The HYDROXON™ process delivers game changing water treatment solutions

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About us

Infinite Water is an Australian organization with a global conscience. We have made it our mission to provide established and emerging economies with sustainable and cost-effective drinking water and wastewater management.

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Our Technology

Infinite Water has developed the HYDROXON™ for treatment of water and wastewater – one core technology for different applications

GROUNDWATER

SURFACE WATER

PROCESS WATER AND WASTEWATER

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Core Principles

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The HYDROXON™ Process – Core Principles

Over the past decade and learning from nature, Infinite Water scientists have developed the HYDROXON™ process, achieving breakthrough performance in water treatment and disinfection.

At its core, the process is a refined combination of:

a. Non-ozone based Catalytic Oxidation (CO)
b. Non-ozone based Catalytic Advanced Oxidation (CAO)

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Catalytic Oxidation

Under properly tuned conditions, Catalytic Oxidation (CO) is unparalleled on a number of fronts in water purification, particularly for the removal of heavy metals and metalloids. Traditionally, CO has been complex and energy intensive requiring high capital and operational costs.

With the HYDROXON™ process, Infinite Water has overcome these drawbacks and refined the process to further increase process capability – making it economical and extraordinarily effective.

Catalytic Reactor

Raw

Treated

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Catalytic Advanced Oxidation

Catalytic Advanced Oxidation (CAO) is a subclass of Advanced Oxidation Processes (AOPs). AOPs rely on production of highly reactive Hydroxyl radicals (·OH) which are the strongest oxidants that can be applied to water. These radicals can oxidise any compound present in the water matrix often at a diffusion controlled reaction rate.

AOPs are capable of eliminating organic compounds in the aqueous phase rather than collecting or transferring pollutants to another phase. Its effectiveness in degrading refractory (difficult to break down e.g. pesticides), toxic or non-biodegradable compounds and heavy metals earned Advanced Oxidation the title of “Water Treatment Process of the 21st Century” when it was first applied to water purification in 1987 .

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Catalytic Advanced Oxidation

Historically, CAO and other AOPs have had higher capital and operational costs than biological or physical (e.g. Ozone Oxidation) systems. The complexity of equipment, high capital costs and energy usage had limited potential applications.

Infinite Water has overcome these drawbacks through its innovative HYDROXON™ process which utilises specific filtration and CAO reactors to produce arguably the most cost effective, reliable and energy efficient water treatment systems in the world.

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Catalytic Advanced Oxidation

Catalytic Advanced Oxidation as applied by Infinite Water, is the process in which a catalytic metal is oxidised, making a transition from a low level oxidation state to a higher level oxidation state generating highly reactive species such as the Hydroxyl radical (·OH) as well as highly reactive oxide ions. In the second stage of reactions, the catalytic metal is reduced back to its initial oxidation state.

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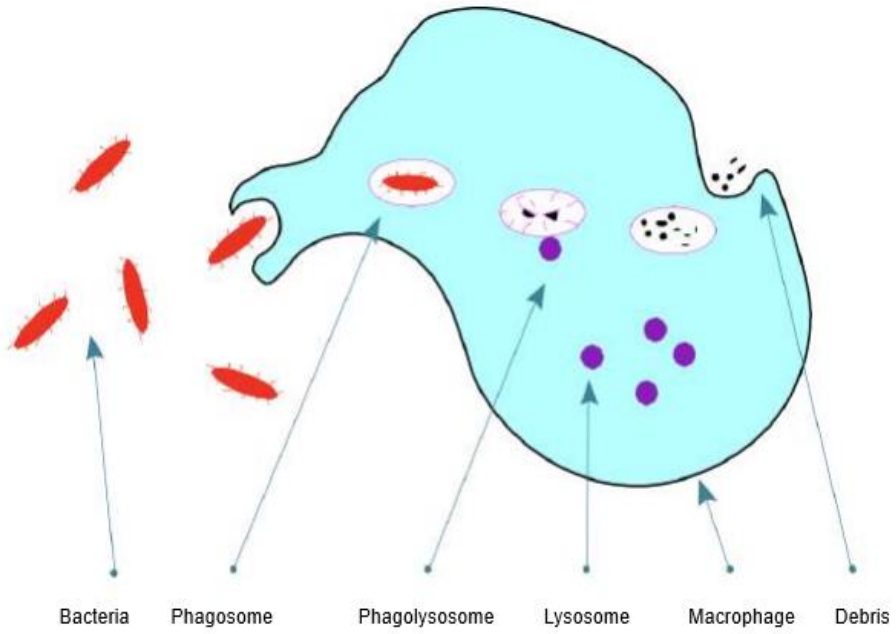
Catalytic Advanced Oxidation

The idea of using CAO came from the defence process of the human body against microbes. This is based on iron chemistry – Fenton like reactions at slightly alkaline pH in which highly reactive radicals are produced. This is comparable to the oxidation capability of ozone.

