مصادر المستقبل | FUTURE RESOURCES

A Common Vision

Back To Nature

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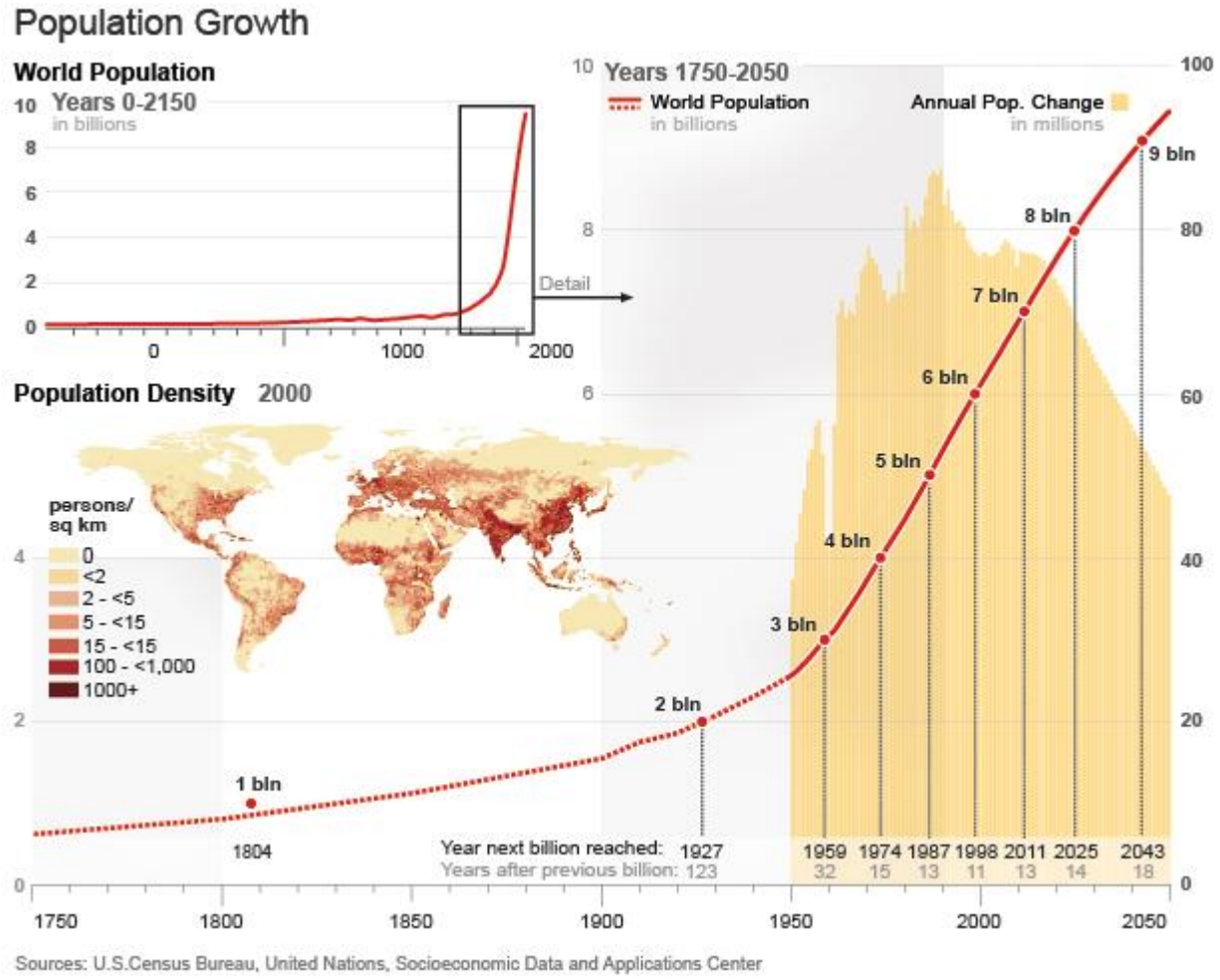
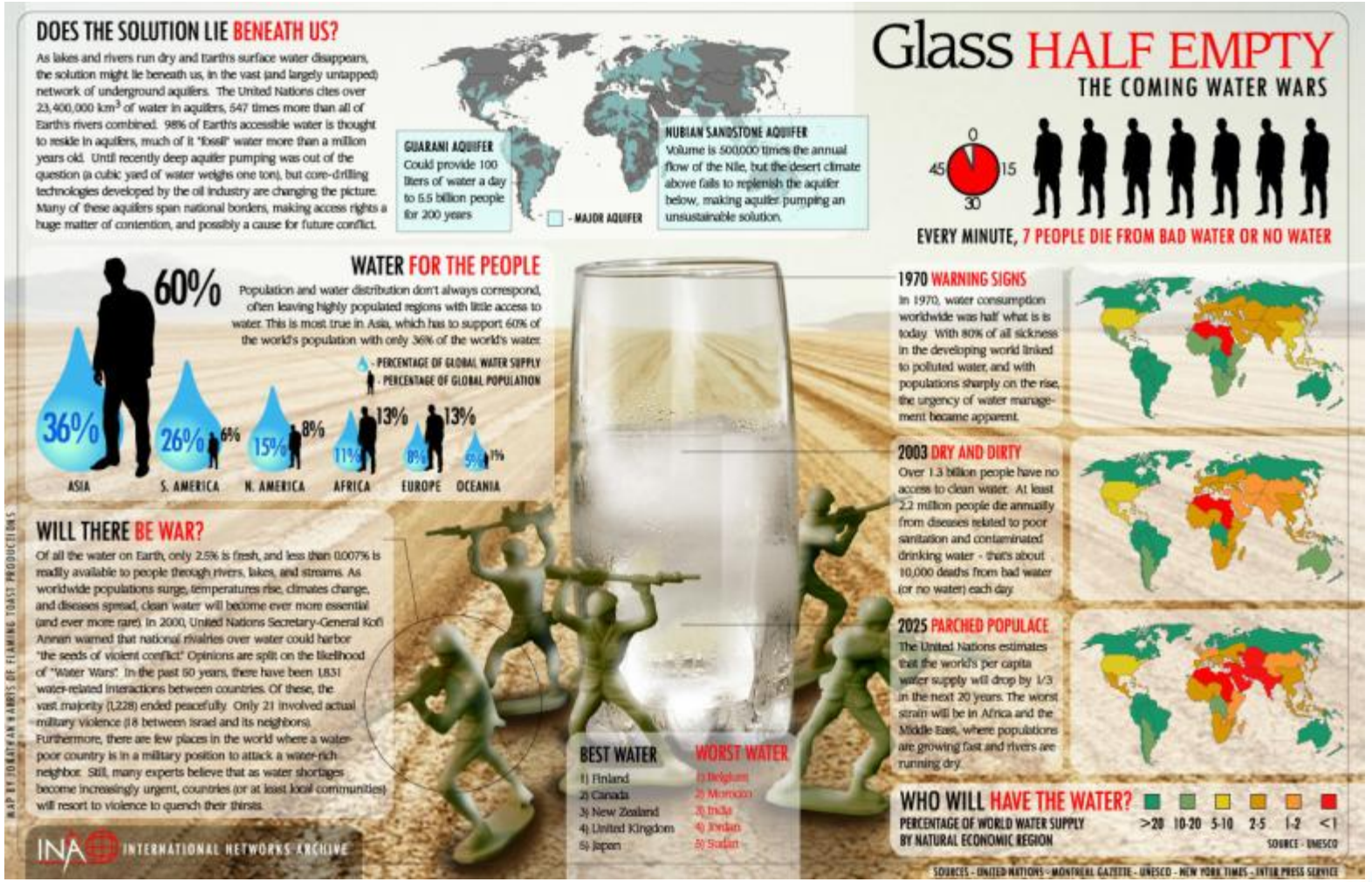
POPULATION GROWTH: A WORLD ISSUE



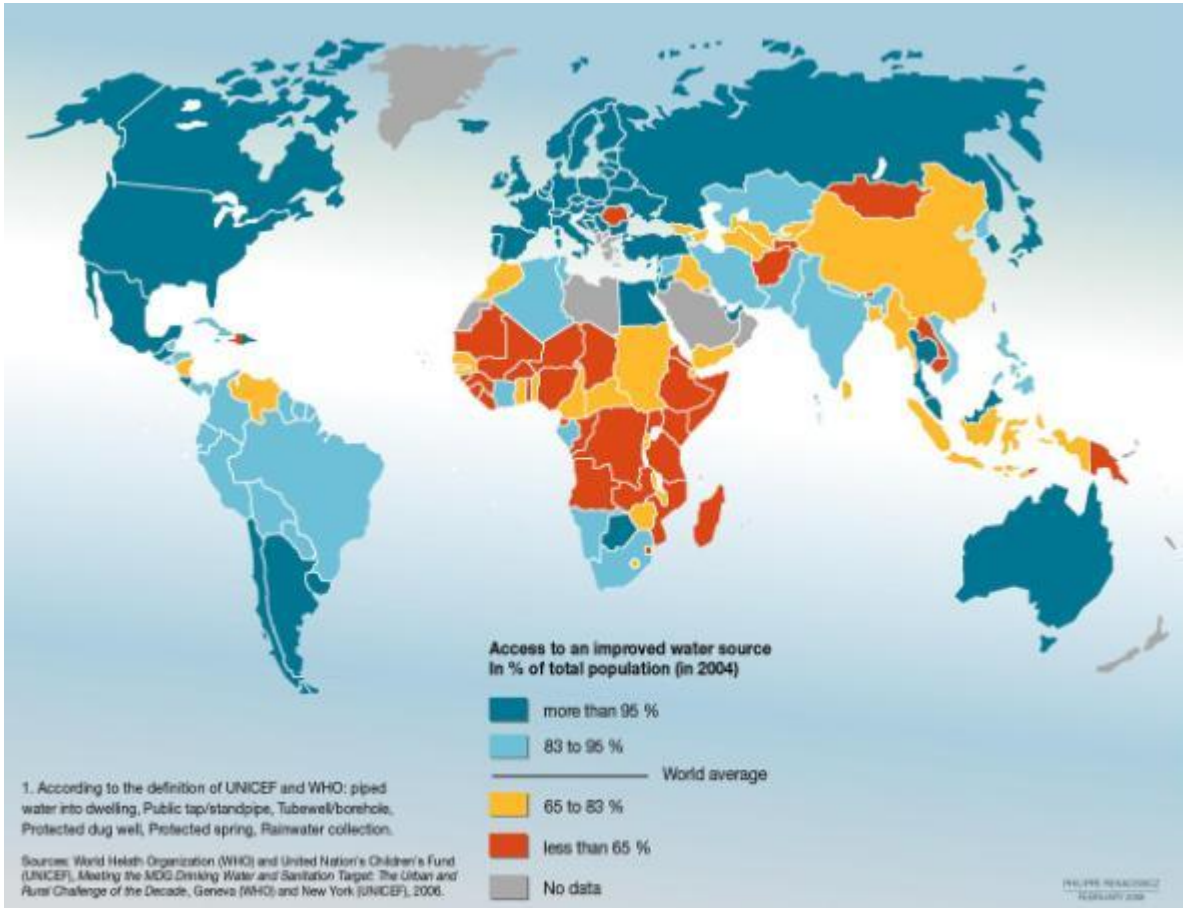
With the world's population more than doubling over the last half century, basics like water are under more strain than ever, and providing for an additional 2-3 billion people in the next 50 years is a serious worry.

