

# Roxia Plasma Oxidizer™

Powerful Water Purification

## BENEFITS

- ✔ Effective Water Purification
- ✔ Safer, Chemical-Free Disinfection
- ✔ Savings in Time & Money
- ✔ Enable Water Reuse

# Plasma Oxidation Basics

Roxia Plasma Oxidizer™ is awesome plasma technology for industrial water purification. Plasma-generated oxidants effectively remove colour, odour and organic residues while disinfecting the water. Roxia Plasma Oxidizer is the superb alternative to ozone, UV and chemical treatment.

## Roxia Plasma Oxidizer Replaces Chemicals with Plasma

Roxia Plasma Oxidizer is unique industrial water treatment technology as it uses non-thermal plasma in direct contact with water to destroy dissolved organic pollutants. It eliminates the need for transportation, storage and handling of risky disinfection chemicals, thereby mitigating costs and environmental risks. Roxia Plasma Oxidizer is safer and environmentally friendlier solution.

## Plasma Oxidation Explained

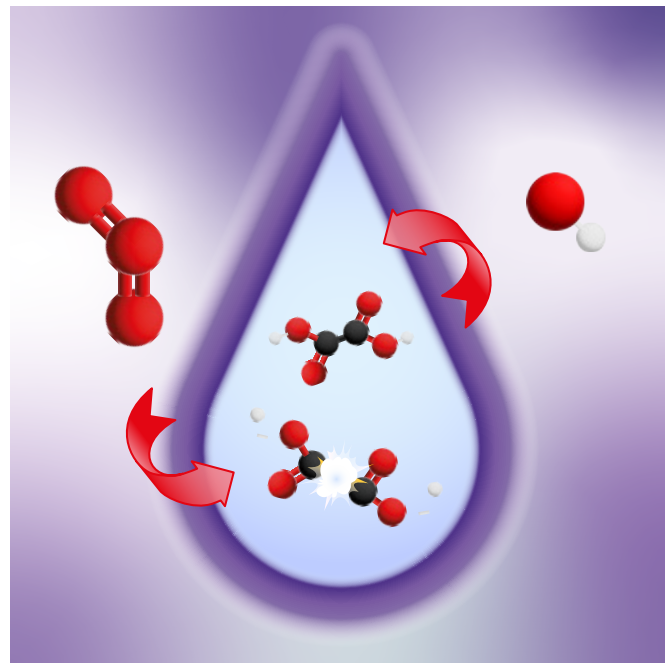
Non-thermal plasma oxidation is based on direct water contact with partially ionized atmospheric gas, i.e. plasma. The core principle is to accurately focus electric energy into gaseous electrons that initiate desirable reactions for the process. The presence of water and air under these conditions result in formation of highly reactive oxidants, hydroxyl radicals and ozone.

The radical oxidants are generated from the treated water itself by plasma electron bombardment, and ozone forms from ambient oxygen. The RPO reactor is a vertical wire-plate configuration where the water is introduced to a large plasma volume in form of droplets. This maximizes the plasma-water contact and provides ample source for radical oxidants and a large mass transfer interface for ozone.

The initial motivation to develop water treatment technology based on direct plasma contact basically stemmed from two things:

1. Creating fast-reacting oxidants *in situ* (right where the water is)
2. Providing more powerful oxidation than achievable with ozone alone

*“ Roxia Plasma Oxidizer: the paradigm shift in oxidative water treatment ”*



Contaminants in the water are subjected to strong oxidation in plasma contact.