When the body's special defence cells (macrophage) detect bacteria, the bacteria is encapsulated. A destructive oxidation package that contains iron is then delivered into that capsule to virtually incinerate the intruder. The debris is then eliminated from the macrophage.



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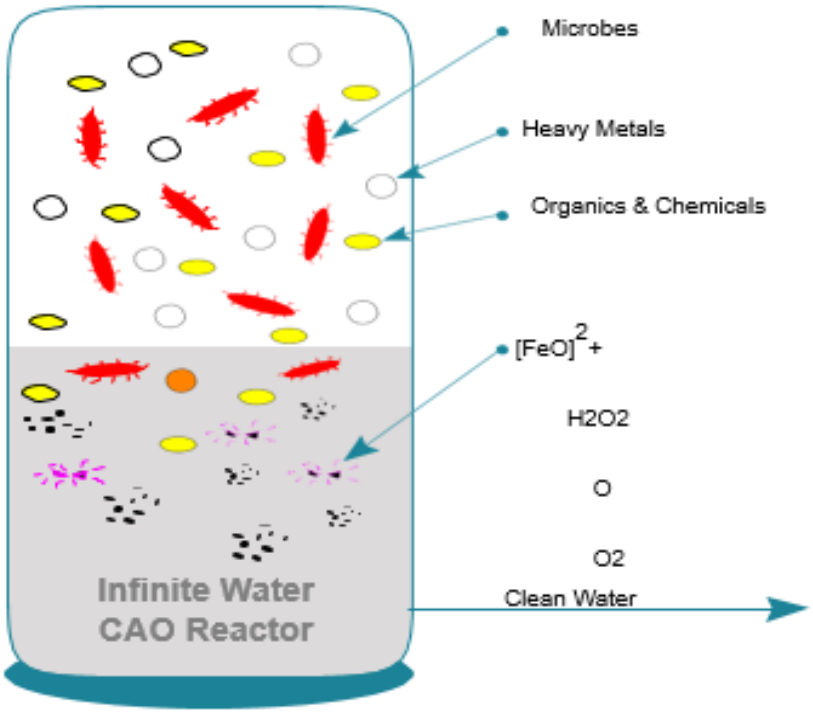
Catalytic Advanced Oxidation

In a similar manner, powerful oxidising radicals are produced in the catalytic reactor vessel. Precipitate and debris are retained in the catalytic bed and removed through back-washing similar to backwashing of a sand filter.

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Treatment Stages

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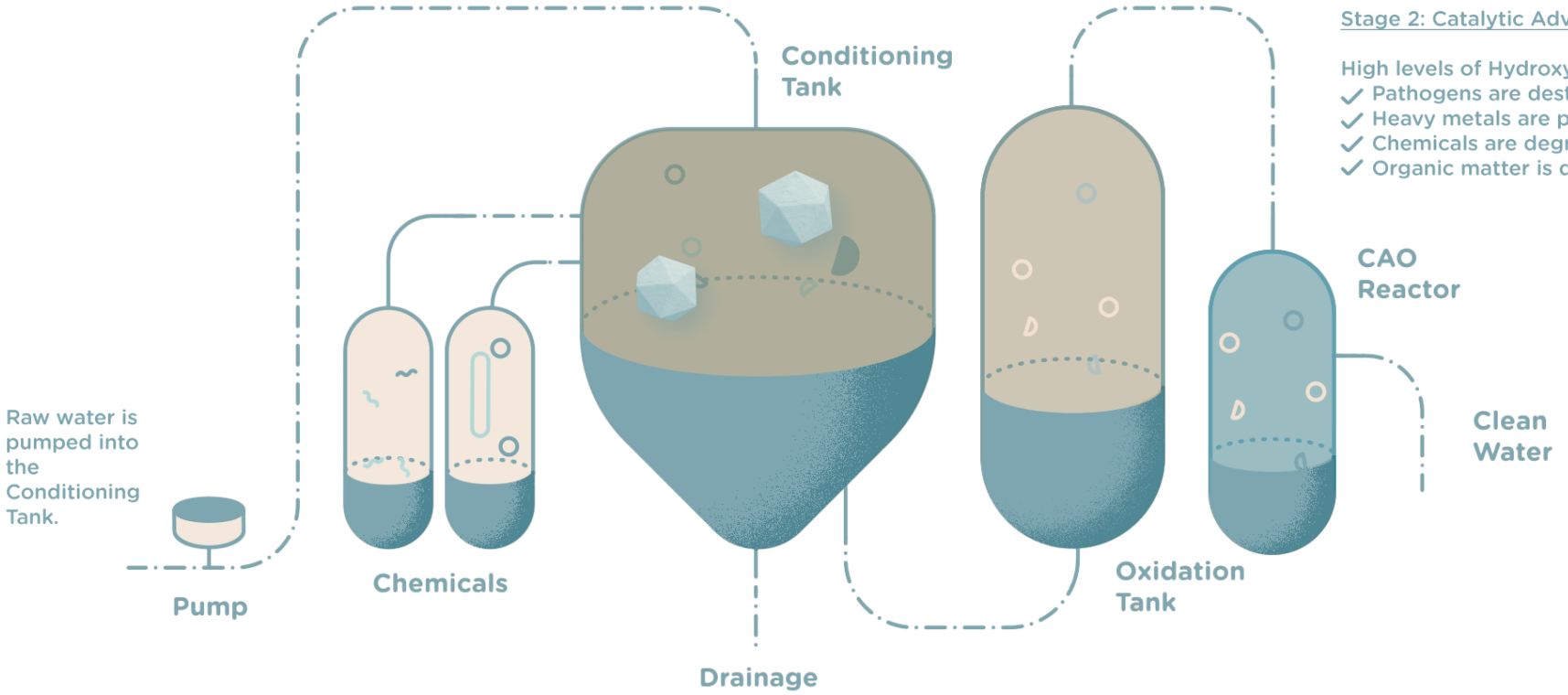
HYDROXON™ Process: How It Works