WAR FOR WATER



ACCESS TO WATER SOURCE

Total population: access to an improved water source



WATER USAGE RISING

Water usage rising faster than global population

Like oil in the 20th century, water could well be the essential commodity on which the 21st century will turn.

Human beings have depended on access to water since the earliest days of civilisation but, with the global population projected to cross the 7-billion mark on Oct 31, exponentially expanding urbanisation and development are driving demand like never before.

Water use has been growing at more than twice the rate of population increase in the last century, said Ms Kirsty Jenkinson of the World Resources Institute, a Washington think-tank.

Water use is predicted to increase by 50 per cent between 2007 and 2025 in developing countries and 18 per cent in developed ones, with much of the increased use in the poorest countries with more and more people moving from rural areas to cities, said Ms Jenkinson.

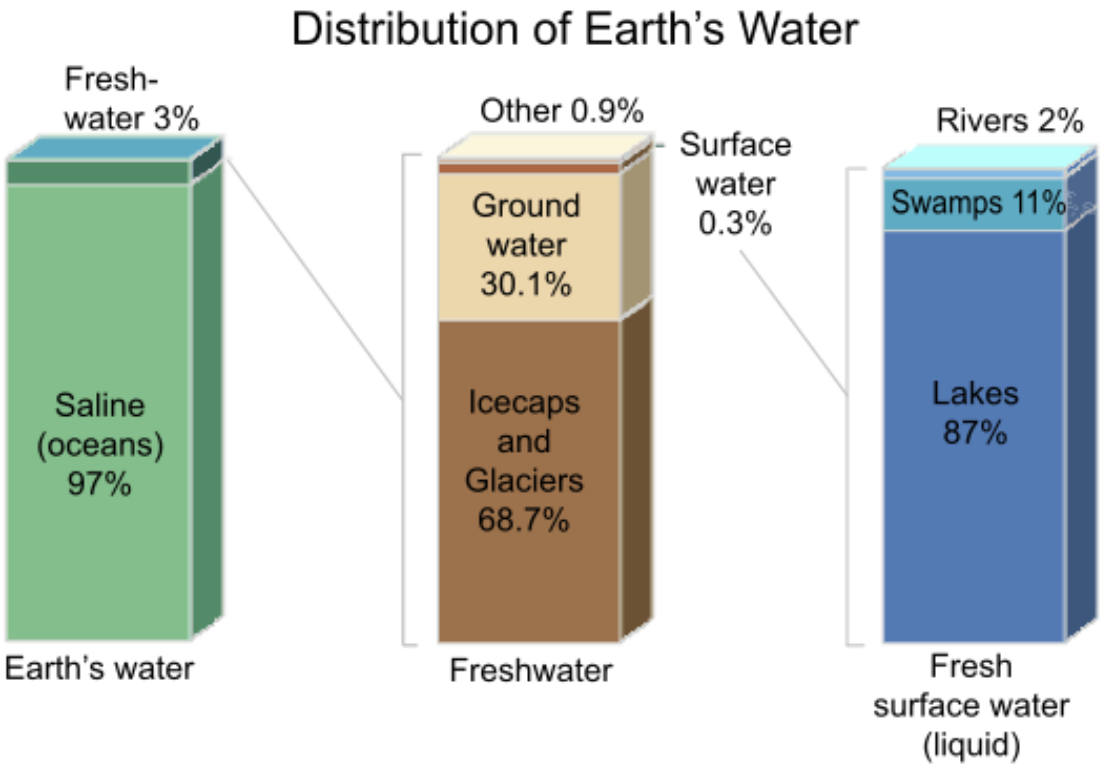
Factor in the expected impact of climate change this century - more severe floods, droughts and shifts from past precipitation patterns - that are likely to hit the poorest people first and worst "and we have a significant challenge on our hands", Ms Jenkinson said.

Will there be enough water for everyone, especially if population continues to rise, as predicted, to 9 billion by mid-century?

"There's a lot of water on Earth, so we probably won't run out," said Mr Rob Renner, executive director of the Colorado-based Water Research Foundation.

"The problem is that 97.5 per cent of it is salty and ... of the 2.5 per cent that's fresh, two-thirds of that is frozen. So there's not a lot of fresh water to deal with in the world." Reuters

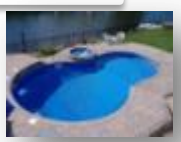
DISTRIBUTION OF EARTH'S WATER



USAGE OF FRESHWATER

It is estimated that 8% of worldwide water use is for domestic purposes. These include drinking water, bathing, cooking, sanitation, and gardening. Basic household water requirements have been estimated at around 50 liters per person per day, excluding water for gardens.

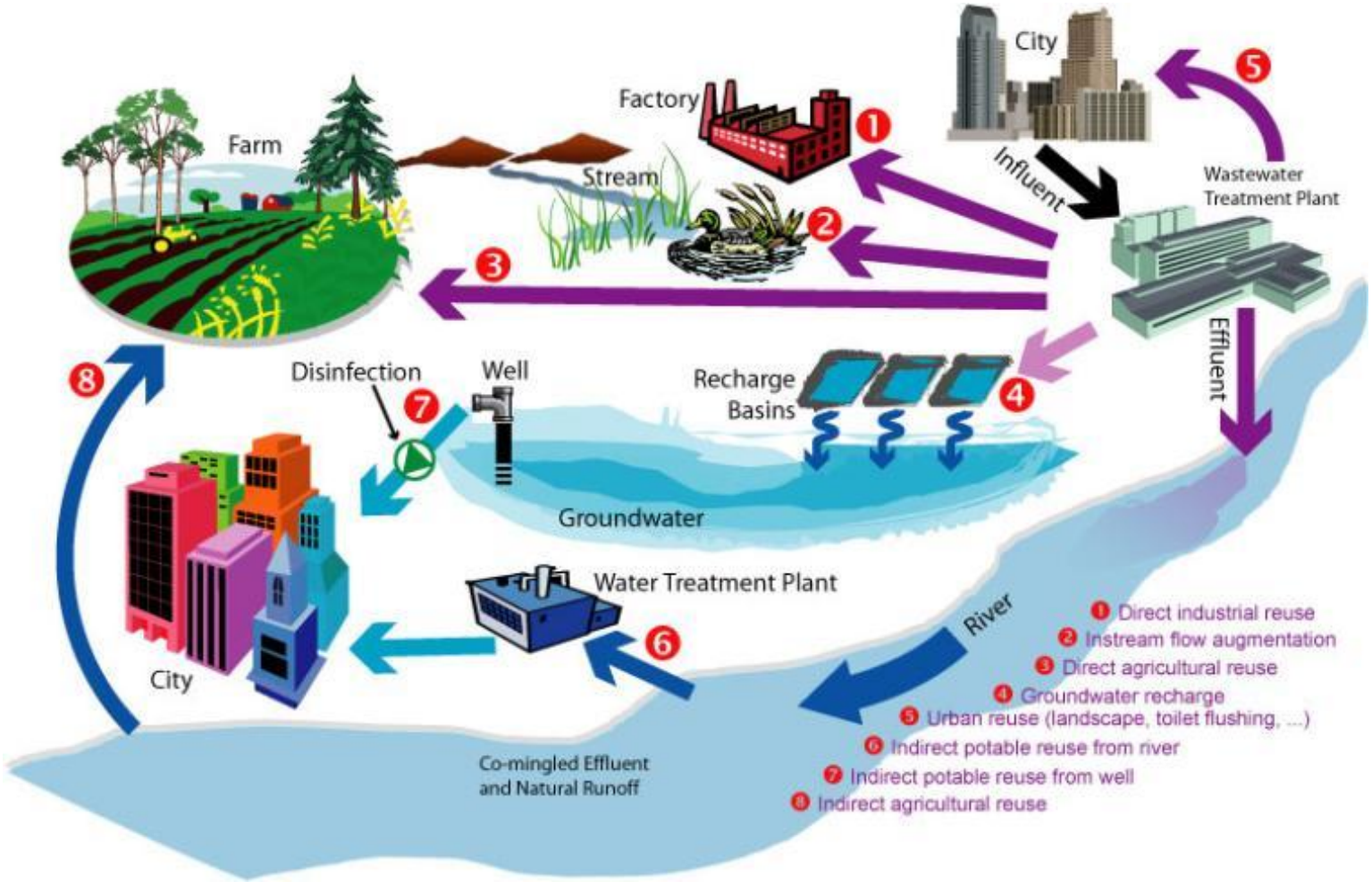
Recreational water use is usually a very small but growing percentage of total water use. Recreational water use is mostly tied to reservoirs.