Conventional systems:	Your value from Roxia Plasma Oxidizer:
Ozone systems	<ul style="list-style-type: none"> <li>× Recirculation of excess ozone</li> <li>× No compressors are needed</li> <li>× No air pretreatment</li> <li>× Lower energy consumption</li> <li>× More powerful oxidation for the money</li> </ul>
UV systems	<ul style="list-style-type: none"> <li>× Robust design ► low maintenance</li> <li>× Insensitive towards turbidity</li> <li>× No UV lamps</li> </ul>
Chemical treatment	<ul style="list-style-type: none"> <li>× No chemical logistics, storage and use</li> <li>× No chlorinated byproducts</li> <li>× Only electricity is used</li> <li>× Reduced safety protocols</li> </ul>

# Tested & Proven Process Water Microbial Control



### Challenge:

- × Biofilm forming, foul smell
- × Inability to reuse water
- × High freshwater consumption, high costs

### Solution:

Roxia Plasma Oxidizer, 2-kW unit

### Results:

- × Plasma oxidation eliminates microbes, results in fresh and clear waters
- × Able to reuse water, sustainability
- × Saves the customer hundreds of m<sup>3</sup> water each day

A dairy products plant circulates a lot of process waters for cooling and washing purposes. The waters are collected from various sources and processes to a collection tank and periodically pumped forward to application according to need.

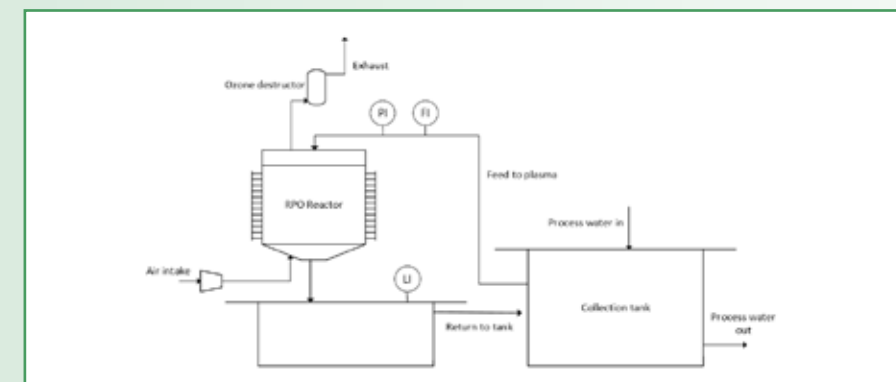
### Issue: Inability to Reuse Water

The site had problems with the quality of these waters due to microbiological activity. Bacterial growth created biofilms and foul smell, disabling reuse of the water. This resulted in need to draw freshwater from the municipal network beyond permitted daily rates, followed by substantial costs.

### Oxidation Treatment Saves Freshwater and Lowers Costs

Roxia Plasma Oxidizer (RPO) offers a convenient solution for improving the water quality and maintaining it at reusable level. The RPO system was installed adjacent to the collection tank to circulate the tank water continuously through the plasma. Very swiftly, the water quality improved and is maintained at an acceptable level, clear and fresh. Being able to reuse the process waters saves the customer hundreds of m<sup>3</sup> water each day.

DAIRY PLANT PROCESS WATERS	
Plasma output power	2 kW
Circulation through plasma	30 m <sup>3</sup> /h (0,067 kWh/m <sup>3</sup> )
Total process flowrate	40 m <sup>3</sup> /h (0,05 kWh/m <sup>3</sup> )
Water temperature	30 °C
Unit special features	<ul style="list-style-type: none"> <li>× 20' shipping container</li> <li>× outdoor installation</li> <li>× high level automation</li> </ul>
Problem	<ul style="list-style-type: none"> <li>× microbial growth</li> <li>× smelly waters</li> <li>× poor visual quality</li> </ul>
Result	<ul style="list-style-type: none"> <li>× microbial control</li> <li>× fresh and clear waters</li> <li>× used up to 100-200 m<sup>3</sup>/day less water</li> </ul>





## Say Goodbye to Ethoxylated Phenols



### Challenge:

- × Tightening EU regulations
- × Water containing ethoxylated phenols is difficult to treat
- × High costs – not possible to discharge water into municipal network

### Solution:

Roxia Plasma Oxidizer, 2-kW unit, the only non-incinerating approach

### Results:

- × Effective batch oxidation treatment removes phenols
- × Waters can be discharged to sewer
- × Lower handling costs

A manufacturing and services company in chemical analysis produces difficult wastewaters containing ethoxylated phenols. Tightening regulation in the EU has set limitations to discharging wastewaters containing ethoxylates into the municipal network.

