

Solutions in Water: Innovative REDO Technology Multi Oxidants Water Disinfection (MOWD)

The German Way for Safe, Healthy and Effective Water Disinfection



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1. INTRODUCTION: THE CHALLENGE



REDO[®]
watersystems

Introduction – Chlorination is phasing out

The Clean Water Challenge

The Clean Water Challenge

Water is one of the most valuable commodities on planet earth.

Death, serious illness and despair are inevitable consequences without a supply of clean drinking water.

In July 2010, the UN general assembly declared clean water a “**fundamental human right**”.

In an economic perspective, investments in drinking water quality, particularly disinfection, are extremely profitable, especially if the **benefits on health of every human** and the **productivity of a national economy** are accounted for.

Protection and Disinfection of Drinking Water evoked various different Treatment Technologies over the decades – but only few are safe, simple and without negative side effects.



Introduction: Chlorination is phasing out

Water Disinfection – The Safety Challenge

Chlorine gas

Discovered and first produced in the 19th century, chlorine gas was first used as industrial bleach and later as a poison gas in the first world war.

Today, the same substance – stored and distributed in pressurized gas cylinders – is mainly used for water disinfection purposes.

Chlorine gas accidents with casualties or severe injuries occur regularly in every nation, when transporting or handling chlorine gas.

Unfortunately, disinfection uses of chlorine gas, e.g. in water production plants, often take place in densely populated areas.

Chlorination is phasing out

To prevent danger from poison gas or explosions (in the case of chlorine dioxide), hypochlorite or chlorine dioxide can be produced on site.

However, health concerns of the use of chlorine substances remain.

Over the years, various carcinogenic, mutagenic and toxic and environmentally harmful effects of many organic chlorine compounds have been proven in scientific studies.

Many safety measures have been introduced – appropriate training of personnel for the handling of hazardous substances is mandatory – and expensive.

Many people do not like the taste and smell of chlorinated water.

The only reason for the continued used of chlorine based disinfection: It certainly is the less harmful alternative in comparison to not disinfecting at all.



Before: disinfection with chlorine gas



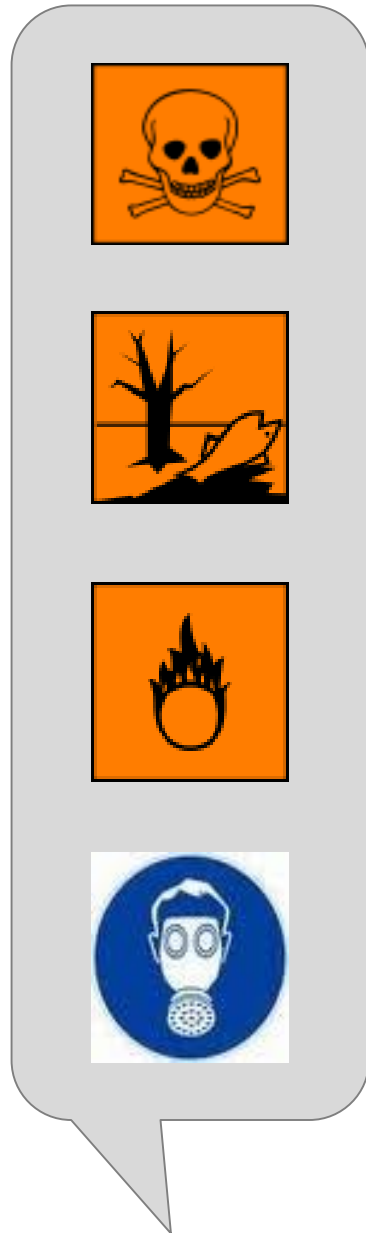
After: disinfection with REDO Technology

Many nations have programs to phase out and replace the use of chlorine gas



Introduction – Chlorination is phasing out Water Disinfection - Health Concerns

- The quality of drinking water is often basically bad. There's a high part of heavy metals, bacteria, algae and germs in the water. Its recommended to boil the water before drinking. The public water plants use mainly chlorine gas for disinfection, which causes a bad taste in the water and doesn't work effectively at all.
- Over the years, various carcinogenic, mutagenic and toxic and environmentally harmful effects of many organic chlorine compounds have been proven in scientific studies.
- Many safety measures need to be installed, to avoid chlorine gas accidents. Appropriate training of personnel for the handling of hazardous substances is mandatory – and expensive.
- Water production plant managers worldwide become increasingly aware of the health hazards of various chlorination byproducts.
- Particularly, trihalomethanes (THMs) have been identified as carcinogenic, toxic and environmental pollutants. However, similar effects are attributed to various other chlorination byproducts, e.g. Haloacetic acids, chlorite and bromates.



