"Our mission is to provide cost effective, safe, environmentally responsible solutions to bacterial control in the food and water industries"

clean water

Escherichia coli. Causes gastroenteritis, urinary tract infections and neonatal meningitis.Found in poorly handled and undercooked meat.

Why use dangerous chemicals

when there are safer more environmentally friendly alternatives ?

Every year people are injured and some even killed with accidents involving *Chlorine* gas. Some of these are caused by accidents involving delivery systems and some by incorrect mixing of cleaning and disinfecting chemicals.

Chlorine and its chemical compounds are extremely effective as disinfecting agents and the safety of our modern food and water supply chain depends heavily on them. The struggle has been to maintain the safety of the food and water supply chain whilst protecting the health and lives of those working in these areas.

Now with the use of a DCW generator it is possible to generate *Hypochlorous Acid* on site from just salt water and electricity safely.

Hypochlorous Acid is one of the most powerful chlorine based disinfection agents. At a concentration of just 0.1 parts per million with an ORP of +700mv and pH7 it can achieve a log3 reduction of E.coli within 10 seconds. (Source: Carlson, S.: Fundamentals of water disinfection. J. Water SRT – Aqua 40 (1991) 346-356)

Using state of the art patented Membrane Electrolysis technology DCW generators produce powerful disinfection agents on site without any risks to humans.

The added bonus is that our disinfection liquids are classed as non toxic and biodegradable under EU guidelines thus helping protect both people and the environment.

All these benefits are coupled with the possibility of making substantial cost savings in many circumstances as on site production is often substantially cheaper than using traditional chlorine based chemicals.

The DCW generators can also save energy and water as they allow some processes to be carried out at lower temperatures and water to be recycled.

How does the system work?

Our disinfectant generators produce a liquid called NEUTHOX through the process of electrolysis of Brine (Salt Water). NEUTHOX contains among other things *Hypochlorous Acid* that is a highly potent bactericide.
Bacteria such as Escherichia coli when exposed to *Hypochlorous Acid* lose viability in less than 100ms. Escherichia coli is a major cause of food and water borne infections in humans.
In addition to killing bacteria NEUTHOX is effective in breaking down Biofilms which protect the bacteria from the action of the *Hypochlorous Acid*.
Hypochlorous Acid is an effective disinfection agent against most bacteria that cause infections in humans such as:

- Legionella pneumophila
- Vibrio vulnificus
- Escherichia coli
- Listeria monocytogenes
- Salmonella enterica
- Campylobacter jejuni

NEUTHOX also contains *Sodium Hydroxide* which is a useful cleaning agent due to its ability to break down grease and proteins.

DCW generators can also be configured to produce two separate solutions Cathox (mainly a solution containing *Sodium Hydroxide*) and Athox (the disinfection solution containing *Hypochlorous Acid*).

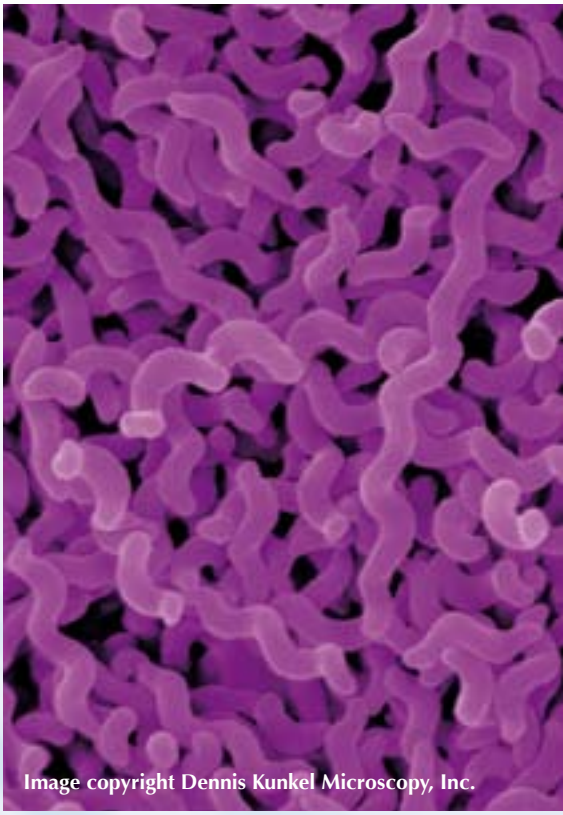
The NEUTHOX can be either dosed directly into your system or alternatively into a buffer tank, if the demand is variable, then through a sensor controlled dosing pump to suit the biological load within your system.

