Result of test

Sterilising effect against the bacterium

Elapsed Time	A	B	C	D	E
At first	4.5×10^5	1.4×10^5	4.2×10^5	8.2×10^5	1.0×10^5
Just after starting	2.0	1.0 x 10	0	0	1.0×10^3
After 30 seconds	0	0	0	0	1.0×10^3
After 1 minute	0	0	0	0	1.0×10^3
After 10 minutes	0	0	0	0	1.0×10^3
After 30 minutes	0	0	0	0	4.0
After 60 minutes	0	0	0	0	0

※ Please refer to (2) c. [Bacterium] for A～E

Sterilising effect against fungus

Elapsed time	F	G
At first	2.0×10^3	2.4×10^3
Just after starting	1.0	0
After 30 seconds	0	0
After 1 minute	0	0
After 10 minutes	0	0
After 30 minutes	0	0

※ Please refer to (2) c. [Fungus] for F～G

Sterilising effect against virus

Elapsed time	H	I	J
At first	4.0×10^4	4.6×10^4	4.3×10^4
Just after starting	0	0	0
After 30 seconds	0	0	0
After 1 minute	0	0	0
After 10 minutes	0	0	0
After 30 minutes	0	0	0

※ Please refer to (2) c. [Virus] for H～J

(3) Comparison of sterilising effect between Super Oxidised Water and Sodium hypochlorite.

a. Name of test facilities : Foundational juridical person

Kitasato Research Center of Environmental Science

b. Specification of the liquid to be tested.

Super Oxidised Water :

pH : 2.50~2.52, ORP : 1120~1131mV, Residual chlorine : 40 ppm.

Sodium hypochlorite :

pH : 8.80~9.70, Residual chlorine : 40 ppm.

c. Result of test

		Super Oxidised Water					Sodium hypochlorite				
Germs to be tested	Number of germs acted	1	2	3	4	5	1	2	3	4	5
A	4.5×10^5	2.0x1	0	0	0	0	$2.6x10^3$	$6.3x10^2$	$2.9x10^2$	*	*
B	1.4×10^5	1.7x1	0	0	0	0	$1.9x10^3$	$2.5x10^2$	1.0x10	*	*
C	4.2×10^5	0	0	0	0	0	$2.0x10^3$	8.5x1	*	*	*
G	2.4×10^3	0	0	0	0	0	$1.7x10^2$	13	0	0	0
I	2.6×10^3	0	0	0	0	0	5.5x1	0	0	0	0

※ Please refer to (2) c. for A~I.

※ 1 : Just after starting
2 : After 30 seconds
3 : After 1 minute
4 : After 10 minutes
5 : After 60 minutes

※ * mark denote that no counting.

5. Safety test

(1) Name of test facilities : Foundational juridical person

Chemicals Safety Center, Hida Laboratory
of Chemical Goods Inspection Association.

(2) Applied GLP : Subject to Art. 313 and 870 of the Drugs, Cosmetics and Medical Instruments Act. of Japan.

Contents of Test	Result
Toxicity test by single time oraly dosing with Super Oxidised water to rat.	No instance of death was recognized while testing. LD 50 value is over50ml/kg Everything was all right in its general condition, change of weight and autopsy.
Toxicity test by single time oraly dosing with Super Alkalised water to rat.	No instance of death was recognized while testing. LD 50 value is over50ml/kg Everything was all right in its general condition, change of weight and autopsy.
Eye stimulability test by Super Oxidised water on rabit.	Examination standard of AFNOR (1982) approved as non-stimulative.
Skin accumulate stimulability test made for 5 days by Super Oxidised water on rabit.	No skin reaction was recognized on either diseased parts of abrasion and non-abrasion. It was therefore conjectured to be no skin accumulate stimulability.
Toxicity test by oraly dosing with Super Oxidised water repeatedly for 7 days to rat.	No instance of death was recognized while testing. Everything was all right in its general condition, change of weight and autopsy. No toxic symptoms was recognized.
Toxicity test by oraly dosing with Super Oxidised water repeatedly for 28 days to rat.	It affected hepatic function and also small intestine on male rat, but either were very slight.
Back mutability test with germs by Super Oxidised water.	Back mutability did not be recognized.

6. General Observations.

(1) The electrolysed water should be used as soon after being formed as practicable or changes in its condition may occur and there may be a diminution of its special characteristics, ie concentration of chlorine, ORP, concentration of hydrogen ions etc. so reducing its effectiveness.
It should always be stored in a container of Vinyl chloride, glass, Teflon (Polytetrafluoroethylene) or PET in order to preserve this water and no metal container should be used.

(2) The electrolysed water reverts to ordinary normal water once it comes into contact with any dirt and the container it is stored in should also be scrupulously clean.

(3) Exposure to light and air should be avoided and the electrolysed water should be stored in an airtight container not exposed to direct light.

(4) As small quantities of hydrogen, oxygen and chlorine gas are given off in the process of producing and using the electrolysed water these operations should be carried out in a well ventilated place if large quantities are being produced or used.

(5) As Super Oxidised water will attack metalware ie copper, brass, iron etc. any contact with such metalware should be immediately dealt with by rinsing the articles with normal water or Super Oxidised water followed by thoroughly drying and mopping up all moisture.

(6) It is not advisable for either Super Oxidised water or Super Alkalised water to be drunk.

7. Some applications of the electrolysed waters in different field.

Uses	Fields and concrete cases
For sterilisation	Medical facilities : · Water for cleaning walls, floors etc. · Water for washing and sterilising medical appliances such as Endoscopes, dialysis equipment, bedclothes, clothes etc. · For hand washing. Farming facilities : · Water to sterilise vegetables, fruit trees etc. (against Mildew, anthracnose etc.). · Water to sterilise greens on golf course (against rhizoctonia etc.).
For medical treatment	Medical : · Water to wash Atopic dermatitis, diabetic gangrene, urethra, bladder etc. Dental : · Water to gargle for treatment of pyorrhoea alveolaris, inflammation of gums etc. · Water for aftercare. Veterinary and Pets : · Water to treat determatitis, injuries etc.
For deodorization	Industrial : · To deodorize exhaust gasses. Stock Farm : · To sterilise and deodorize cattle sheds etc.
For washing	Industrial : · For washing precision items. Food sanitation : · To wash and sterilize carrying trays and apparatus used in food preparation. · Cleaning floors and walls of food processing facilities. · Washing down pipework etc.