From the product data sheet
for chlorine based substances

Introduction - Disinfection Byproducts (DBP)

Traditional reduction approaches

Total THM limits

- **1979**, United States Environmental Protection Agency: limit 0.08mg/L
- **1998**, European Union guideline: limit 0.1 mg/L plus additional national reduction efforts required
- **2003**, German Drinking Water ordinance: limit 0.05 mg/L at consumer, limit 0.01 mg/L at water production plant
- **2004**, World Health Organization: Further specification of limit values for all four THMs

Water production plant managers worldwide become increasingly aware of the health hazards of various chlorination byproducts.

Particularly, trihalomethanes (THMs) have been identified as carcinogenic, toxic and environmental pollutants. However, similar effects are attributed to various other chlorination byproducts, e.g. Haloacetic acids, chlorite and bromates.

There is already clear statistical evidence on the adverse effect of chlorination byproducts. As further research on the precise biological mechanisms and individual medical impact is published, scientists expect an increasing amount of pressure towards a tighter DBP and THM regulation.

The international regulation shows a tendency towards stricter and more sophisticated guidelines.



Transport of chlorine gas as an hazardous substance

Introduction - Disinfection Byproducts (DBP)

Health Hazards

THMs and other DBP are created by reactions between chlorine gas and organic materials found in the water.

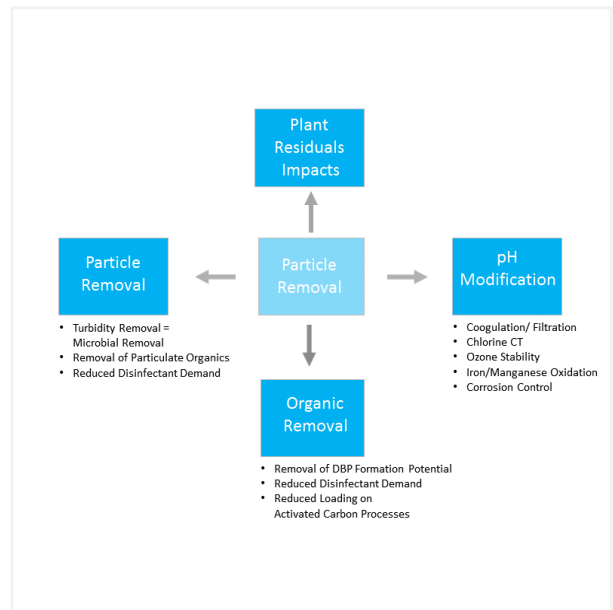
Newer legislation takes into account that organic materials can also be introduced in the water system AFTER the water production plant, so THMs can increase after the water production plant.

Therefore, reduction of THMs often requires a very complex bundle of measures in all stages of water production, in order to get below the limits even at peak times, e.g. flooding situations.

Other types of disinfectants produce different byproducts. E.g., ozone disinfection produces formaldehyde and other aldehydes, chlorine dioxide disinfection produces chlorite which affects red blood cells and may be toxic to DNA.

An example for complex THM reduction efforts is the Article [“Strategies for Attaining DBP Rule Compliance”](#) by George C. Budd, published www.waterworld.com

Coagulation – A multidimensional / Multigoal Process



DBP reduction is a challenging task with traditional disinfection methods – but easy with REDO.

Introduction - Corrosion

Danger of high damages in water distribution networks

A major factor for corrosion in water distribution networks is the pH value.