The only requirements for our generators to work are a supply of salt, water and electricity. The generators are controlled by PLC with an easy to operate HMI (Human machine interface) allowing the end user to accurately control the pH value of the NEUTHOX and ensure the correct dosing levels for a particular application.

Typical operating costs for a number of European Countries are shown below (figs in Euros).

Country	Energy cost per kwh.Typical	Salt costs Per kg. Typical	Cost per 1000 litres Neuthox
Germany	12.72cents	21 cents	5.81 Euros
Poland	7.61cents	25 cents	4.29 Euros
Denmark	11.84cents	31 cents	6.16 Euros
U.K.	11.44cents	27 cents	5.76 Euros
France	7.01cents	33 cents	4.60 Euros
Italy	15.63cents	15 cents	6.41 Euros

Campylobacter jejuni. Causes campylobacteriosis one of the common causes of diarrhea. Found in badly handled and undercooked poultry.



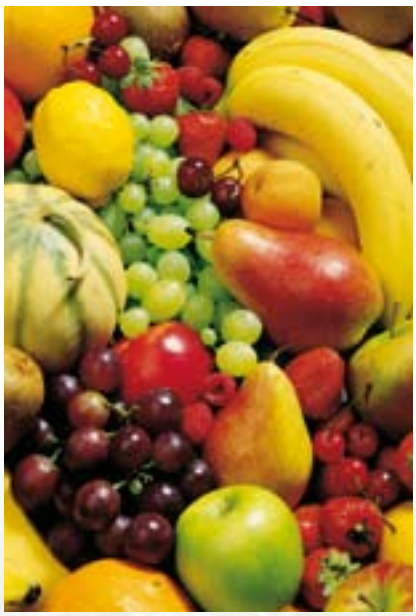
Applications

Brew and Beverage Industry
DCW disinfectant generators have a number of applications in this industry. They include Tunnel Pasteurizers, Bottle Wash and cleaning of Conveyor and Transport Systems. The use of a DCW generator can result in significant savings as it allows processes to be run at lower temperatures and water to be recycled.

Cooling Towers and Ponds
NEUTHOX produced by our on site generators effectively controls Legionella and other bacteria maintaining a safe and healthy environment. The powerful disinfecting solution also destroys bio-film yet is no more corrosive than tap water.

Meat Industry
Bacterial contamination of meat is an ever present problem. DCW can help with its powerful NEUTHOX solution ideally suited to surface cleaning of preparation areas, packing cases and transport systems yet without the problems associated with traditional chlorine based chemicals.

Drinking Water
NEUTHOX is approved for use as a disinfection agent for drinking water making it safe for consumption without the unpleasant smell and taste associated with conventional chlorine based water treatment.



Fruit and Vegetable washing
NEUTHOX is a highly effective disinfection agent for the washing of Fruit and Vegetables both whole and cut, increasing the shelf life and providing a safer product for consumers.

Waste Water Treatment
The addition of NEUTHOX to waste water can reduce bacterial count to safe levels without contaminating the environment.

Horticulture
Misting or spraying glasshouses with NEUTHOX gives effective bacterial and algal control.

Swimming Pools
On site NEUTHOX generators can ensure a safe swimming environment without the unpleasant smell or eye stinging effects of traditional chlorine based treatments. It also is safer for staff as they do not have to handle potentially dangerous chemicals.

Medical Facilities
Due to its non-toxicity and non-corrosive nature it is ideal for surface sterilization of medical facilities to help prevent bacterial infection.

Food and Dairy Industry
Due to its non-toxicity NEUTHOX is approved for use in the food industry for disinfection in a wide range of areas including preparation surfaces, pipes, transport systems and packaging.

Shellfish Industry
NEUTHOX has been shown to be highly effective in destroying bacteria such as Vibrio and E.coli. making for a safer product for consumers.

Agriculture
The use of NEUTHOX in agriculture can result in increased yields and improved animal husbandry by destroying bacteria in animal drinking water and stock pens.