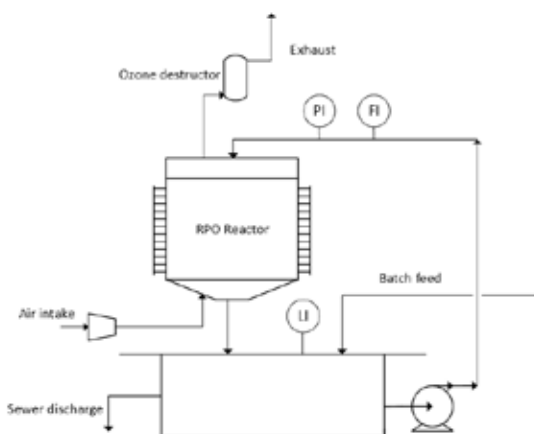
### Issue: Costly Water Disposal

There are multiple point sources on site where they collect problematic wastewaters containing ethoxylates. Not being able to discharge to sewer, the company had to transport all these waters to hazardous waste treatment with high fees and logistic costs

### Cleaner Water Meets Limits for Sewer Discharge

Roxia Plasma Oxidizer enables onsite treatment of the wastewaters to allow sewer discharge. These surface active, refractory substances are not the easiest ones to be removed or oxidized, which means intense treatment is required. Roxia Plasma Oxidizer is used for batch treatment of the wastewaters onsite.

CHEMICAL WASTEWATERS	
Plasma output power	2 kW
Batch volumes	0,2...1,5 m <sup>3</sup>
Total volumes	4-10 m <sup>3</sup> /week
Water temperature	Ambient
Unit special features	<ul style="list-style-type: none"> <li>× 20' shipping container</li> <li>× outdoor installation</li> <li>× batch mode</li> </ul>
Challenge	<ul style="list-style-type: none"> <li>× EU regulation requires best available treatment for ethoxylated phenols</li> </ul>
Winning solution	<ul style="list-style-type: none"> <li>× Plasma oxidation is the only, successfully demonstrated non-incinerating approach</li> </ul>



## Eliminate Biocides from Greenhouse Waters



### Challenge:

Persistent organic pollutants are difficult to remove from greenhouse waters

### Solution:

Roxia Plasma Oxidizer, 2-kW unit

### Results:

- × Chemical-free treatment with non-thermal plasma
- × Plasma oxidation studied for degradation of more than 70 organic contaminants

Pesticides, fungicides, insecticides and other biocides are biologically active. Although they are important chemicals for securing food production, they can cause many problems when released and accumulated in the environment. One of their environmental effects is or example fatal toxicity for bees and other important pollinators. These persistent organic pollutants (POPs) eventually also end up in freshwater supplies and drinking water.