Stage 1: Conditioning

Raw water is dosed with proprietary chemicals to:
- ✓ Correct the pH
- ✓ Remove large suspended solids
- ✓ Prepare water for optimal conditions in CAO via oxidation



Stage 2: Catalytic Advanced Oxidation

High levels of Hydroxyl radicals are created.
- ✓ Pathogens are destroyed
- ✓ Heavy metals are precipitated
- ✓ Chemicals are degraded
- ✓ Organic matter is degraded

Large suspended solids settle and are disposed.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Disinfection &
Contaminant Removal

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Key Contaminants Treated

- Pathogens (disinfection)
- Bad taste and odour
- Suspended solids (up to 500mg/L without pre-treatment)
- Heavy metals & metalloids
- Dissolved organic content
- Dissolved toxic chemicals
- Dissolved petroleum hydrocarbons
- Algae and associated toxins
- Organic / Inorganic Combinations
- Nutrients (N&P)

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Disinfection

The ability of a treatment technology to reduce or deactivate pathogens in recycled water is calculated using Log Reduction Values (LRV) through following equation:

$$\text{LRV} = log_{10}\left(\frac{untreated\ concentration\ of\ the\ target\ pathogens}{treated\ concentration\ of\ the\ target\ pathogens}\right)$$

In which 1 LRV equals 90% removal of a target pathogen, 2 LRV means 99% removal, 3 LRV is 99.9% removal and so on. Three recommended LRV levels by World Health Organization (WHO) are illustrated in table. The Australian Drinking Water Guidelines (ADWG) requires comply with highly protective tier.

Target	Log_{10} reduction required: **Bacteria**	Log_{10} reduction required: **Viruses**	Log_{10} reduction required: **Protozoa**
Highly protective	≥ **4**	≥ **5**	≥ **4**
Protective	≥ **2**	≥ **3**	≥ **2**
*Interim**	Achieves "protective" target for two classes of pathogens and results in health gains		

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Disinfection

A validation test was performed jointly by The University of NSW – Global Water Institute (UNSW-GWI) and South Australia Water (SA Water) to study the disinfection capabilities of the HYDROXON™ process on ground water.

The study proved that the HYDROXON™ process exceeds the “Highly Protective” level of disinfection through Catalytic Advanced Oxidation alone without requiring any chemical disinfectants (e.g. chlorine), the injection of ozone (to increase the oxidative species) or UV light.

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Disinfection

It is good practice to introduce redundancy by maintaining multiple barriers for pathogen removal. In line with this practice, 1mg/L of ClO_2 was introduced into the process as a second line of defence (with a dual function to keep the catalytic reactors free from bacterial slime). With the addition of ClO_2, the required LRVs were met and exceeded.

Results of a challenge test performed by spiking the water with known concentrations of stock solutions of microorganisms have been summarised in the table below:

Pathogen	LRV for HYDROXON™ ™	LRV for HYDROXON™ +ClO_2	Highly protective LRV requirement
Bacteria (E. Coli)	>4	>4	4
Viruses (MS2)	>6	>7	5
Protozoa (Cryptosporidium)	>4	>4	4

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A Note on Disinfection By-Products (DBPs)

When chlorine is used to disinfect water, it reacts with organic matter in the water to form disinfection By-products. Two major classes make up the bulk: Trihalomethanes (THMs) and Haloacetic acids (HAA) which at high concentrations have been known to cause cancers and other health problems.

- ✓ The HYDROXON™ process disinfects water without using Chlorine and therefore, no THMs and HAAs are introduced by the process.
- ✓ The HYDROXON™ process completely degrades organics in its catalytic reactor vessels and therefore, no THMs and HAAs are introduced by any post chlorination.
- ✓ Further, any carcinogenic by-products already present in the feedwater as a result of upstream pre-chlorination, will be reduced by over 50% as it passes through Catalytic reactors.