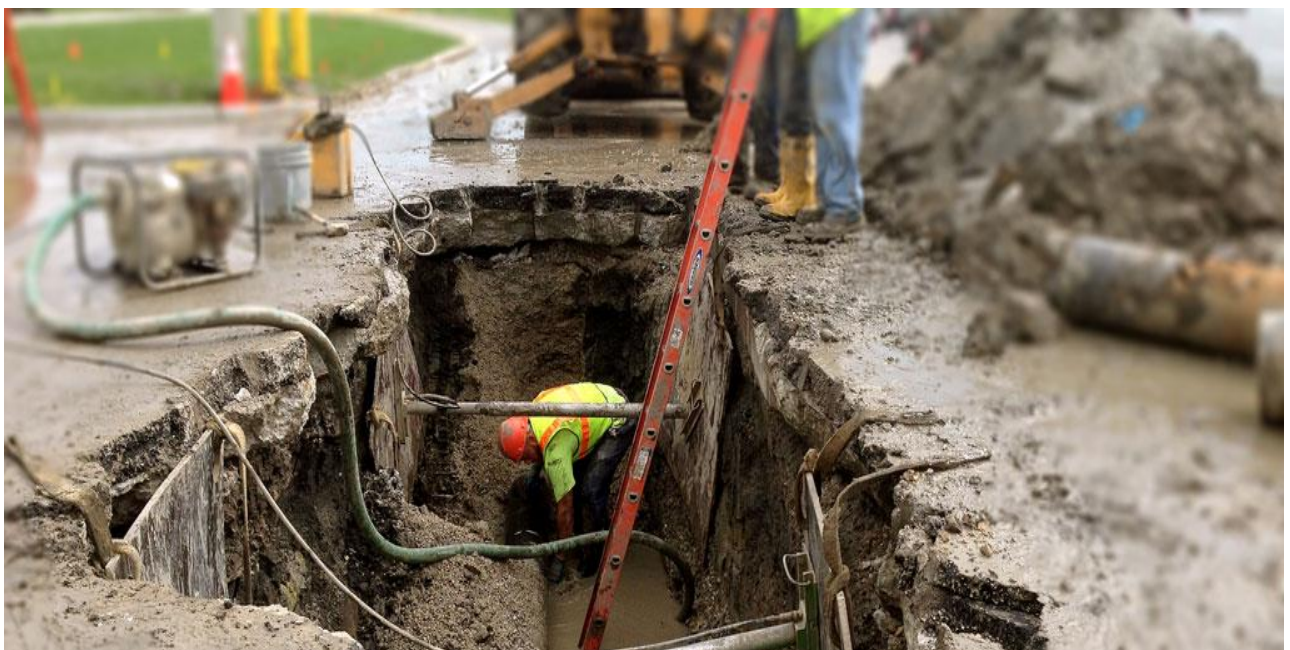
Water disinfection based on chemical additions often changes the pH value. Chlorine addition in the gaseous form will tend to lower the pH while adding chlorine in the hypochlorite form will tend to raise the pH.

Even though chlorine gas and hypochlorite seem to be cheap at first sight, cost analyses completely change if damages in the water distribution network through corrosion are taken into account.

In recent years chlorine gas has often been replaced through hypochlorite in order to reduce the danger potential in disinfection.

But after short time it appeared that the highly corrosive nature of hypochlorite results in out of scale corrosion damages to the distribution network, water pipes and other installations.

Disinfection with REDO technology avoids these problems. REDO disinfection, based on 6 oxidants, is pH neutral and has no corrosive effects.



2. REDO TECHNOLOGY



REDO[®]
watersystems

The Multi-Barrier Technology

REDO Water Systems' award winning technology is the answer to drinking water disinfection and hygiene challenges.

- REDO units are developed based on superior technology that works **with 6 different oxidants**. In contrast to conventional forms of water treatment, chemical additives are not necessary. With small amounts of salt and electricity, the highly reliable units disinfect water to ensure a high quality of drinking water.
- REDO installations fit any size of water production plant from small, decentral wells with only hundreds of cubic metres of water per day to large central plants with more than 100,000 cubic metres of water per day.
- In any case, REDO disinfection is particularly thorough, safe, economical and environmentally friendly.



REDO technology was awarded with the Federal Innovation Award of Germany in 2004

The Power of Six

Multi Oxidants Water Disinfection (MOWD-Process)

Safe, healthy and effective water disinfection

REDO Disinfection Systems use

- water
- pure common salt
- and energy



to produce the six strongest disinfection agents on site within the customers' premises.