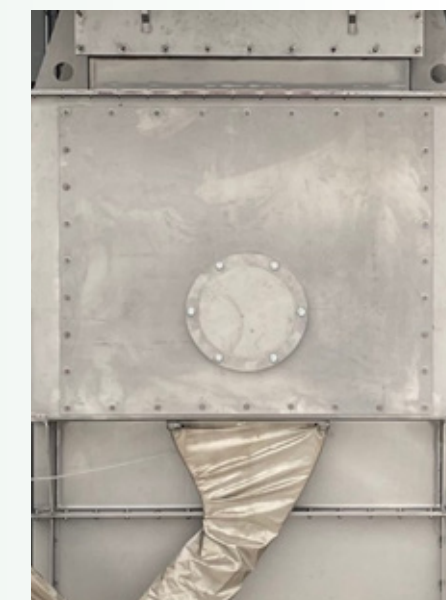
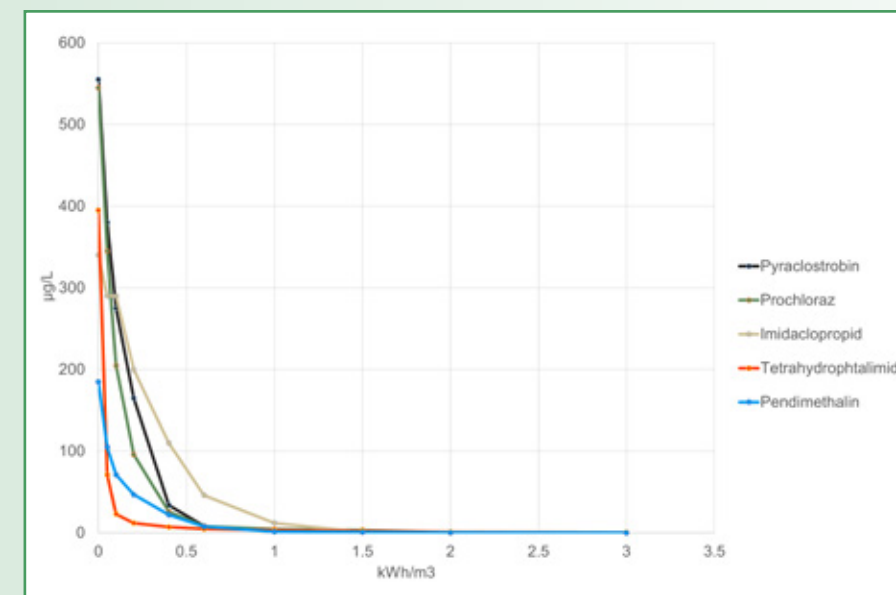
### Effective Plasma Oxidation Technology

Many technological approaches have been applied to address the challenge. Advanced oxidation processes (AOPs) have been identified as one particularly effective due to reliance on hydroxyl radicals – the most powerful oxidant

feasible for water treatment. Non-thermal plasma in direct contact with water produces abundant radical oxidants for efficient destruction of POPs.

### Plasma Eliminates 70+ Organic Pollutants

Roxia Plasma Oxidizer has been tested and trialed for successful destruction of dozens of POPs, biocides as one important group. We have tested more than 70 chemical compounds for their degradability in the process, including pharmaceuticals, phenolics, surfactants and fuel additives.



# Get Effective Microbial Control for Ice Water



### Challenge:

- × Ice water disinfection
- × Maintaining constant high quality of water

### Solution:

Roxia Plasma Oxidizer, 3 kW unit

### Results:

- × Plasma disinfects water with a lasting effect
- × Very cold water ideal for maximum efficiency
- × Replacing chemicals with plasma reduces work and improves safety

In the dairy industry, ice water is used for cooling milk before processing. The water is usually chilled to a temperature of 0-1 °C. The quality of the water must be high with no observable contaminants or smells, and no microbial growth. Periodic changes in ice water quality and occasional blooms in microbial growth can be a major challenge for a dairy products plant.

### Low Energy Input, Maximum Results

Plasma oxidation relies on reactive oxygen species. In colder temperatures the rates of non-desirable oxidant decay reactions are slower. Consequently, the plasma technology is even more efficient in those conditions. This means that ice water quality control is an ideal application for plasma oxidation – very low specific energy input can achieve and maintain the desired quality.

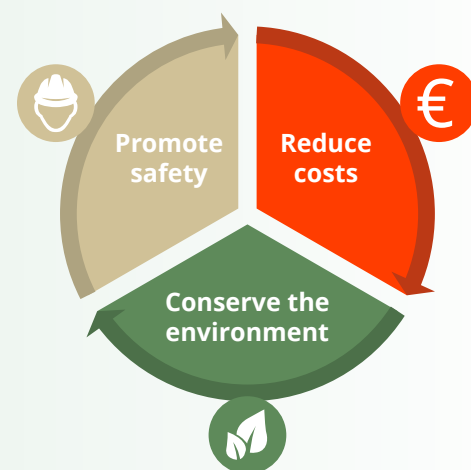
### Water Disinfection with a Lasting Effect

Roxia Plasma Oxidizer can be used to keep waters deserted of microbial activity and rid of attributable quality problems. A low-power system can be enough to generate enough oxidants even for large volumes of water, literally out of thin air and the treated water itself, with no need for chemical input.