It is estimated that 22% of worldwide water use is industrial. Major industrial users include hydroelectric dams, thermoelectric power plants, which use water for cooling, ore and oil refineries, which use water in chemical processes, and manufacturing plants, which use water as a solvent.
Water withdrawal can be very high for certain industries, but consumption is generally much lower than that of agriculture.

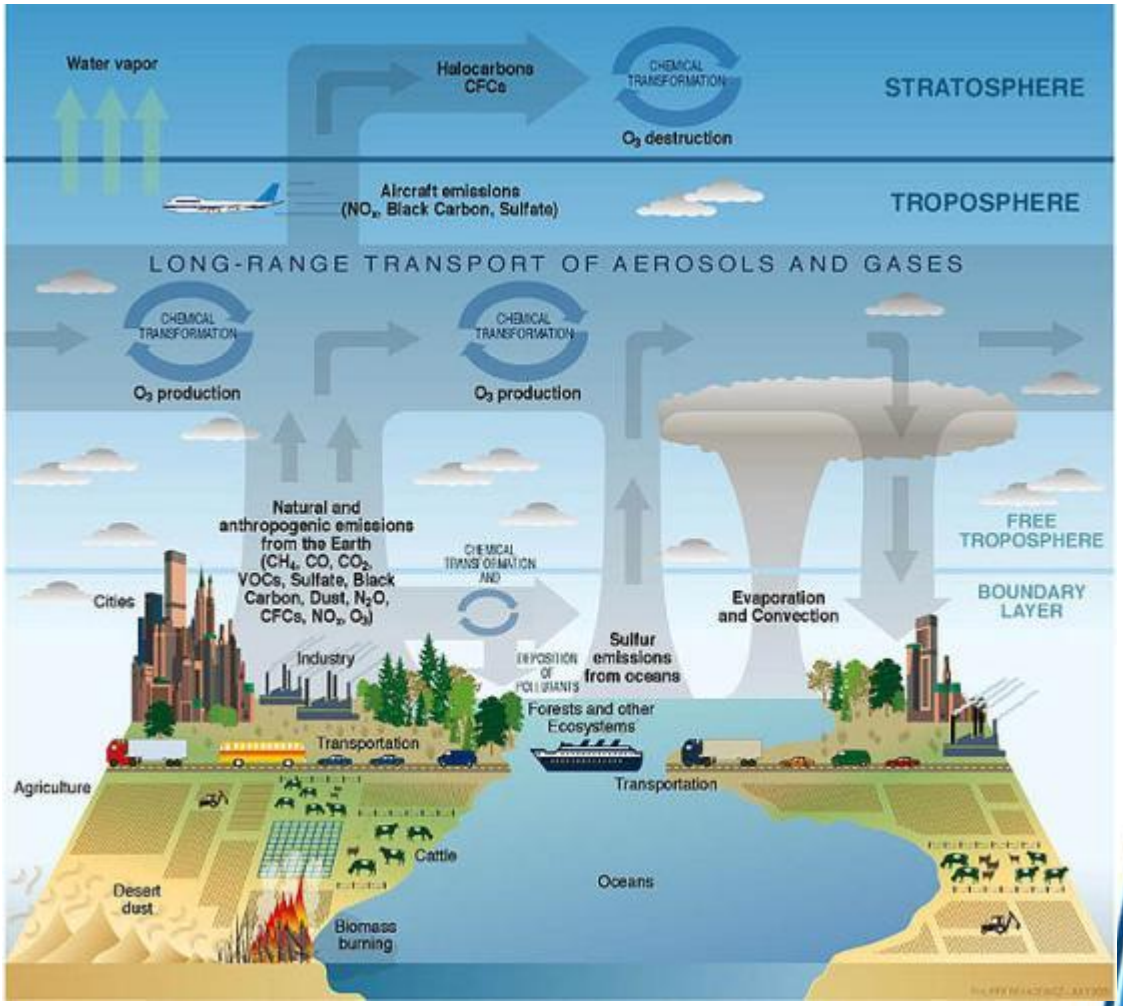
It is estimated that 69% of worldwide water use is for irrigation, with 15-35% of irrigation withdrawals being unsustainable. It takes around 3,000 litres of water, converted from liquid to vapour, to produce enough food to satisfy one person's daily dietary need.

WATER CYCLE


City
Factory
Farm
Stream
Influent
Wastewater Treatment Plant
Effluent
Disinfection
Well
Recharge Basins
Groundwater
Water Treatment Plant
River
City
Co-mingled Effluent and Natural Runoff
1 Direct industrial reuse
2 Instream flow augmentation
3 Direct agricultural reuse
4 Groundwater recharge
5 Urban reuse (landscape, toilet flushing, ...)
6 Indirect potable reuse from river
7 Indirect potable reuse from well
8 Indirect agricultural reuse

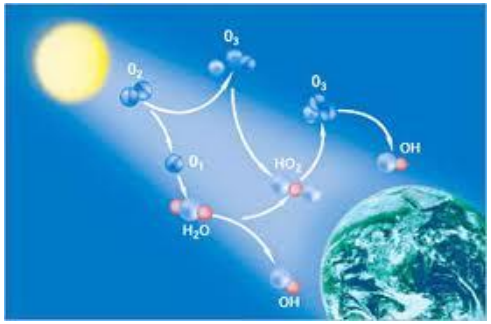
NATURE'S CLEANING DESIGN

Nature's Cleansing Design

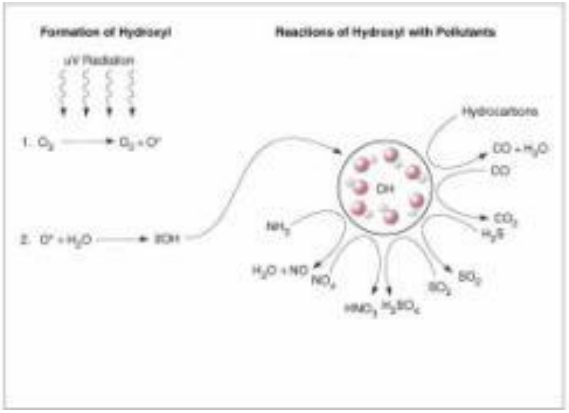


INTRO: HYDROXYL RADICAL

Hydroxyl Radical - Detergent of the troposphere



The hydroxyl radical is often referred to as the "detergent" of the troposphere because it reacts with many pollutants, often acting as the first step to their removal. It also has an important role in eliminating some greenhouse gases like methane and ozone.



HYDROXYL RADICAL IN ATMOSPHERE

Study of Hydroxyl Radical at NOAA

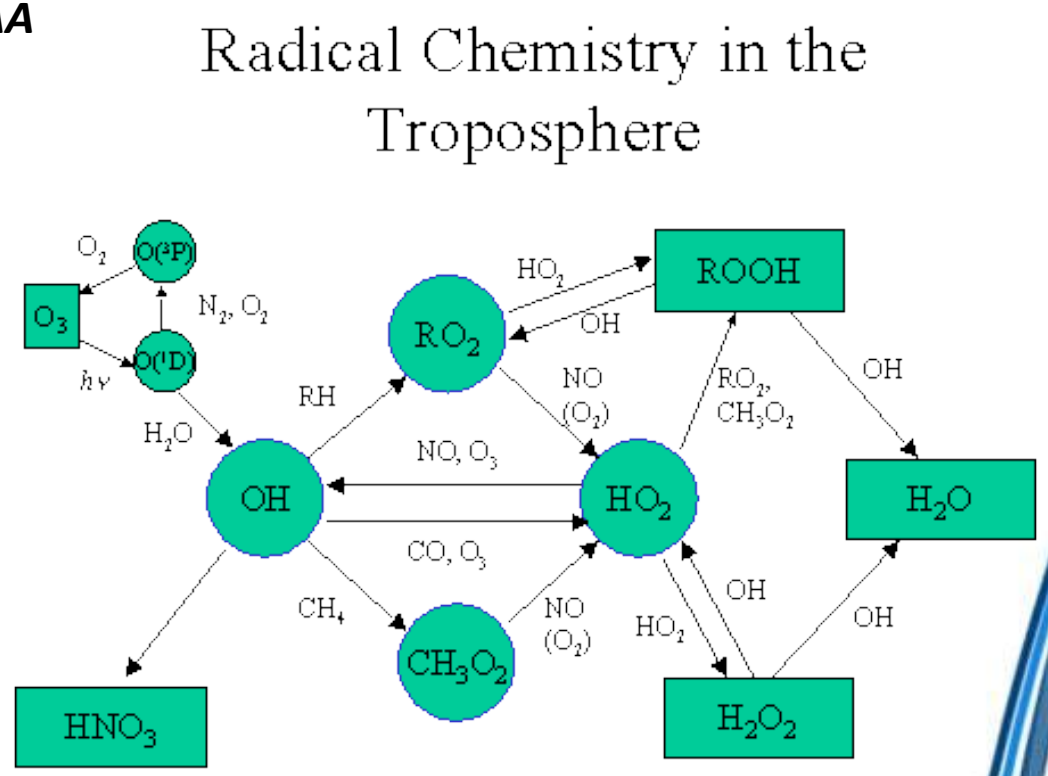
Levels of hydroxyl, which help clear many hazardous air pollutants and some important greenhouse gases, excluding carbon dioxide, dip and rise by only a few percent every year — not by up to 25 percent as once estimated.