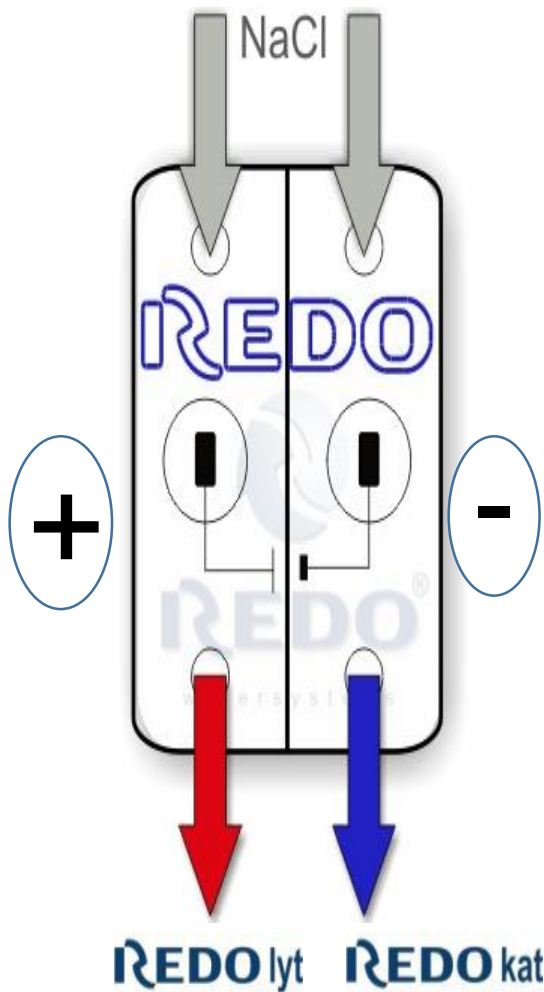
The unique combination of the advantages of **ozone, chlorine dioxide, chlorine and oxygen supported through dihydrogene dioxide and sodium hydroxyde (MOWD process)** results into an insuperable 'multi-barrier disinfection process' – with the final removal of bacteria, germs, spores and other harmful vermins. The disinfection solution is biodegradable, nonhazardous in operation and without dangerous side effects or byproducts.

REDO Disinfection Technology combines and accumulates the power of six disinfection agents to exceptional short contact time with an outstanding long-term effectiveness.

Different disinfection agents fight different microorganisms - the REDO combination of disinfection agents is **most effective** and **avoids the disadvantages** of high dosing of a single active ingredient.

REDO Technology

Electrolysis of an aqueous & saline solution



The combination of two disinfection liquids produced on site:

REDOlyt:

- Oxygen (O_2^{Singlet})
- Ozone (O_3)
- Chlorine (Cl_2)
- Chlorine dioxyde (ClO_2)

Acidic

REDOkat:

- Dihydrogene dioxyde (H_2O_2)
- Sodium hydroxyde ($NaOH$)

Alcaline



REDO neutral

to a harmless, ph-neutral and powerful disinfection product...

The Key Step | The Innovation

- Advanced Diaphragma Electrolysis
- High-Tech Electrodes made of special alloys and coatings
- Consumables: Saturated NaCl-Water („Brine“) + Electricity



REDO UNITS

SCALABLE FROM 1 – 1000 MLD



Video full REDO Installation

<https://www.youtube.com/watch?v=25RY9BkWYM4>



ENGINEERED & MADE in 
GERMANY

Success Factors of REDO Technology

Extremely broad and intensive disinfection

Instantly and with long term effectiveness and minimal DBP

The success factor is the mix of six disinfecting agents: E.g., the ozone component of REDO[®]lyt immediately and effectively kills all germs.

Chlorine and chlorine dioxide concentration are not used up for immediate disinfection, their concentration - needed for long term disinfection of contamination in the water distribution network - can be kept at relatively low levels.