Hotels and Public Facilities
Legionella is a major health problem in facilities with a large water system where parts are not often used such as Hotel rooms in low season. The unused areas can result in the build up of Legionella and other health endangering bacteria within the water system. The addition of a Neuthox generator to the water system can prevent this without costly high temperature flushing.

Marine Industry
NEUTHOX generators are suitable for shipboard sterilization of drinking water. NEUTHOX can also be added to water used in ice making machines for the fishing industry to ensure a safer product.

Frequently Asked

Salmonella enteritidis. Causes food poisoning (Salmonellosis) in humans when ingested. Found in poultry eggs meat and shellfish.

Is NEUTHOX corrosive ?
NEUTHOX is no more corrosive than tap water in most applications.

How expensive is the system ?
Typical investment recoupment period can be as low as 18 months.

What is the pH value of NEUTHOX ?
The pH value of NEUTHOX is typically set between 7and 7.5 but can be controlled to suit the requirements of the end user via the control panel.

Are there any by products produced ?
If the end user requires a low pH value it will result in a small over production of a weak Sodium Hydroxide solution.

What guarantees are offered on the generator ?
All electromechanical parts are covered by a 12 month warranty and the generator cells by a 36month warranty.

Is NEUTHOX toxic ?
No, it is approved for use in drinking water in countries such as Germany and the food industry in countries such as Denmark.

Does the generator require a high degree of maintenance ?
No, the generator is PLC controlled. The brine tank needs to be kept filled with salt and once a month there are some simple maintenance tasks that take about 10 minutes.

Is NEUTHOX safe to handle ?
Yes .Unlike traditional chlorine based chemicals even in its most concentrated form it has only a mild irritant effect on some sensitive people and after washing with water this will disappear.

What is the shelf life of NEUTHOX ?
If stored in an airtight container it can remain effective up to 12 months but the efficacy does reduce over time.

How large a generator will I require ?
We will assist you in calculating this as the requirements vary depending on the biological load, simply email(info@danishcleanwater.dk) us or visit our website (www.danishcleanwater.dk) and enquire on line.

What sizes are the generators available in ?
Our smallest generator produces 40litre of NEUTHOX per hour and we recommend that the generators run for a maximum of 12-15 hours per day thus giving a safety margin if your system experiences any spikes in its biological load. This also allows the machine time for it to carry out some automatic

Questions

routine maintenance procedures. There is no theoretical maximum size.

Can I have automatic alerts if there is a problem in the system ?
Yes .Options are available with either alerts and or system parameters, usage history and sensor reading history via Ethernet or GPRS

Can I link sensors from my system to the PLC controlling the disinfectant generator ?
Yes. You can either interface your own control systems via an RS232 port or similar or we can provide sensors such as ORP or pH value to link to the generator. Normally they must be located within 10 metres for hardwired connection but we also offer remote wireless sensing for larger systems.

What water and power supplies do I need to provide ?
The machine requires a connection to the local drinking water supply with a constant pressure of between 2 and 7 bar. The power requirements vary according to the size of machine. A 40litre machine consumes 1.4 kw per hour other sizes are prorate.

Are there any special requirements on water quality ?
Not normally. The local drinking water supply is usually acceptable as the generator has a built in softener .If you are using well water or are in an area with a particularly high mineral or sediment content it may be necessary to fit an additional high capacity filter and or additional softening system.

Is NEUTHOX environmentally safe ?
Yes. NEUTHOX breaks down in the environment without any toxic by products.

Will I receive assistance in installing and using the generator ?
Yes a member of staff from DCW or its local dealer will attend during installation, assist in setting up the machine and give full training to your operators.

What guarantees do I have that the generator will do what I want it to do ? *The best guarantee of all, if the generator does not perform as we say it will there is a full money back guarantee.*

What salt do I need to use and how much ?
Chemically pure salt (Sodium Chloride 99.7%) which is commonly available. Typical consumption is around 5 to 8 grams per litre of NEUTHOX produced.

How do I control the amount of NEUTHOX I need to add to my system ?
The generator can be set up to switch itself on or off depending on the demand of your system. Alternatively the generator can produce into a buffer tank and we can provide sensing and dosing solutions from the buffer tank. Producing to a buffer tank can be particularly useful in applications such as surface disinfection in food handling areas where the demand is only at certain times of the day.