"The new hydroxyl measurements give researchers a broad view of the 'oxidising' or self-cleansing capacity of the atmosphere," said Stephen Montzka, the study's lead author and research chemist at NOAA lab.

"Now we know that the atmosphere's ability to rid itself of many pollutants is generally well buffered or stable," Montzka said.

Hydroxyl is central to the chemistry of the atmosphere. It is involved in the formation and breakdown of surface-level ozone, a lung-damaging and crop-damaging pollutant.

It also reacts with and destroys the powerful greenhouse gas methane and air pollutants, including hydrocarbons, carbon monoxide and sulphur dioxide.

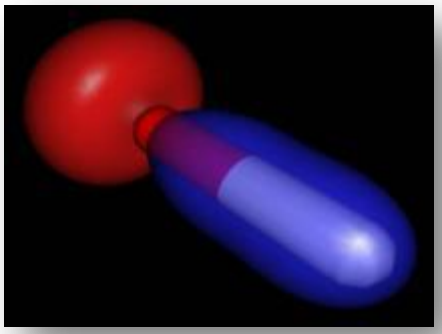


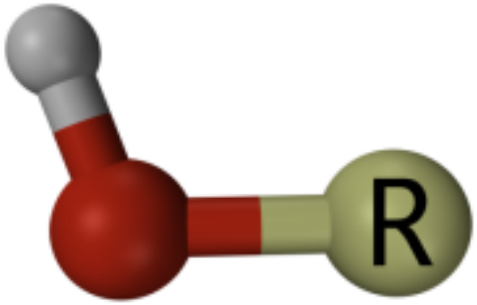
THE HYDROXYL RADICAL

The Hydroxyl Radical

The hydroxyl radical, OH·, is the neutral form of the hydroxide ion (OH–). Hydroxyl radicals are highly reactive and consequently short-lived; however, they form an important part of radical chemistry. Most notably hydroxyl radicals are produced from the decomposition of hydro-peroxides (ROOH) or, in atmospheric chemistry, by the reaction of excited atomic oxygen with water.

Molecular orbital of the hydroxyl radical with unpaired





HYDROXYL OXIDIZING STRENGTH

OXIDIZING STRENGTH OF ·OH

Oxidizing agent	Half Reactions	Standard-State Reduction Potentials, *Eo*
MnO_2	$MnO_2(s)+4H^++2e^- =Mn^{2+}+2H_2O_2$	1.23
Cl_2	$Cl(g)+2e^-=2Cl^-$	1.36
ClO_2	$ClO_2+2e^-= Cl^-+ O_2$	1.50
H_2O_2	$H_2O_2+ 2H^++2e^-=2 H_2O$	1.77
O_3	$O_3+2H^++2e^-= H_2O+ O_2$	2.07
·OH	**$\cdot OH+ H^++2 e^-= H_2O$**	**2.80**
F_2	$F_2(g)+ 2H++2e-=2HF$	3.06

·OH oxidizing properties are comparable to Fluorine (F_2)
the most electronegative element in the periodic table

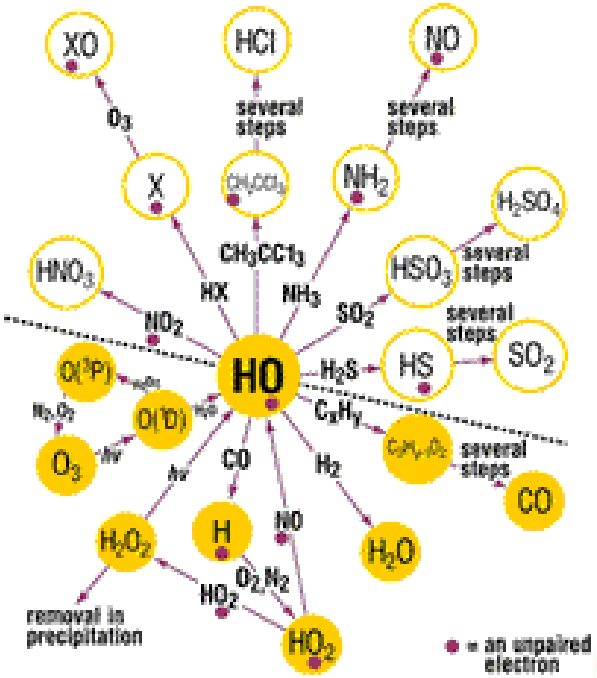
HYDROXYL EFFECTS ON ORGANICS

EFFECTS OF ·OH ON LONG ORGANIC CHAINS

• The high oxidizing properties of ·OH radicals is highly effective in breaking down long organic chains.

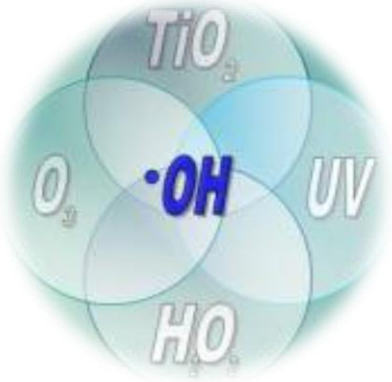
• Most organic waste passing through the DHR is quickly broken up into carbon dioxide, water, and smaller organic and inorganic ions through oxidation.

• Minimal sludge is produced.

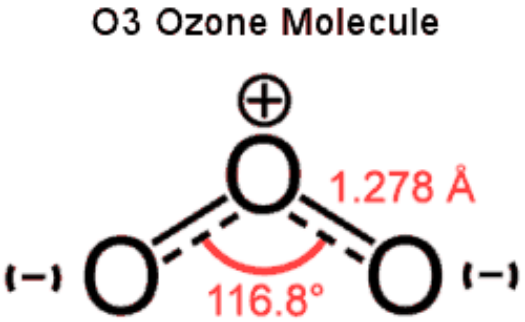


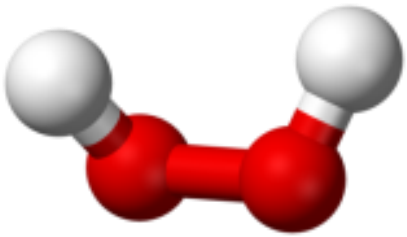
HYDROXYL TO CLEAN WATER

Development of Reaction Treatment System



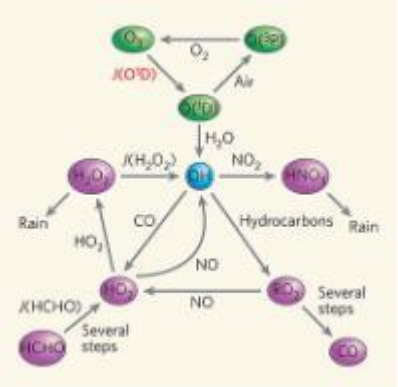
- Primary Oxidation reaction to break the solubility of the contaminants
- Generate low cost strong oxidation material versus the conventional method, e.g. Ozone, Hydrogen Peroxide, UV.
- Oxidation break and precipitate the contaminants





HYDROXYL TREATMENT TECHNOLOGY

REACTION TREATMENT CHARACTERISTICS



• The hydroxyl (·OH) radical is unstable and highly reactive. Required retention time is short, usually less than 30 minutes.

• The reactor starts a chain reaction, in which longer and unstable organic chains are first broken down to smaller ones. The treated water is **highly suitable for further biological treatment.**

• COD reductions for most applications range from 30% to 65%.

• May be used to effectively decolorized waste water in many applications.

• Disinfects. Oxidizing effect kills most bacteria and viruses.

• Algae removal.

HYDROXYL TREATMENT TECHNOLOGY

INDUSTRIAL WASTE WATER

Location: Jubail Industrial Area, Saudia Arabia

Client: Marafiq

Purpose: Combined with the Client's existing aeration method to treat 18,000 m3 waste per day out of 45,000 m3 of waste water within the 4 lagoons.