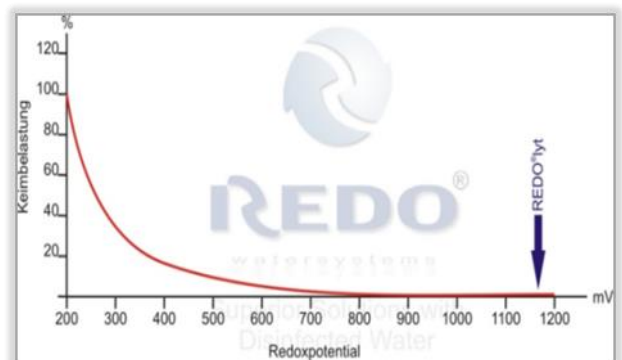
The interplay of different oxidizing and disinfecting agents with different ranges of efficacy provides a particularly broad disinfection. The intensity of REDO[®]lyt, e.g. measured by an excellent Redox potential, guarantees a very effective disinfection even at relatively low overall concentrations.

With the REDO mix of six disinfecting agents, each of the disinfecting agents is used in very low concentrations, so that even the strictest limits for disinfection byproducts are easily met.

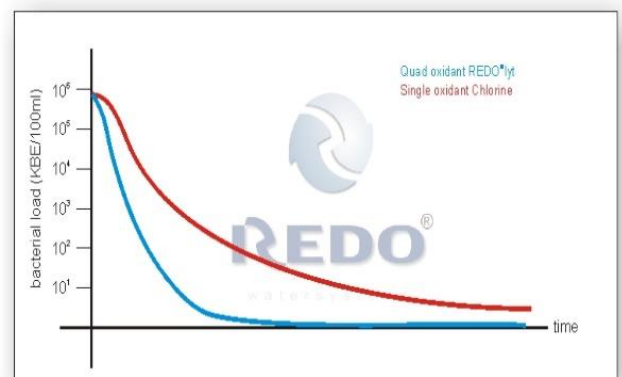
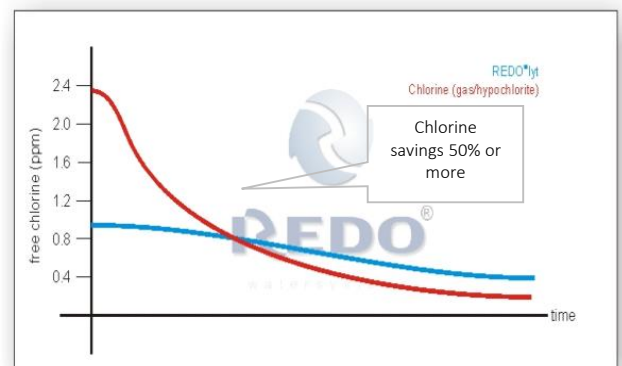
Disinfection with REDO is

- ✓ extremely broad
- ✓ intensive
- ✓ instantly
- ✓ with long term effectiveness
- ✓ minimal DBP
- ✓ pH neutral

High Redox potential immediately kills all germs:



REDO[®]lyt: Comparison with Chlorine

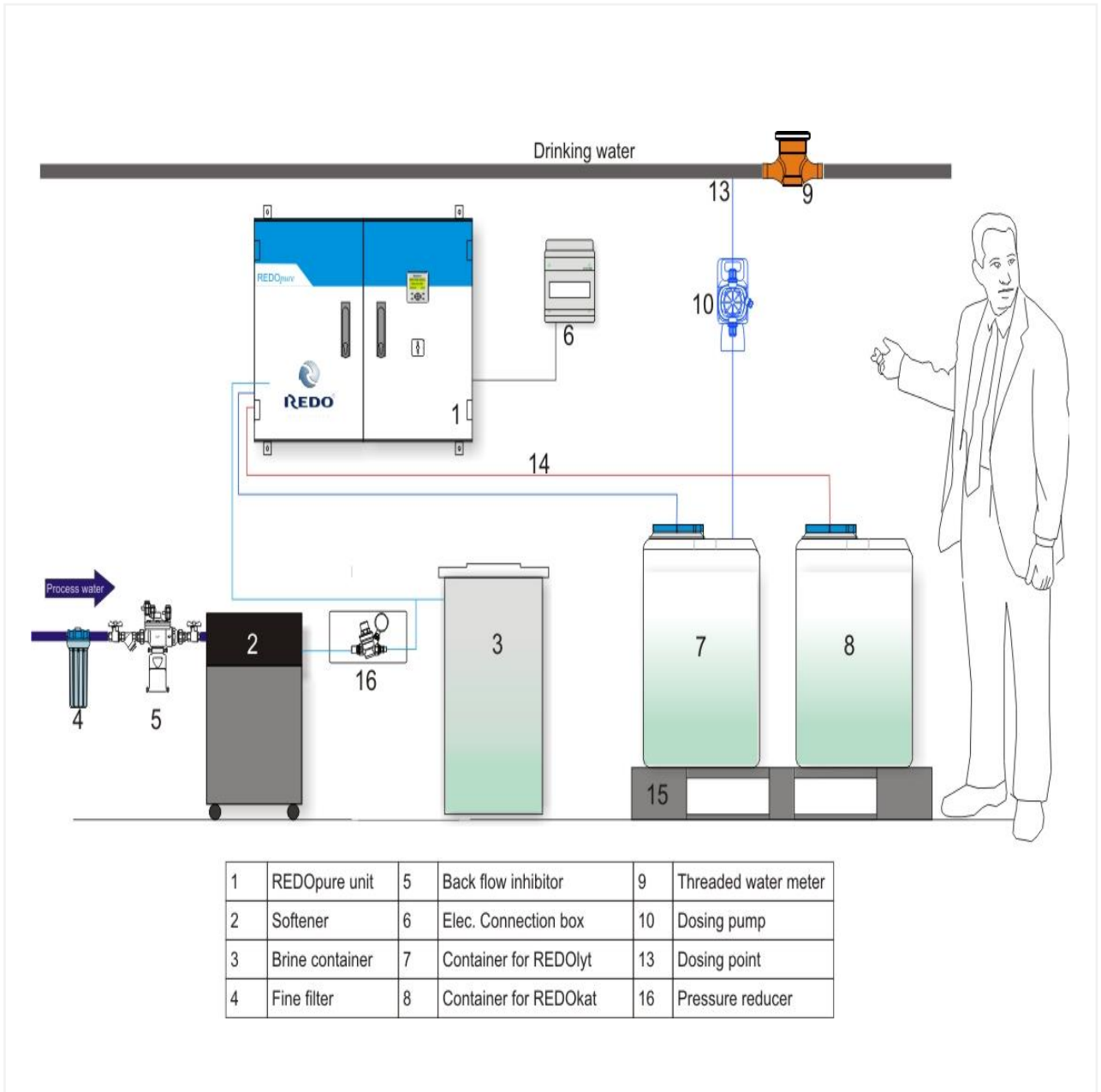


Technology comparison

Chlorine, Chlorine Dioxide, Ozone and UV

	Chlorine	Chlorine Dioxide	Ozone	UV	REDO
Depot effect	Long term	Very long term	Very short term	None	Very long term
Disinfecting effect	Average	Strong	Strong	Average	Very strong
Disinfection byproducts health hazard	Critical (THM, HAA)	Average (chlorites)	Average (bromates, aldehydes)	None	Minimal
Safety hazard	Extreme	High	Average	Very low	Very low
Operating resources	Chlorine Gas, Hypochlorite	HCl / NaClO ₂	Oxygen and Energy	Energy	Salt and Energy
Operating costs	Average	Average	High	High	Low to average

Installation Scheme





REDO Installation Waterwork

Essential REDO advantages

- ✓ Safe
- ✓ Effective
- ✓ Environmental friendly
- ✓ Easy to handle
- ✓ Low maintenance

- **Very strong disinfection, fighting also difficult germs**
- **Totally safe treatment process – no hazardous substances**
- **No public health risks – minimization of disinfection byproducts**
- **Elimination of biofilms**
- **No corrosion** due to pH neutral water disinfection
- **Very long lifetime**
- **Most effective, quick disinfection with long depot effect**
- **Water treatment meeting highest international standards**
- **Best energy efficiency – very low electricity consumption**
- **Base product salt** is a natural resource with low cost
- **Easy to handle – no expert stuff needed**





Cost concerns lead to on-site production of disinfection agents

Chlorine gas disinfection seems to be cheap at first sight. However, including the cost of safe handling, appropriate training, monitoring subcontractors, etc., safer alternatives are actually more economical for many water suppliers.

Hypochlorite is safer, but turns out to be even more expensive and less effective than chlorine gas, especially if surface water shows high microbiological load. Also, there are often challenges in ensuring that sodium hypochlorite supplied by contractors is original and potent.