What concentration do I dilute the NEUTHOX to ?
This can vary depending on the application and biological load . Most applications fall within the 1:500 to 1:2000 range. We will be pleased to advise you if you send an email to info@danishcleanwater.dk with an outline of your project.

Which bacteria is NEUTHOX effective against ?
NEUTHOX is highly effective against most disease causing bacteria such as E.Coli, Legionella, Campylobacter, Listeria etc. If you have a particular bacteria you would like information on please contact us.

Legionella pneumophila. Causes Legionaires disease (Legionellosis). Found in cooling towers and water systems.

The Basic principles
behind the System

basic

Our PLC controlled generators can produce three different liquids to suit a range of applications.

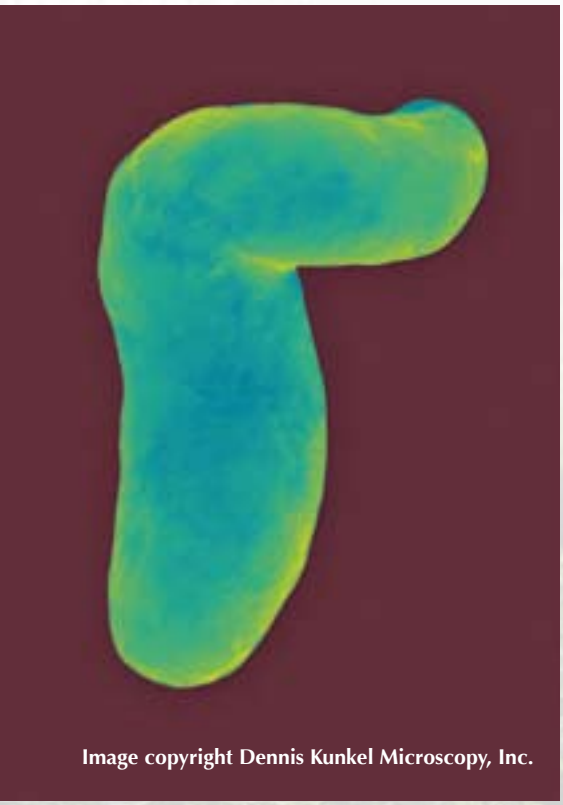
ATHOX
A powerful disinfecting fluid whose main active constituent is Hypochlorous Acid. It also contains small amounts of Chlorine Dioxide and Ozone that are also useful in controlling bacteria. Athox is also highly effective in destroying Bio-Film.

CATHOX
A useful cleaning agent composed of Sodium Hydroxide in solution, particularly effective in breaking down grease and fats.