HYDROXYL TREATMENT TECHNOLOGY

INDUSTRIAL WASTE WATER

HYDROXYL TREATMENT TECHNOLOGY

Spent Caustic

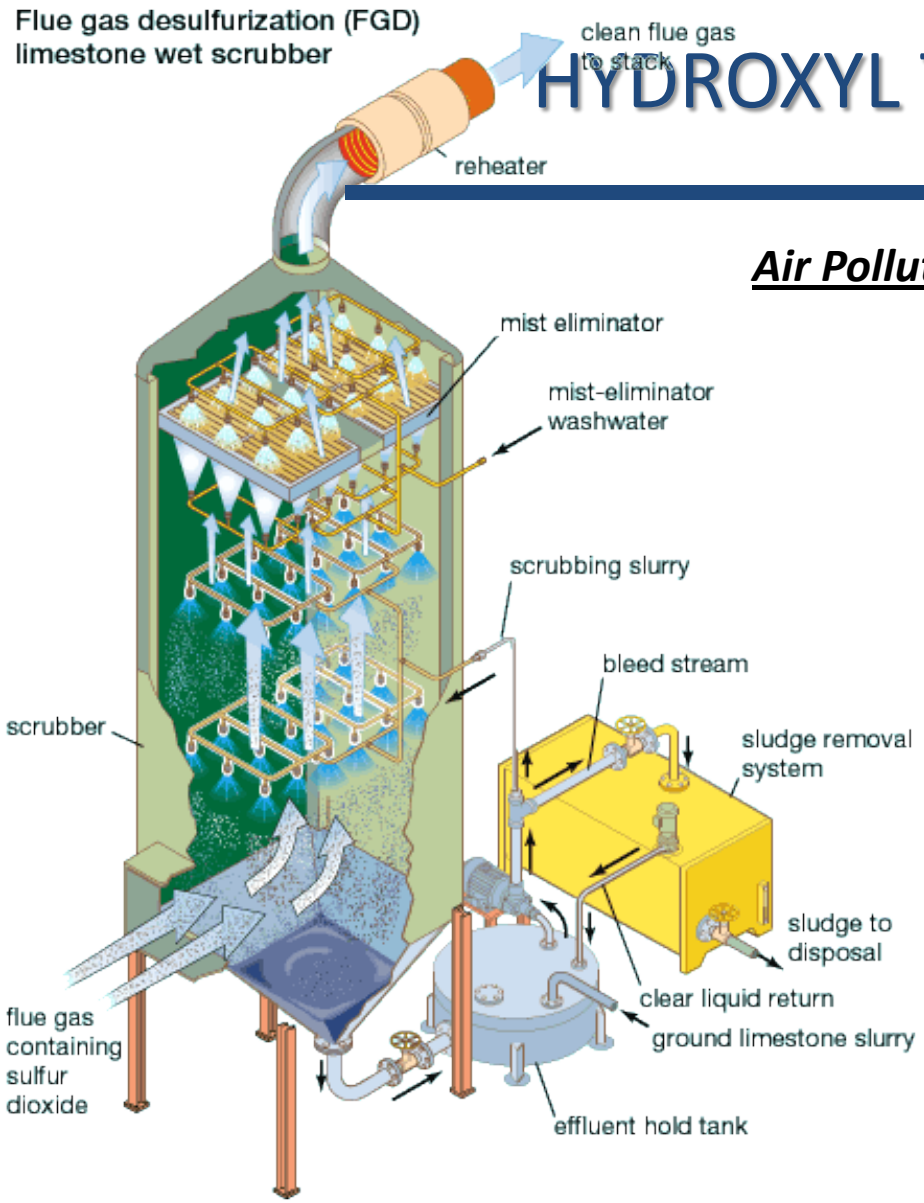
ANALYSIS RESULTS:		
TESTS	UNIT	RESULTS
PHENOLIC COMPOUNDS (as PHENOL)	mg/L	1.03
CHEMICAL OXYGEN DEMAND	mg/L	64944

ANALYSIS RESULTS:		
TESTS	UNIT	RESULTS
PHENOLIC COMPOUNDS (as PHENOL)	mg/L	0.09
CHEMICAL OXYGEN DEMAND	mg/L	1092

One of the key contributors to relatively high chemical oxygen demand (COD) and biological oxygen demand (BOD) is from the acid gas (both CO2 and H2S) removal system(s) typically using dilute caustic soda (NaOH) as the active reagent – the resultant waste stream is otherwise known as *spent caustic*.

Typical sulfidic spent caustic derived from acid gas removal in either a petrochemical or refinery facility can contain significant contaminants comprised of dissolved hydrocarbon, polymers and active polymer precursors in addition to the well defined levels of sodium salts and free caustic. These lesser known contaminants can grossly inhibit the conversion level of sodium sulfide to its highest oxidation state – sodium sulfate.

HYDROXYL TREATMENT TECHNOLOGY



Air Pollution

HYDROXYL TREATMENT TECHNOLOGY

INDUSTRIAL WASTE WATER

Water Condition Before Installation

Water Condition After Installation

HYDROXYL TREATMENT TECHNOLOGY

Meeting Discharge Standard Vs. Recycle and Reuse

HYDROXYL TREATMENT TECHNOLOGY

INDUSTRIAL WASTE WATER

The system has not only reduces COD to regulated levels but also sustained life in the area.

HYDROXYL TREATMENT TECHNOLOGY

INDUSTRIAL WASTE WATER

The system has not only reduces COD to regulated levels but also sustained life in the area.

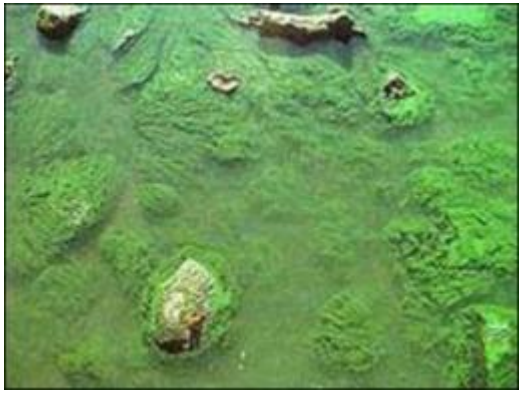
Back To Nature

HYDROXYL TREATMENT TECHNOLOGY

ALGAE

Harmful algal blooms may cause harm through the production of toxins or by their accumulated biomass, which can affect co-occurring organisms and alter food-web dynamics. Impacts include human illness and mortality following consumption of or indirect exposure to HAB toxins, substantial economic losses to coastal communities and commercial fisheries, and HAB-associated fish, bird and mammal mortalities. To the human eye, blooms can appear greenish, brown, and even reddish-orange depending upon the algal species, the aquatic ecosystem, and the concentration of the organisms.

Blue-Green Algae Bloom in Dianchi Lake, The Sixth Largest Freshwater Lake in China

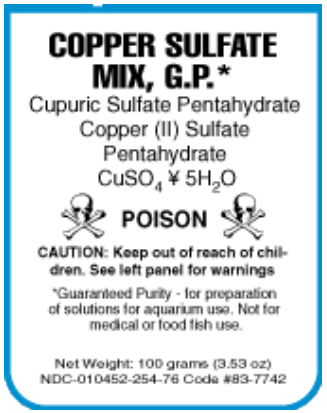


Minnesota Pollution Control Agency

HYDROXYL TREATMENT TECHNOLOGY

ALGAE

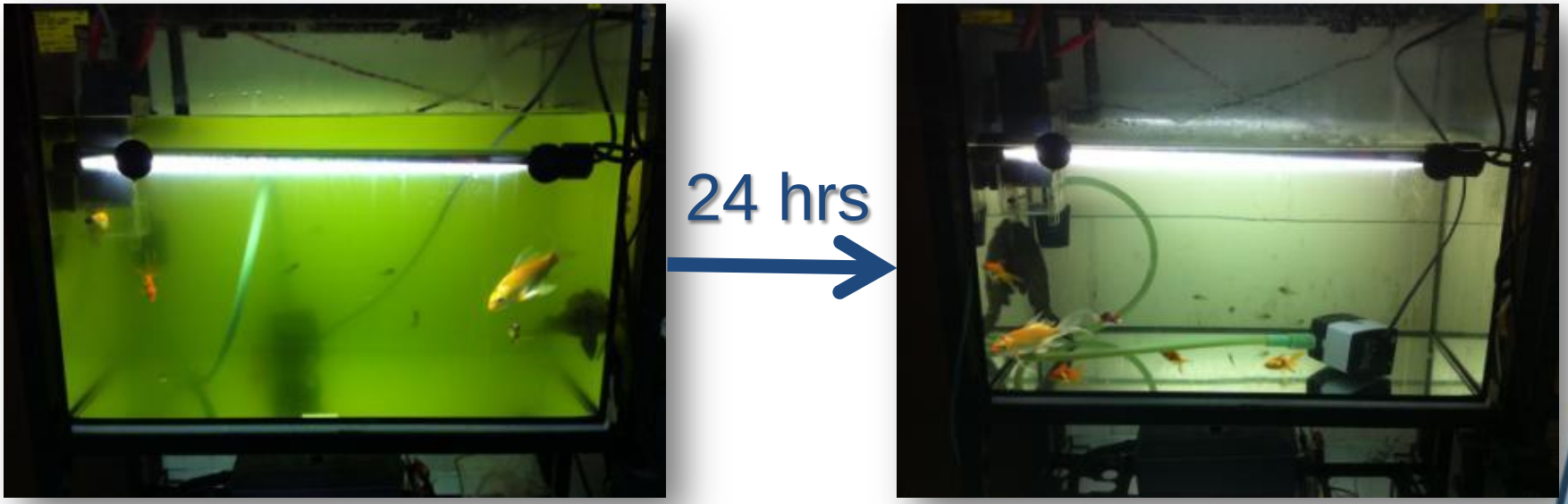
As algaecides remove algae. Several sources have indicated that the use of excessive copper-based algaecides and alum can kill fish and other aquatic animals as well as interfere with the reproduction systems in fish. Copper compounds found in algaecides can kill beneficial bacteria in the lakes that typically feed on bottom organic sediment, or muck. Similarly, Alum can leave an aluminium hydroxide flocculent on the bottom of the lake that will interfere with fish reproduction and many other organism in the ecosystem .



HYDROXYL TREATMENT TECHNOLOGY

ALGAE

A system developed generates hydroxyl radicals with a electrical charged reactive chamber to remove algae was used in fish tank test. Fishes remain alive in healthy state while water turns clear.