Furthermore the quality of Hypochlorite varies due to the production and transportation process. Finally, worldwide production capacities for Hypochlorite are going down, shortages must be expected.

Therefore, many public water suppliers conclude that on site production of disinfectants is the best alternative. Here, REDO clearly provides the most potent and reliable on-site disinfection.



Cost of operation: Only salt and power ..

Energy: 12 – 16 Watthours per m³ water

Salt: Common salt (NaCl) for brine production





Simple operation and effective control



Operating requirements are mainly limited to regular replenishment of salt.

No specifically experienced operating personnel is required

REDO installations require very little maintenance and repair. REDO units always come with a 24 month guarantee.

REDO installations can be remotely monitored and controlled. A constant supervision of all production parameters and the overall disinfection can be performed for several water production plants in a central control center.



Remote monitoring and documentation

The REDO disinfection stage can be monitored from any location via secure remote access.

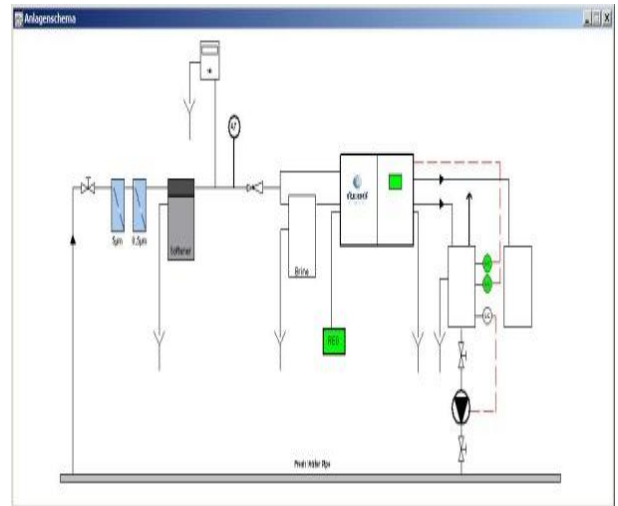
This way, any potential issue or alert can be identified quickly and routed to the appropriate personnel. Seamless integration in any existing monitoring centre of the water production plant is easy.

It is even possible to integrate other stages of the water production plant into the remote control system, thus automating the whole water production plant.

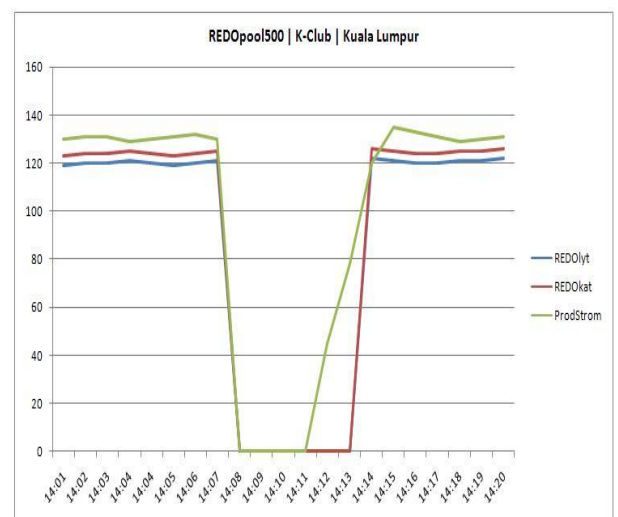
Upon request, REDO also provides monitoring and control services.

REDO identifies potential issues requiring maintenance or service operations BEFORE they have any impact on the disinfection performance.

Also, a complete documentation of disinfection performance is possible and facilitates public relations activities of the water production plant



Online supervision, remote monitoring of the overall installation



Remote monitoring of production parameters in Kuala Lumpur



REDO scalable installations small to large water production plants

The REDO stationary units are compact and extremely powerful when it comes to disinfection.

For small water production plants or wells, stationary units can be easily installed in an existing building. Networks of small wells can be monitored remotely and operated without daily personnel on site.

In large central water production plants, REDO installations require little building space, and can often be fitted into existing building layouts.