Note:
When ClO_2 is used as a secondary disinfection barrier, it will add small concentrations of Chlorites (not exceeding 0.6mg/L) and Chlorates to the treated water. As per the ADWG the acceptable level of Chlorites in drinking water is 0.8 mg/L while Chlorate is un-regulated.

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A Note on Disinfection By-Products (DBPs)

	Unit	Raw	Settled	Treated	Reduction
Turbidity	NTU	5.1	1	0.2	96%
Manganese	mg/L	0.21	0.18	0.01	95%
Total Iron	mg/L	1.14	0.25	0.02	98%
DOC	mg/L	31	7	1	98%
Total THMs*	ug/L	-	128	31	76%

*Note: Total THMs were measured after allowing 24 hours of contact time with 10mg/L total Chlorine

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Key Features & Benefits

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System Design

- The HYDROXON™ system features a simple design that can serve a broad range of applications with minor modifications, requiring minimal assembly.
- Occupies a significantly smaller footprint than conventional solutions
- Modular, scalable design with small number of sub-assemblies
- Can be skid-mounted or containerized
- Process efficiency up to 95%
- Plants are equipped with remote link to Infinite Water's Robust Connected Operations System (RCOS) for remote monitoring and data analysis, as well as management of service and maintenance operations.

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Safety Barrier Against Unknown Contaminants

The HYDROXON™ process does not rely on a sequential treatment train to degrade and remove targeted contaminants.

The highly oxidative environment created inside the Catalytic Advanced Oxidation reactor simultaneously oxidises contaminants removing them from the water matrix.

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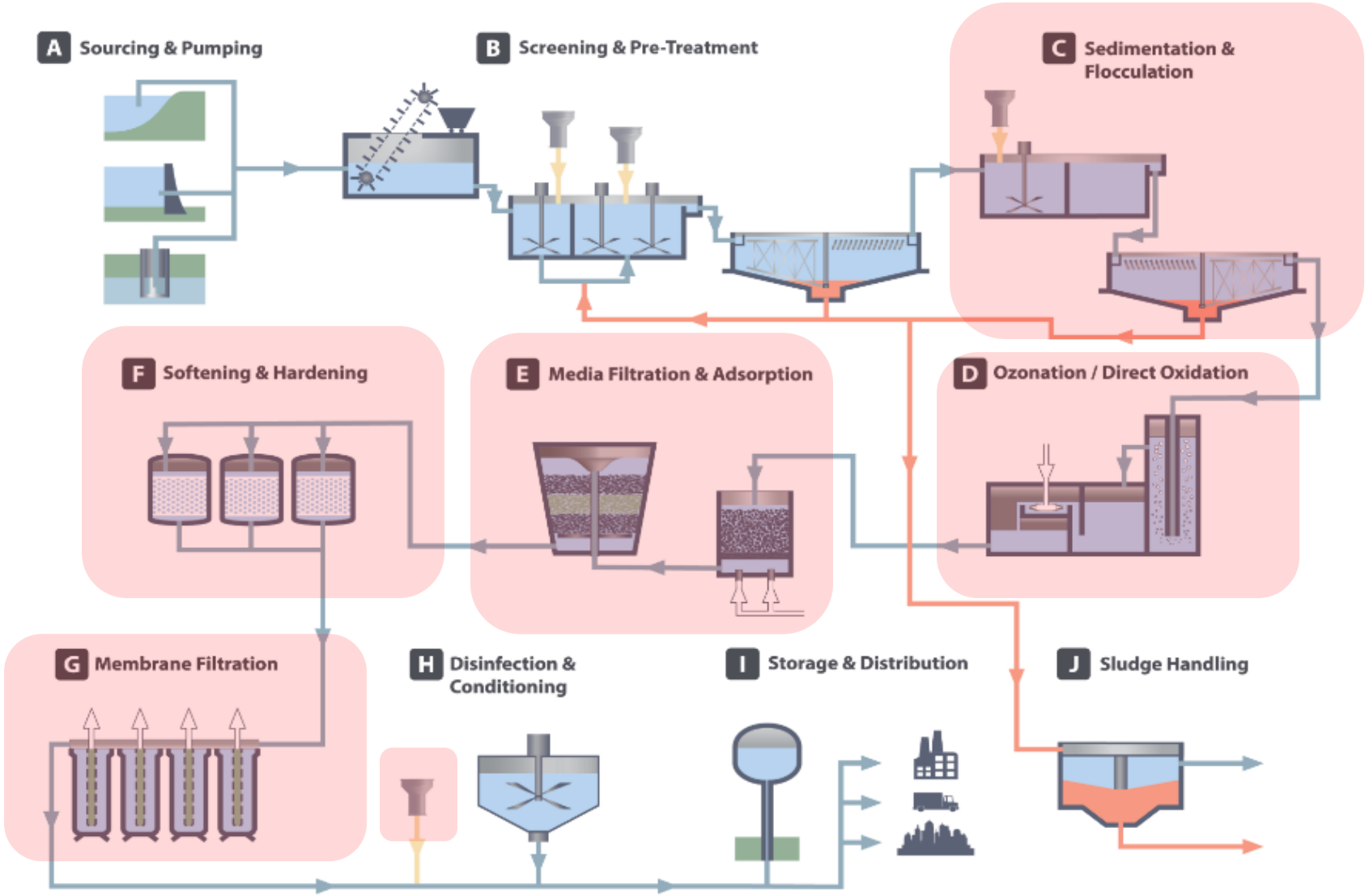
The Treatment Train