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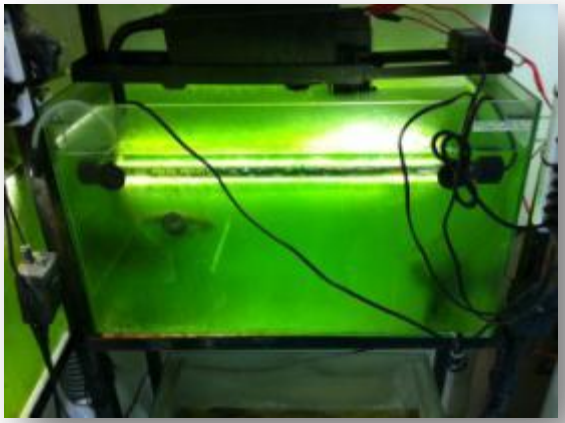
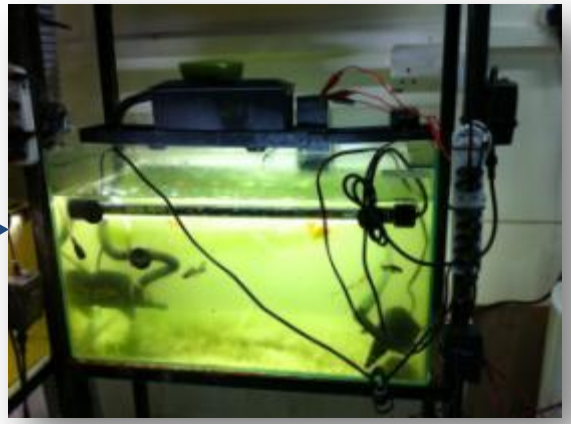
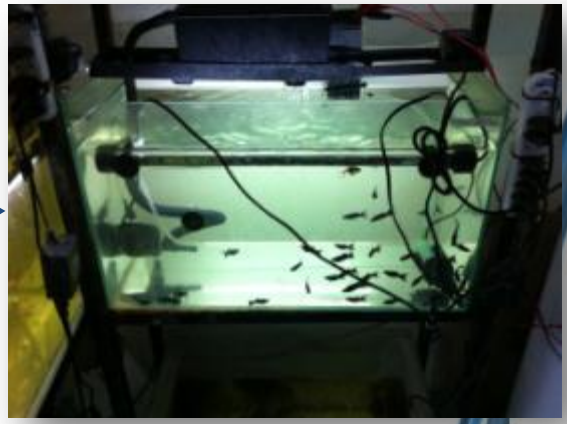


12 hrs



12 hrs

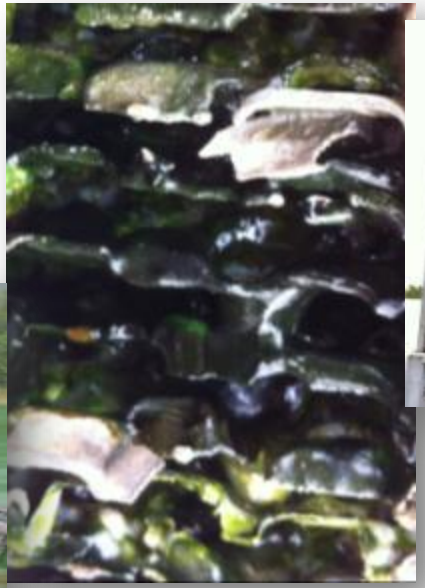


Back To Nature

HYDROXYL TREATMENT TECHNOLOGY

ALGAE

Applications of Algae removal unit



Cooling Tower

Back To Nature

HYDROXYL TREATMENT TECHNOLOGY

Enhancing Marine Life

Our range of products used in the ornamental fish industry has proven records in reducing ammonia and nitrates

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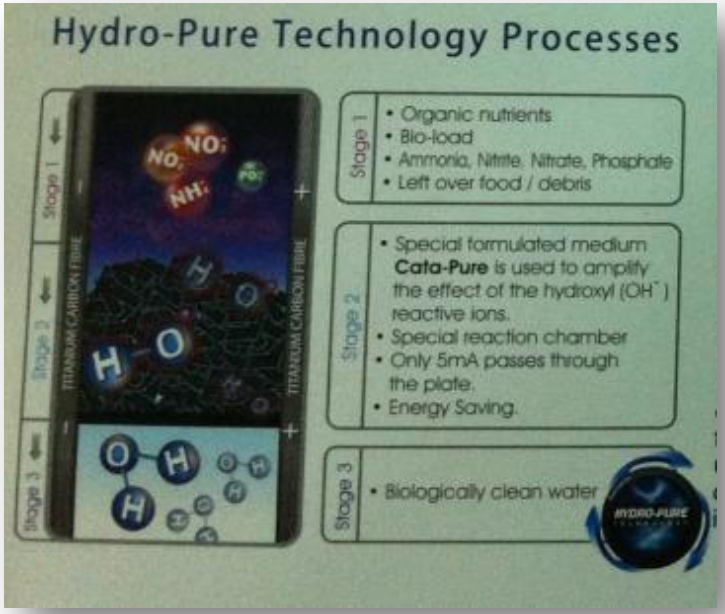
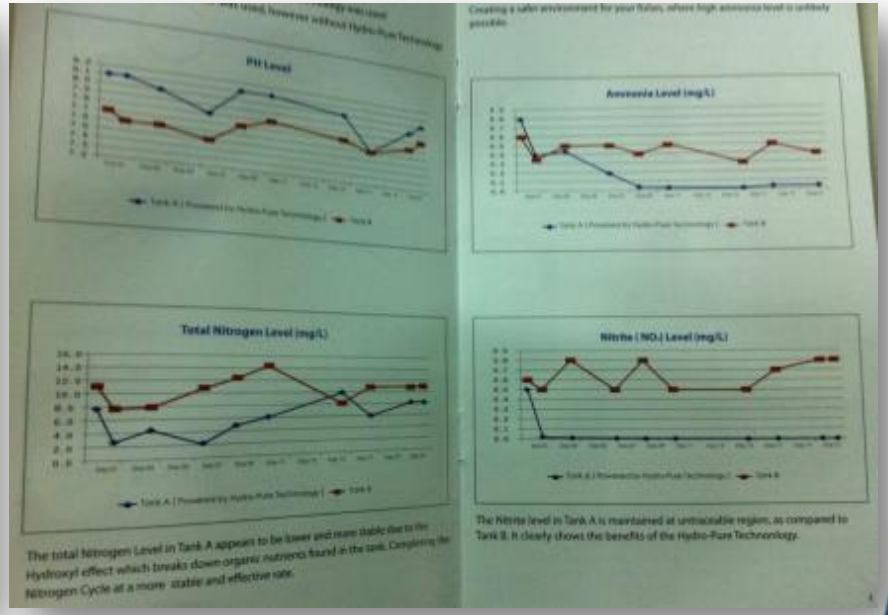
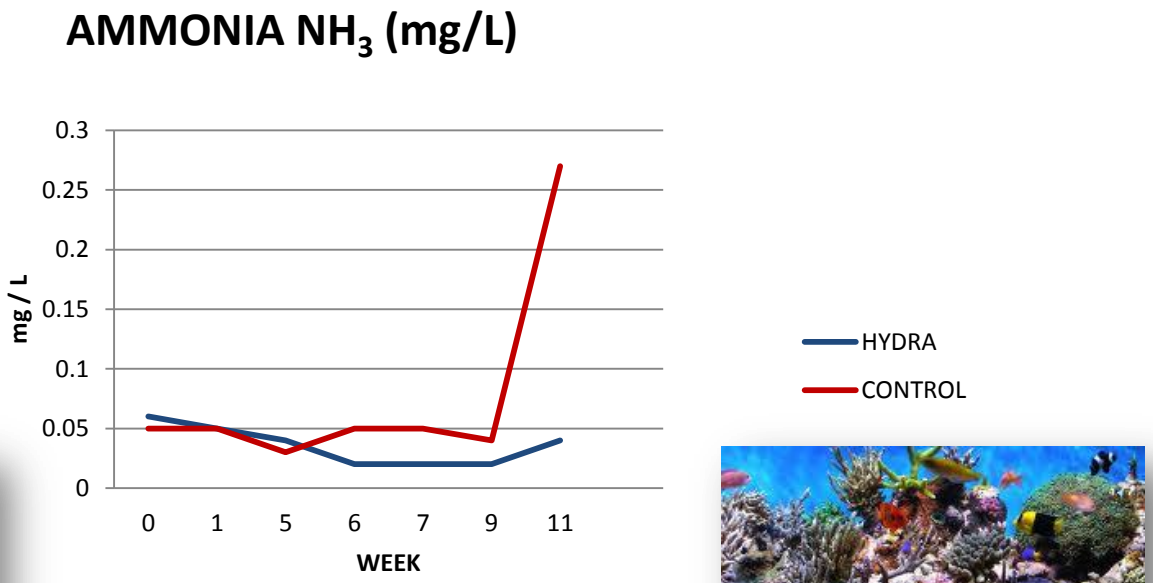




HYDROXYL TREATMENT TECHNOLOGY

Enhancing Marine Life

Tests with marine (seawater) tank indicated that with our hydroxyl reactor, ammonia levels is controlled and coral growth was promoted.