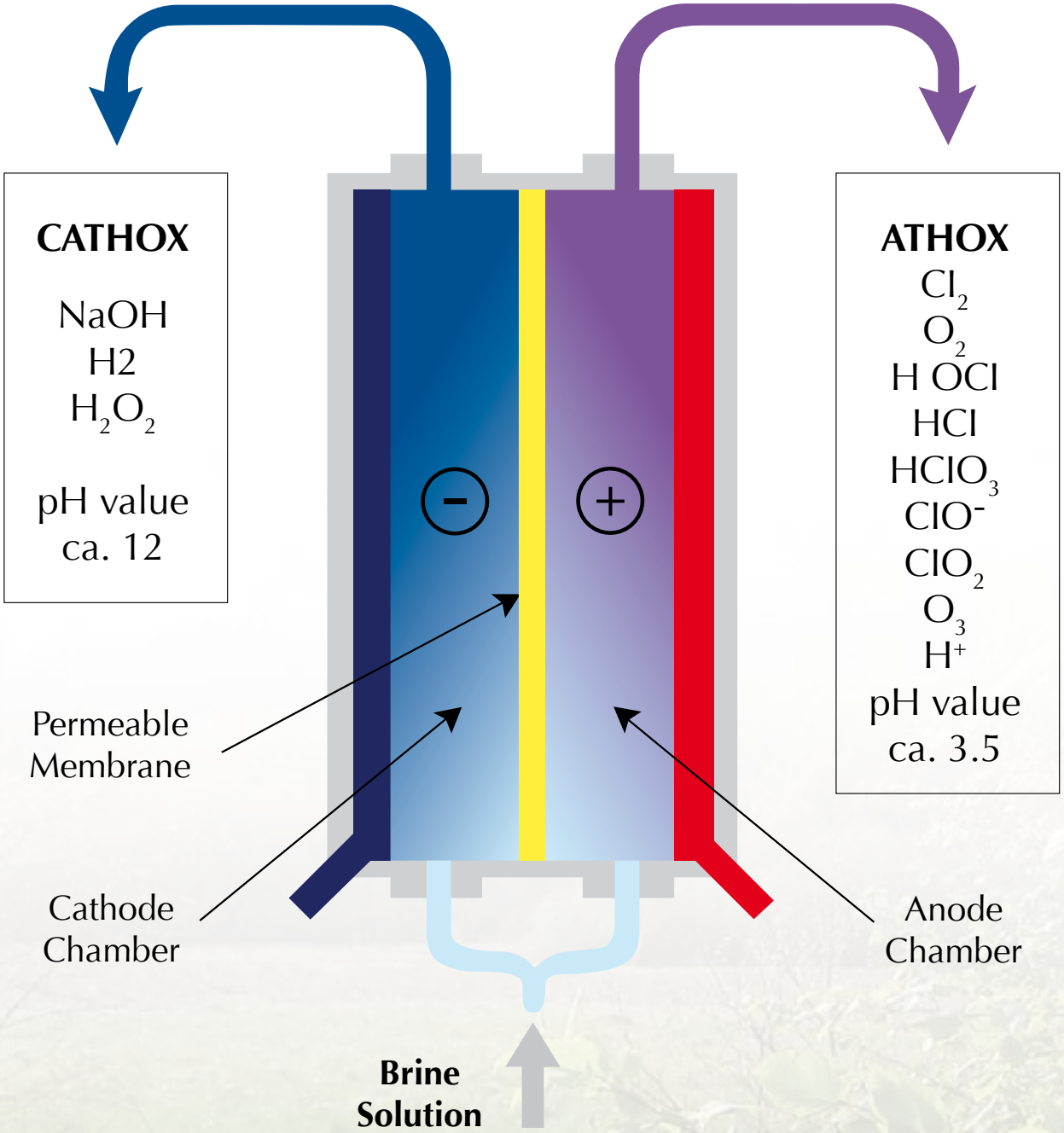
NEUTHOX
A mixture of ATHOX and CATHOX that combines the cleaning and disinfection properties of these two liquids. The ratio of the two liquids can be controlled via the PLC unit thus enabling the operator to control the pH value of the liquid.

The Generator
On the opposite page you will see a schematic of the generator cell which shows the basic principles of the electrolysis process. The cell contains a unique patented membrane which ensures separation of the fluids during the manufacturing process. The strength of the Brine (Salinity) is carefully controlled by the PLC to ensure optimum production of the disinfection agents and to minimize any salt residue in the finished product. By carefully controlling the flow, the salinity and the power our generators can ensure a consistent product in terms of both pH value and free chlorine. The PLC unit monitors the variable parameters within the system up to 300 times per minute and makes the necessary adjustments to ensure consistency of product.

The generator is normally equipped with a water softening system to prevent the build-up of limescale on the electrodes but it is normal for there to be some accumulation which can affect the efficiency of the cell. The PLC detects when the cell efficiency to starts to fall and initiates a flushing and cleaning cycle to ensure the generator is always operating at optimum values.



Vibrio vulnificus. Causes vomiting, diarrhea, reduced blood pressure and blistering dermatitis. Found in shellfish.



Neuthox

A mixture af Cathox and Athox
with an adjustable pH value between 6.5 and 8.5

Below is a full list of the reactions at the Anode and Cathode.

Anode

1. Generation of free radicals, active oxygen, and hydrogen peroxide
   $H_2O = H^+ + {}^\bullet OH + e^-$
   ${}^\bullet OH + {}^\bullet OH = H_2O_2$
   $H_2O = {}^\bullet O + 2H^+ + 2e^-$
   $O_2\text{-} = 2O + e^-$

2. Generation of ozone gas
   $3H_2O = O_3 + 6H^+ + 6e^-$
   ${}^\bullet O + O_2 = O_3$
   $O_2 + H_2O = O_3 + 2H^+ + 2e^-$ ($E^0 = 2.07$ V)

3. Generation of oxygen gas
   $2H_2O = O_2 + 4H^+ + 4e^-$
   $4OH^- = O_2 + 2H_2O + 4\ e^-$
   $H_2O_2 = O_2 + 2H^+ + 2e^-$
   $2Cl_2 + 2H_2O = 4H^+ + 4Cl^- + O_2$