Conventional Drinking Water Treatment Train



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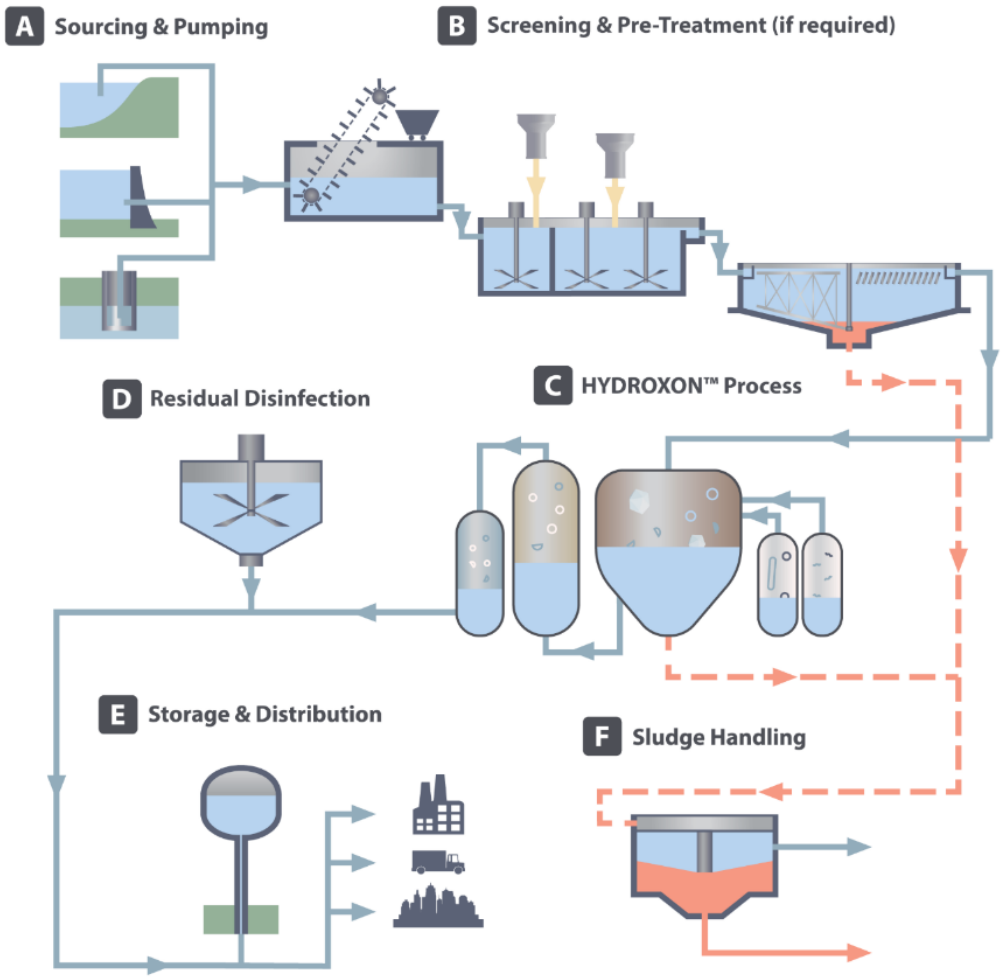
The Treatment Train

Drinking Water Treatment Train with HYDROXON™



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Energy Efficiency

The HYDOXON™ process has an average energy consumption of 0.1 kWh/m^3. Which is essentially the energy required to pump water through the plant – comparable with direct filtration.

All the benefits of a direct filtration solution, in terms of low capital and ongoing costs, chemical and energy consumption are retained and improved by the HYDROXON™ process.

The table depicts typical energy consumption for a variety of plant configurations. It is important to note here that conventional plants, without the use of membranes and UV disinfection are limited in their treatment performance. They require a high quality of source water.

Type of treatment	Energy consumption (kWh/m3)
Clarification + Filtration + MF + UV	0.52
DAF + UF + UV	0.72
Clarification Filtration + Ozone / Granular Activated Carbon (GAC) + UV	0.46
Filtration + GAC + Filtration + RO (without energy recovery) + UV	3.30
HYDROXON™ Water Treatment Plant	**0.15**

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Energy Efficiency

What is the main reason for this energy efficiency ?

Infinite Water uses catalytic processes similar to those found in the human body making the process like nature, extremely efficient.