HYDROXYL TREATMENT TECHNOLOGY

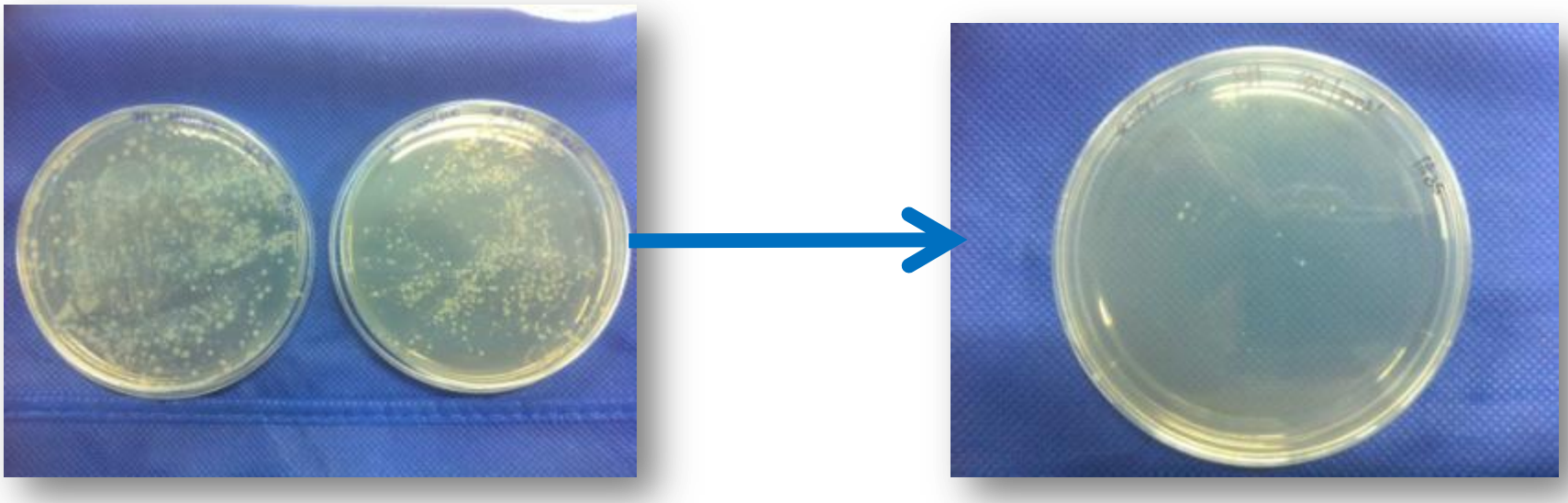
Disinfection

Waterborne diseases are caused by pathogenic microorganisms which are directly transmitted when contaminated fresh water is consumed. Contaminated fresh water, used in the preparation of food, can be the source of foodborne disease through consumption of the same microorganisms. According to the World Health Organization, diarrheal disease accounts for an estimated 4.1% of the total DALY global burden of disease and is responsible for the deaths of 1.8 million people every year. It was estimated that 88% of that burden is attributable to unsafe water supply, sanitation and hygiene, and is mostly concentrated in children in developing countries.

HYDROXYL TREATMENT TECHNOLOGY

Disinfection

The hydroxyl radicals ($^{\cdot}OH$) play a significant role in microbial inactivation. The test uses microorganisms in natural reservoir water.



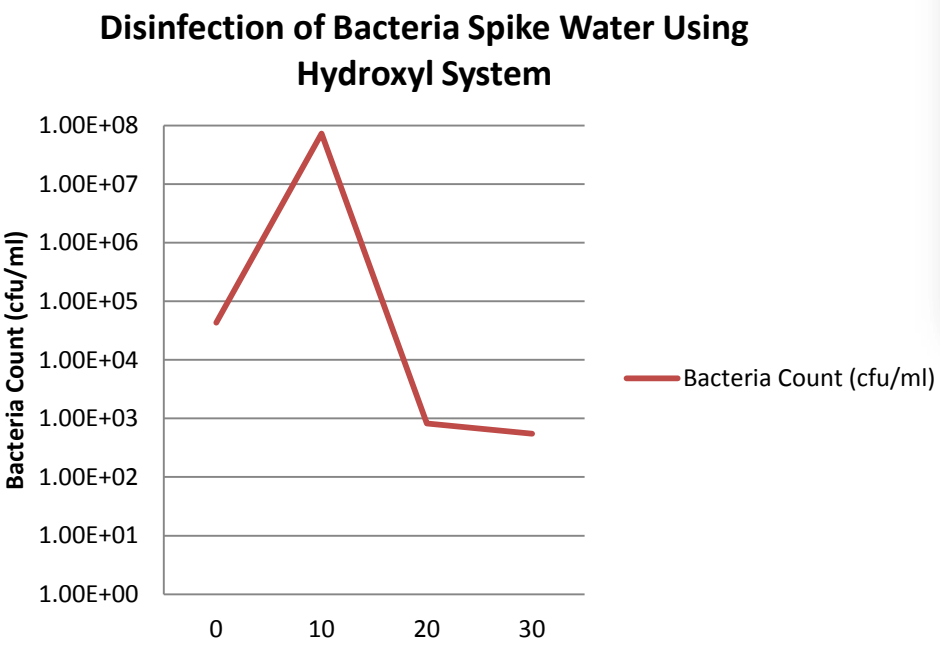
Total Plate Count of Original Sample water

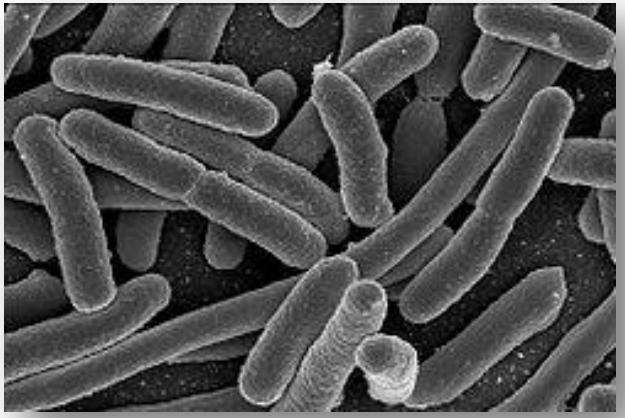
Total Plate Count of Sample water after passing through Hydroxyl Disinfection Unit

HYDROXYL TREATMENT TECHNOLOGY

Disinfection

The hydroxyl radicals (·OH) play a significant role in microbial inactivation.
This test uses *E.Coli* spiked water and passed through the disinfection system. Results show 5 logs kill in 30 minutes.





HYDROXYL TREATMENT TECHNOLOGY

Deionization

Water is desalinated in order to convert salt water to fresh water so it is suitable for human consumption or irrigation. Sometimes the process produces table salt as a by-product. Desalination is used on many seagoing ships and submarines. Most of the modern interest in desalination is focused on developing cost-effective ways of providing fresh water for human use in regions where the availability of fresh water is, or is becoming, limited.

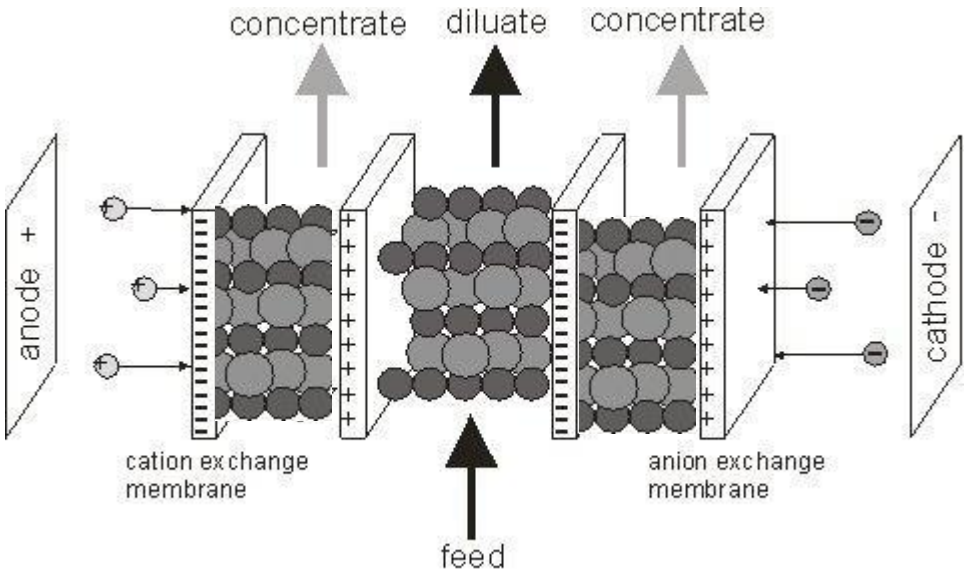
Large-scale desalination typically uses extremely large amounts of energy as well as specialized, expensive infrastructure, making it very costly compared to the use of fresh water from rivers or groundwater.

A new desalination plant, hailed as being the world's largest, has now been completed in the new Jubail II Industrial Zone in the Kingdom's Eastern Province.

HYDROXYL TREATMENT TECHNOLOGY

Deionization

We have re-invent the deionization process that treats seawater with low energy consumption and long membrane life. The project is current in process to achieve WHO drinking water standard



Hydroxyl Generating Catalyst

HYDROXYL TREATMENT TECHNOLOGY

Deionization

The key advantage of this method is that it completely avoids the high mechanical energy needed to go against the osmotic pressure in the RO process.

The system operates in low DC voltage and current requirement, thus energy consumption is extremely low.

The unit function in ambient temperature, this allows the selection of low thermal resistance construction material which translates to a substantial cost savings in capital investment.

HYDROXYL TREATMENT TECHNOLOGY

Deionization

At 110,000m3/day, the Tuas seawater reverse osmosis (SWRO) plant has sufficient capacity to meet around 10% of the national demand

The water resources of Singapore are especially precious given the small amount of land and territory in Singapore's geography while having a large urban population in the city-state. Without natural freshwater lakes, Singapore relies on four water sources:
rainfall, collected in reservoirs or water catchment areas (about 20% of supply in 2010),
Imported water from Malaysia (about 40% of supply),
Reclaimed water (producing NEWater) (30% of supply), and
Seawater desalination (10% of supply).
This "four tap" strategy aims to reduce reliance on supply from Malaysia by increasing the volume supplied from the three other sources, or "national taps".