4. Generation of oxygen gas and chlorine gas
   $4Cl^- + 2O_3 + 4H^+ = 3O_2 + 2Cl_2 + 2H_2$
   $2Cl^- + 2O_3 = 3O_2 + Cl_2 + 2e^-$

5. Generation of chlorine gas and dissolved chlorine
   $2Cl^- = Cl_2(g) + 2e^-$ ($E^0 = 1.359$V)
   $2HOCl + 2H^+ + 2e^- = Cl_2 + 2H_2O$ ($E^0 = 1.63$V)
   $Cl_2(g) = Cl_2(aq)$

6. Generation of hypochlorous acid and hypochloric acid
   $Cl_{2(ap)} + H_2O = HCl\ (=H^+ + Cl^-) + HOCl$
   $Cl^- + H_2O = HOCl + H^+ + 2e^-$
   $2Cl^- + H_2O = HOCl + HCl + 2e^-$
   $2Cl^- + H_2O_2 = 2HOCl + 2e^-$
   $ClO^- + H_2O = HOCl + OH^-$

7. Generation of hypochlorite ion, etc.
   $Cl_{2(aq)} + 2OH^- = ClO^- + Cl^- + H_2O$
   $Cl_{2(aq)} + H_2O = ClO^- + Cl^- + 2H^+$
   $HOCl = ClO^- + H^+$
   $2HOCl\ ClO^- = ClO_3^- + 2Cl^- + 2H^+$

The liquid produced at the Anode is known as ATHOX and is a powerful disinfection agent.

Cathode

1. Generation of hydrogen gas
   $2H_2O + 2e^- = H_2 + 2OH^-$ ($E^0 = -0.828$ V)
   $2H_2O = H_2 + 2{}^\bullet OH$

2. Generation of hydrogen and sodium hydrate
   $2Na^+ + 2H_2O + 2e^- = H_2 + 2NaOH$
   $2Na + 2H_2O = H_2 + 2NaOH$
   $Na^+ + OH^- = NaOH$

3. Generation of hydroxide ion and separation of sodium
   $Na^+ + e^- = Na$
   $2{}^\bullet OH + 2e^- = 2OH^-$
   $O_2 + 2H_2O + 4e^- = 4OH^-$

The liquid produced at the Cathode is a useful cleaning and degreasing agent. Neuthox is a mixture of these two liquids providing a powerful cleaning and disinfection agent.

Company Profile

Listeria monocytogenes. Causes Listeriosis, Meningitis, Septicemia, Encephalitis and food poisoning. Found in water, vegetables and cheese contaminated by birds and rodents.

Danish Clean Water A/S (DCW) is located on the Danfoss Industrial Park in Southern Denmark. It was founded to exploit the technology of on-site production of environmentally safe disinfection systems for bacterial control.

DCW was founded by Bent Kristensen of Nordic Venture Capital A/S a company specializing in developing and enabling new technologies and Peter Mads Clausen of Danfoss A/S the world reknowned manufacturer of valves, controls and fluid handling systems.

It has been recognised that with the centralization of food and drink production throughout much of the world outbreaks of food poisoning from bacteria such as E.coli, Campylobacter, Salmonella and Listeria can have serious consequences.

In addition to this the worlds supply of safe drinking water is coming under increasing pressure from a growing population coupled with the demands of industrial growth in many second and third world countries.

" Our mission is to provide cost effective, safe, environmentally responsible solutions to bacterial control in the food and water industries"

To this end DCW has designed and produced a range of machinery that helps to ensure safe food and water in a wide range of applications.

DCW is ***"A Company Trusted by Danfoss"*** and as such has access to the full range of Danfoss facilities at its Headquarters in Southern Denmark. These include a state of the art fully accredited laboratory plus a manufacturing facility world renowned for its quality of engineering. All DCW machines are manufactured by Danfoss Industry Services to the highest standards of engineering excellence.

In the Danish tradition of environmental responsibility all DCW machines are designed to minimize any negative environmental impact whilst ensuring that its technology contributes to a healthier and safer world.

All Press and Investor Relations enquiries should be addressed to **info@danishcleanwater.dk**.

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Danish Clean Water

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