DAIRY PLANT ICE WATERS	
Plasma output power	3 kW per module
Maximum throughput capacity	up to 65 m <sup>3</sup> /h per module
Water temperature	0...1 °C
Disinfection target	3-7 log (typical)

### Non-thermal plasma benefits:

- × Robust technology, no moving parts
- × No mercury (or any) lamps to replace
- × Insensitivity towards turbidity
- × OH-radicals as primary oxidant
- × Ozone as secondary oxidant
- × No compressors or oxygen vessels required
- × Low temperature = maximized efficiency
- × No chemical storage and use

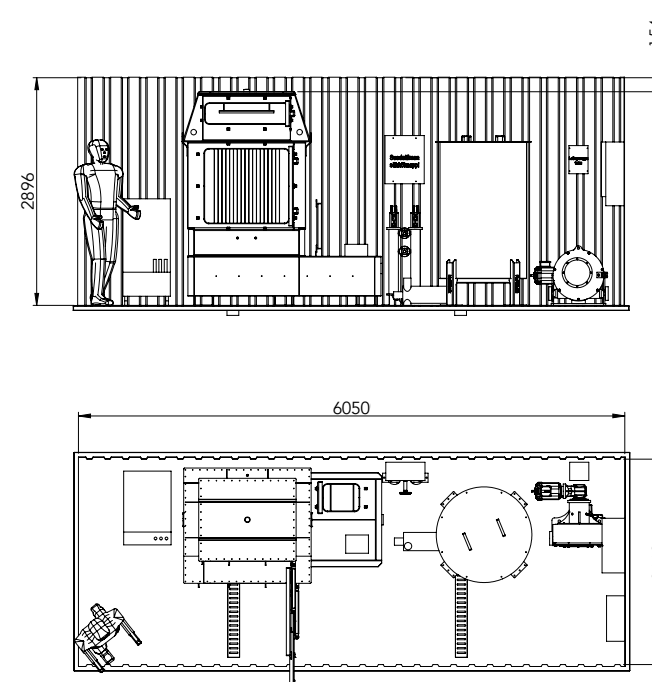


# Roxia Plasma Oxidizer™, Full-Scale Demonstration Unit 2 kW

## Roxia Plasma Oxidizer Test Unit is a full-scale 2 kW unit for on-site pilot testing.

It can be used for both batch testing and continuous flow-through operation. The unit is built in a standard 20' HC OS shipping container for fast and easy installation. The container is equipped with insulation, heating and air conditioning for year-round piloting. The setup is equipped with a HMI interface for on-site operation as well as full remote monitoring and control possibilities.

### External dimensions (mm)



Configuration may vary according to specific requirements.

### Technical Data

Container	20' HC OS (High-cube open-side)
Net weight	Approx. 6000 kg
Gross weight	Approx. 7000 kg
Water tank volume l	630 l
Volumetric capacity	1–30 m <sup>3</sup> /h
Input power	~3,5 kW
Nominal plasma power	2,0 kW
Voltage / frequency	400 V / 50 Hz 3 phase 32 A, Power plug
Water continuous inlet	DN65
Water outlet	DN100
Water overflow	DN100
Water batch inlet	3/4"
Water tank drain	3/4"
Min. & max. ambient temp.	-30 °C to 35 °C
Min. & max. water temp.	1 °C to 35 °C
Inputs	24 V DC for remote operation
Outputs	24 V DC, 230 VAC relays indicating system operation & alarms
Materials in contact with water	AISI 316, PEEK, silicone, HDPE
Measurements	Water tank level
	Flow
	Reactor inlet pressure
(Accessories) * depending on case requirements	Container flooding
	Oxygen concentrator
	Air pump
	Duplex basket strainer

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## About us

Roxia delivers high-tech dewatering, industrial automation and environmental technologies. Specializing in mining, minerals, metallurgy, chemical, food and pharmaceutical industries, our team generates best performing solutions for each specific need.

We offer our support from Australia, Chile, China, Finland, Germany, Peru, Russia, South Africa, Sweden and the United States.



Plasma Oxidizer - Roxia (EN) / 02-2022