Unlike Advanced Oxidation Processes (AOPs) employed by other treatment technologies, neither does the HYDROXON™ process require an injection of ozone to increase the oxidative species nor does it use UV light for disinfection – both of which are energy intensive.

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Low Maintenance

Infinite Water systems are fully automated, and can be equipped with remote monitoring

Chemical levels are required to be topped-up, typically on a weekly basis and at this time it would be expected that a visual check and inspection of system performance and operation would be performed

IWH recommends a monthly service visit by one of our qualified technicians to ensure stable operation of the system

The Catalytic Reactor media has a lifespan of 8 – 10 years without requiring replacement or re-generation

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Sectors, Applications & Case Studies

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Typical Applications

Groundwater

Surface Water

Tertiary Treatment for Re-use

Plant Upgrades

Pre-treatment for RO & IX

Industrial Effluent Treatment

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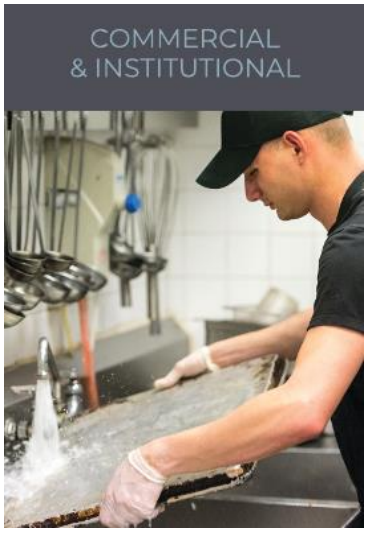
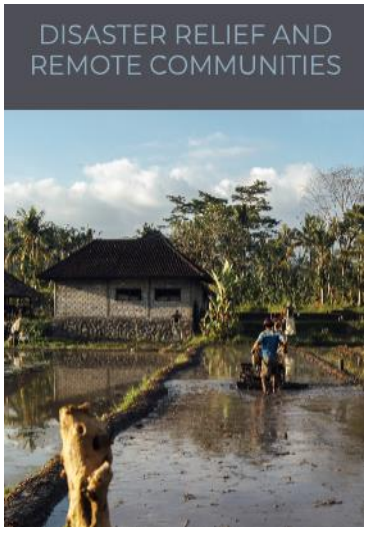
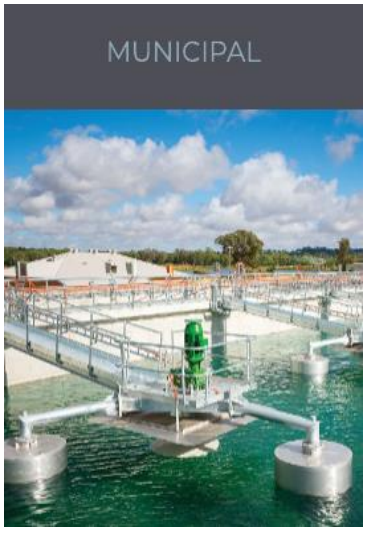
Sectors

The versatility of Infinite Water's HYDROXON™ solutions finds applications in a variety of sectors and applications either as a standalone process or in conjunction with conventional treatment processes







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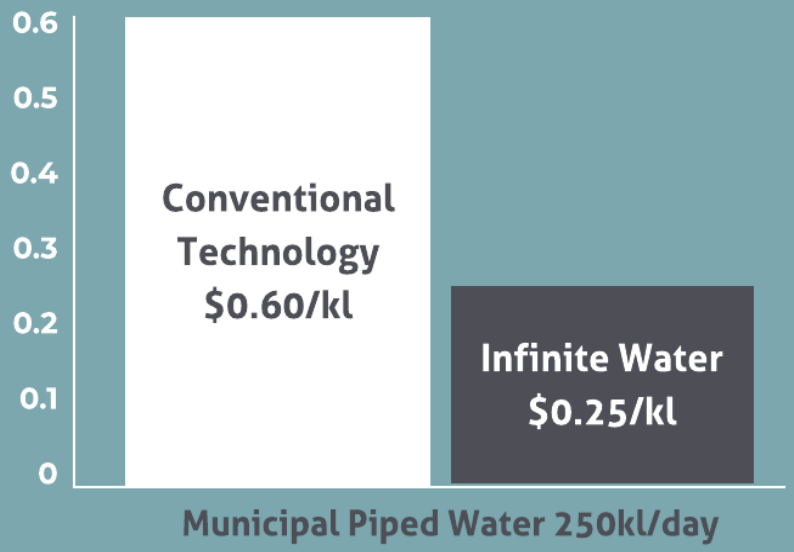
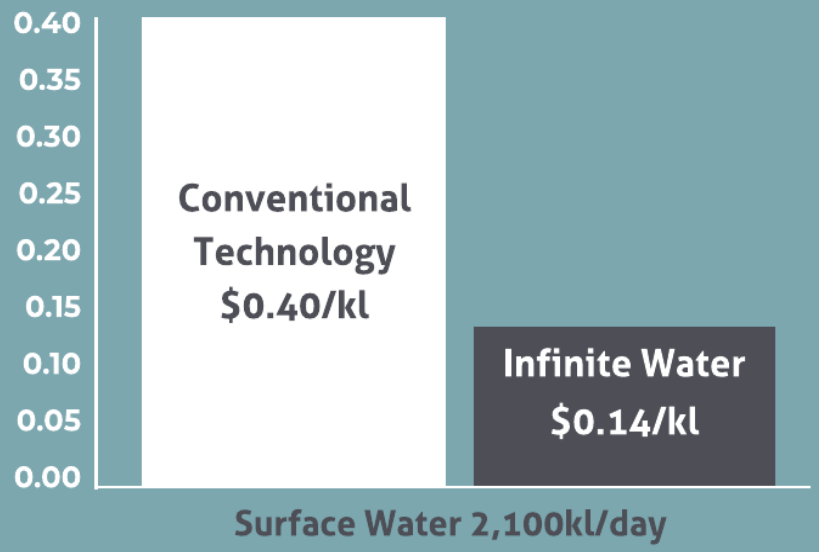
Operational Costs Comparison