HYDROXYL TREATMENT TECHNOLOGY

Deionization

PROJECT TRIAL LOCATION:

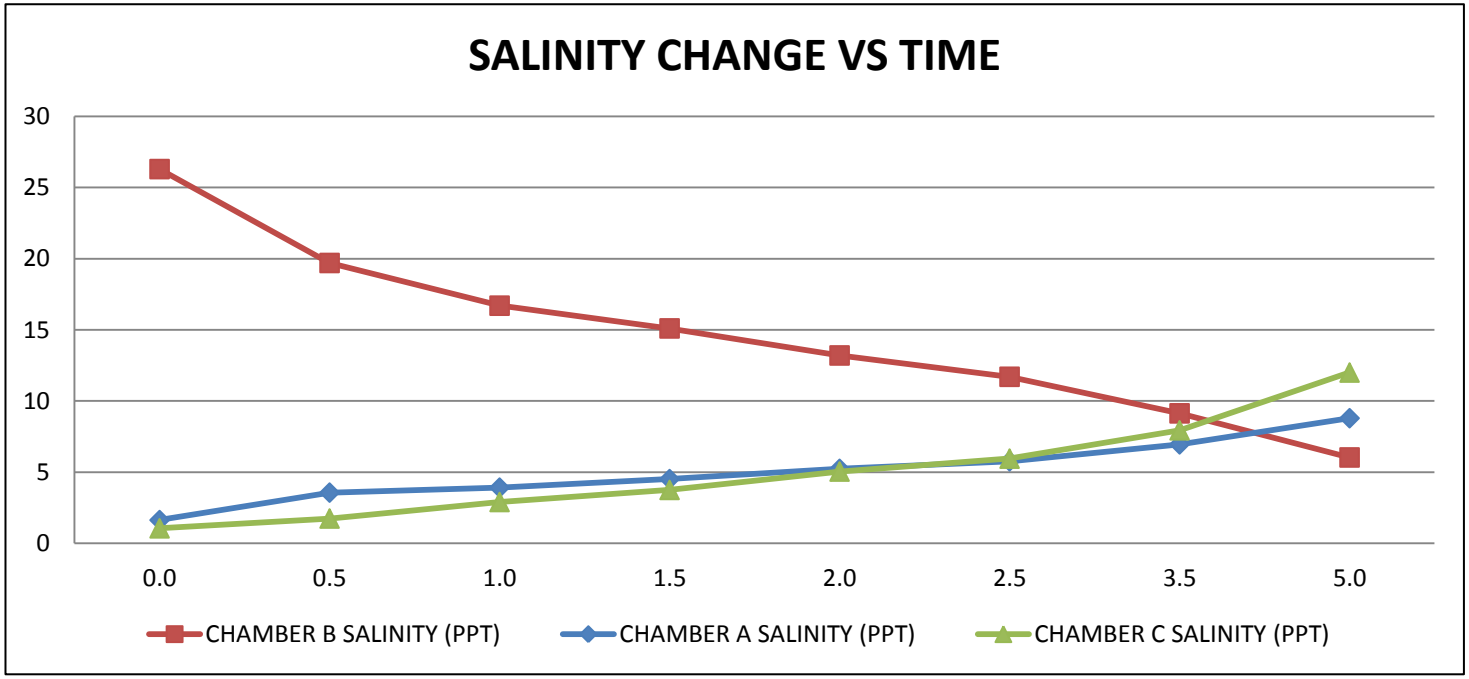
SINGAPORE – EASTERN REGION
EAST COAST PARK

SALINITY – 25 TO 27 PPT

pH – 7.6

HYDROXYL TREATMENT TECHNOLOGY

Deionization



Initial trials exhibited salinity reduction of seawater of more than 50% can be achieve with basic setup.

The salinity of chambers reached a crossing point. This result could depict a high potential of low concentrate rejects.

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Table 1 Diluate seawater as a function of voltage. (Source - Sea Water from East Coast Park, Section D)					
	pH			**Conductivity**	**mS/cm**
A	B	C	A	B	C
3.50	7.10	11.85	3.45	35.40	2.27
8.40	7.40	11.88	3.77	34.4	2.5
8.44	7.70	11.89	3.95	33.9	2.9
8.00	8.35	11.90	4.04	33.5	3.2
9.00	8.80	11.95	4.21	32.8	3.45
8.45	9.52	11.91	4.33	32.3	3.69
9.10	9.70	11.95	4.47	31.7	3.97
9.20	8.87	12.02	4.57	31.30	4.17
9.40	9.85	12.05	4.64	31	4.42
8.90	8.65	12.05	4.71	30.4	4.6
9.30	8.85	12.05	4.78	29.9	4.77
9.00	8.80	12.08	4.9	29.43	4.86
8.80	8.57	12.08	5.12	28.9	5.1

DC Voltage (V)	**Current (A)**	
24	4.35	
Real Power	104.4	Watt
Effective KWh	0.0348	(20 mins)
Rate ($/Kwh)	0.2728	(PUB for the month of Sep 11)
Cost	$0.01	
Sea Water treated	5	Litres
$ / Litre	0.00190	(Estimated)

Data collected in a lab trial, estimate of energy consumption per stage is computed

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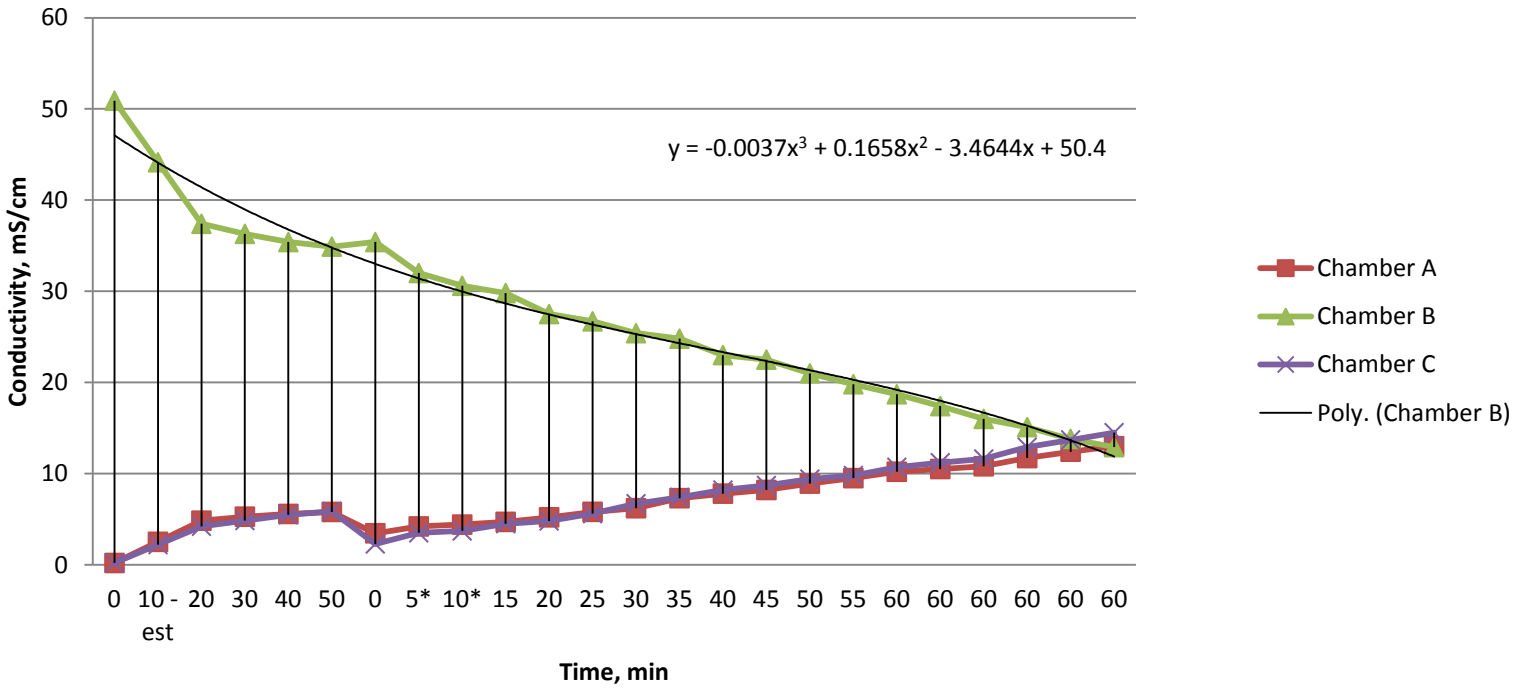

Chart 1. Measurement of conductivity in reactor chamber with simulation

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Deionization

Current phase of project is trending the various parameter such as optimum voltage (DC) and current. Simulation of multistage – continuous process designs. Lifespan test for membrane.

Further review is being conducted with detailed energy consumption to trend energy – economic and planning model to design a pilot scale system.

Use of solar power is being studied to reach self sustainability

Comparison with Other Technologies

The Oxidation Flocculation Reaction (OFR) concept was first developed in 1983 to solve the drawbacks in other water treatment technologies such as UV + TiO2, H2O2, Cl2, O3, WAO (wet air oxidation). The OFR was introduced over the last two decades to many countries i.e. China, Japan, Korea, Singapore, Malaysia, USA, Finland, Switzerland, England, Russia, Thailand, Vietnam. The application is different from one country to the other in terms of specification and magnitude.

Since 2009 Future Resources have introduced this technology to the region through two major projects in Jubail.

Comparing the OFR technology to other conventional water treatment technology is not a straight forward comparison since the OFR has completely different concept in the water treatment. It uses the Hydroxyl Radicals to oxidize contaminate in the waste water without using chemical. The system generate the radicals by its reactors thus it is a totally environment friendly solution. Most of the other treatment technology uses extensive chemicals to treat the water.

We can proudly describe our technology as going back to nature.

Cost Analysis

The comparison below is between two existing projects in Saudi Arabia:

Characteristics	Company A	Future Resources Co.
Project cost SR.	(X)	4.6 % (X)
Project capacity	55,000 m3/d	18,000 m3/d
Operating cost	Min 3%	Max 1%
Manpower during construction	Approx. 600	Approx. 25
Project Duration	30- 36 months	4-6 months
Manpower for operation	Min 20 per shift	2 per shift
Maintenance Cost	High	Almost maintenance free
Expansion	Redesign	Modular

Cost Analysis

- The installation & operation costs are vary from project to other project.
- Using this Technology is saving up to 50% comparing with the conventional Biological Technology.
- Lifespan of projects using this technology is up to twenty years.

THE FUTURE

Our future lies in our hands.

We believe in developing the technology to sustain life for our future generations

Back To Nature

مصادر المستقبل | FUTURE RESOURCES

THANK YOU

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