Municipal Piped Water 250kl/day



Surface Water 2,100kl/day

Wastewater - Bauxite Mine 350kl/hour

Wastewater - Food Processing 291kl/hour

Costs represented in Australian dollars. Costs are based on specific projects/case studies.a

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CASE STUDY:

Industrial Wash Water, Australia

Removal of glyphosate from industrial effluent.

Situation

Glyphosate is the world's most widely used herbicide and crop desiccant. In recent years the cancer-research arm of the WHO announced that it is probable that glyphosate is carcinogenic to humans. Vacuum Distillation (Evaporation) - the most popular method for removing glyphosate has high capital and operational costs.

Implementation

Infinite Water designed a process to treat 25,000 litres/day of industrial effluent high in organics, glyphosate and other hydrocarbon-based herbicides.

Result

The HYDROXON™ process successfully reduced glyphosate levels from 500 mg/L to below 20 mg/L (>95% reduction!) as well as treated other pollutants to meet discharge regulations. The capital cost and operational cost was less than half of an evaporator system.

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CASE STUDY:

Drinking water, Bangladesh

Removal of arsenic from groundwater in a remote village.

Situation

The Meherpur district in the western region of Bangladesh has been plagued with problems stemming from the high levels of arsenic in the groundwater. Exposure to arsenic in drinking water can cause cancer, skin lesions, cardiovascular diseases and impediments in cognitive development. Data from a national survey estimates an annual death toll of nearly 43,000 from arsenic poisoning. Over the years the government has trialled multiple technologies to treat this water economically but has not been successful in finding a comprehensive solution.

Implementation

In association with the Government's Department of Public Health Engineering (DPHE), Infinite Water ran a 15,000 litre/day pilot evaluation to prove the efficacy of HYDROXON for arsenic removal.

Result

The process successfully reduced arsenic concentrations from 0.2 mg/L to less than 0.004 mg/L bringing it in full compliance with WHO standards (0.01 mg/L) for drinking water.

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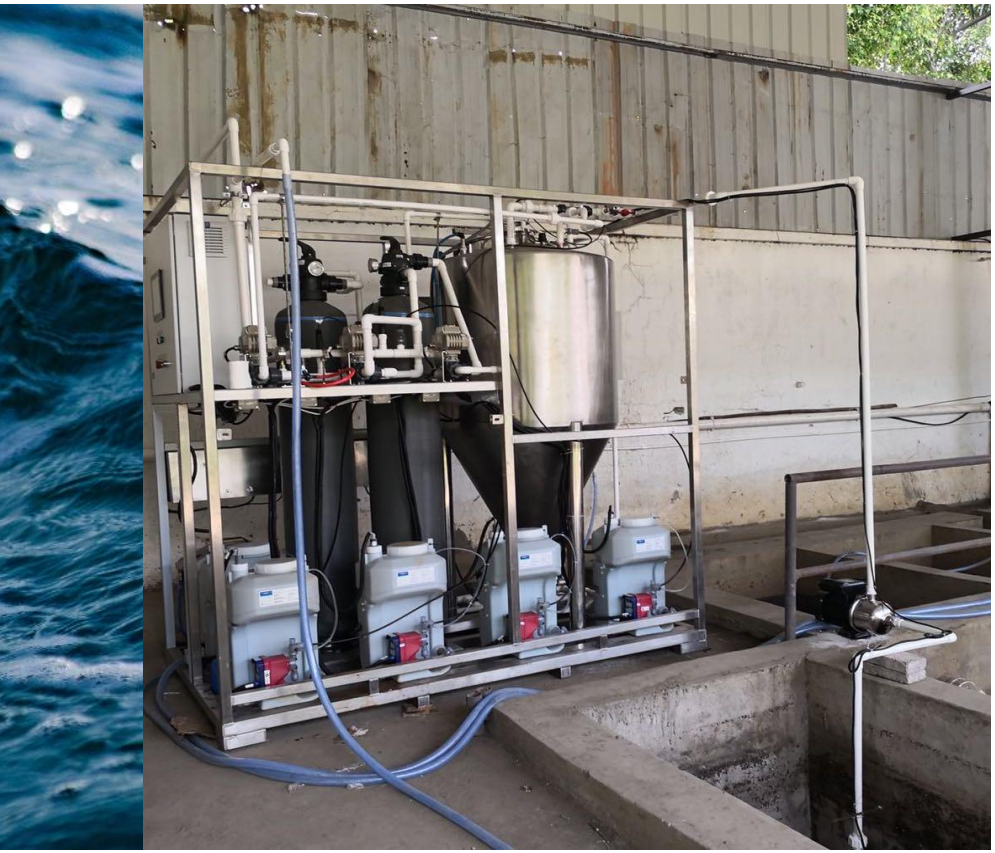
CASE STUDY:

Industrial Wastewater, China



The industrial park was required to meet new regulatory discharge limits.

Situation

The industrial park houses a variety of manufacturing and processing plants such as paint stripping, petrochemical product manufacturers and metal platers. The main challenge was the large variance in the chemical composition mix.

Testing & Implementation

Testing showed that the pH varied from 3 to 12 over the course of a day. A 10,000 litre a day pilot plant successfully removed all targeted chemicals to meet the regulatory discharge limits. In fact, the high quality of treated water went beyond meeting discharge limits and also met the more stringent re-use standards.

Result

Infinite Water supplied a 200,000 litre per day plant to safely discharge the wastewater. The treated water could also be re-used in the industrial parks variety of processes at an economical cost.

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CASE STUDY:

Drinking water and general water supply, China

Treating municipal piped water to supply commercial office building.

Situation

A new 8-story commercial building required its existing municipal source water to be treated to drinking water standards to supply clean and safe water to the employees.

Implementation

A 25,000 litre/day containerised system was designed and installed to service 500 people within the building.

Result

The municipal piped water was treated at low cost to supply water to WHO drinking water standards. Due to the low treatment cost the high quality water was also used to supply water for all other areas in the building including showers, toilets, kitchens and sinks.

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CASE STUDY:

Xstrata Copper Mine, Townsville

Treatment of industrial wastewater from mining equipment wash down for safe discharge.

Situation

Infinite Water conducted a field trial at Xstrata Copper, a multinational industrial mining firm, in Townsville, Australia to treat industrial wastewater for safe discharge. The scope of the project involved the treatment of raw water from the wash down of mining equipment.

Testing & Implementation

The raw water had a very high pH level making it difficult to remove heavy metals through conventional processes. Conventional water treatment processes raise pH to 11 or higher to precipitate and co-precipitate heavy metals. However, the pH of the raw water was already at 10.9. It also had high turbidity and contained high levels of heavy metals including lead, aluminium, copper, iron, manganese, molybdenum, nickel and zinc.

Result

Infinite Water successfully removed all heavy metals and achieved exceptional water clarification. The treated water was brought in full compliance with the Australian Drinking Water Guidelines and was safely and cost effectively disposed into the ocean.

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CASE STUDY:

Multiplex Construction

Multiplex required a water treatment plant to treat and de-water a construction site to reduce the water table to enable the building of foundations.

Situation

Multiplex, a leading global contractor in the construction and property industry, turned to Infinite Water to treat and dewater a construction site prior to building the Steve's Hotel in Nedlands, Australia. The water to be treated included a combination of ground water and accumulated rain water.

Testing & Implementation

Testing showed that the ground water was high in heavy metals, including iron (more than 50gm/L) and aluminium (more than 26 mg/L). Infinite Water designed a filtration system to treat these and other contaminants.

Result

Infinite Water supplied, installed and commissioned a filtration unit for the Multiplex development site that successfully removed all contaminants in accordance with the Australian Drinking Water Guidelines. Under supervision of the Swan River Trust, a state government agency, Infinite Water discharged the treated water into the nearby Swan River. The water treatment plant capacity was 400,000 l/day.

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CASE STUDY:

Packaging Company, New Zealand

With a global directive to reduce water footprint, our client required a treatment process to enable re-use of water on site.

Situation

Our customer, a global conglomerate for packaging and material handling, had a requirement to re-use wash water generated from scheduled maintenance activities. The water for re-use had to be suitably disinfected and safe for human contact.

Testing & Implementation

Testing showed that the wash water had a solids content of over 10%, and was high in dissolved organic matter and surfactants.

Result

Infinite Water designed a treatment process to separate the high solids content, reduce dissolved organic matter and remove pathogens making it safe for re-use. Sludge collected from the process was de-watered and the de-canted water returned to the front of the process to improve efficiency.

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Contact Us

Learn more about how we're making high quality water treatment more accessible, sustainable and cost effective for communities and organisations all over the world.

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