REDO 500

up to 150,000 litres/h
up to 3,000,000 litres /day (20 h time of operation)

REDO 3.000

up to 900,000 litres/h,
up to 18,000,000 litres/day (20 h time of operation)

REDO 30.000

up to 9,000,000 litres/h
up to 180,000,000 litres/day (20 h time of operation)

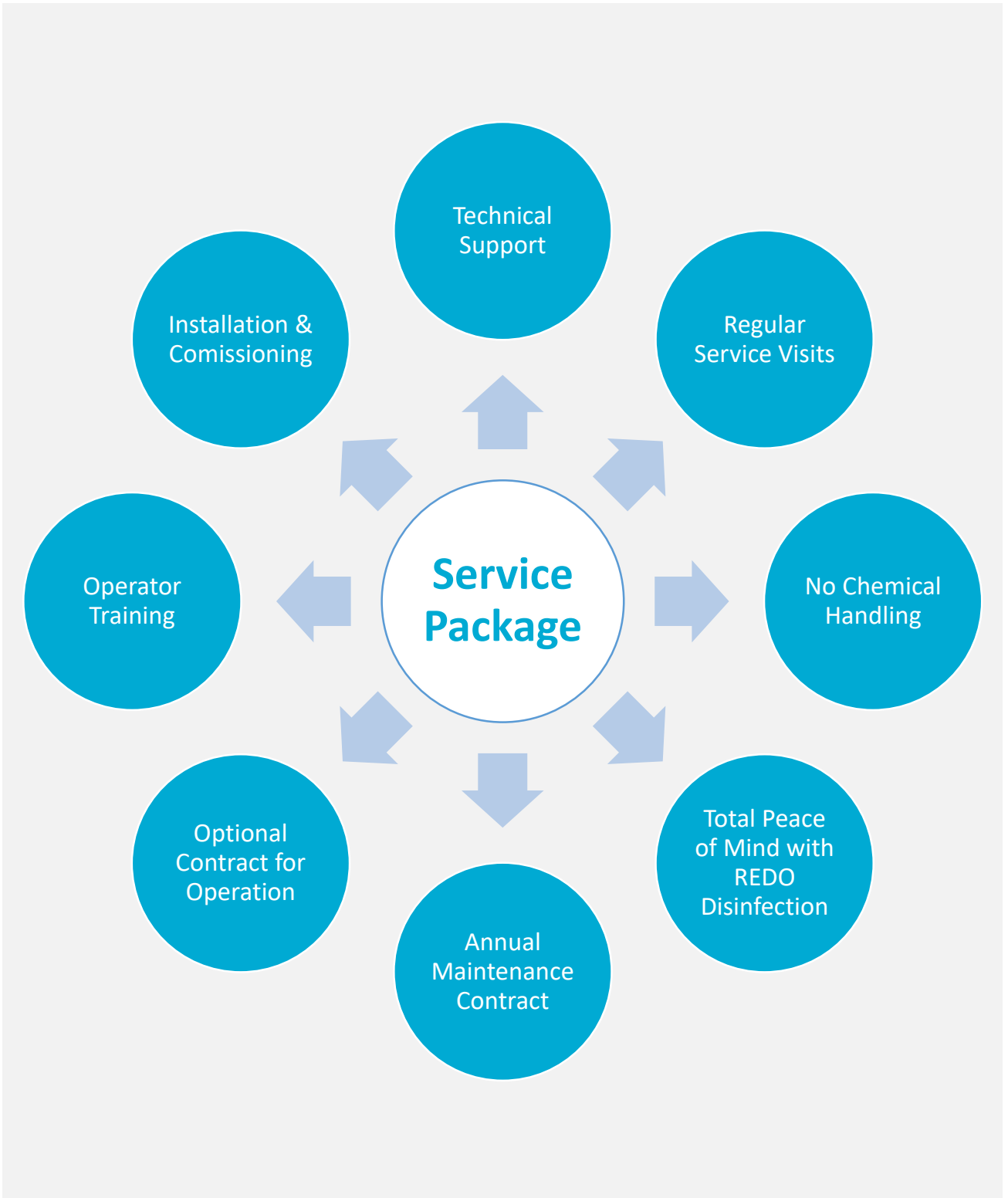


Containerized REDO Solutions

pre-engineered and pre-installed: for „plug and play“



Service package for REDO installations



3. OVERVIEW APPLICATION AREAS



REDO[®]
watersystems

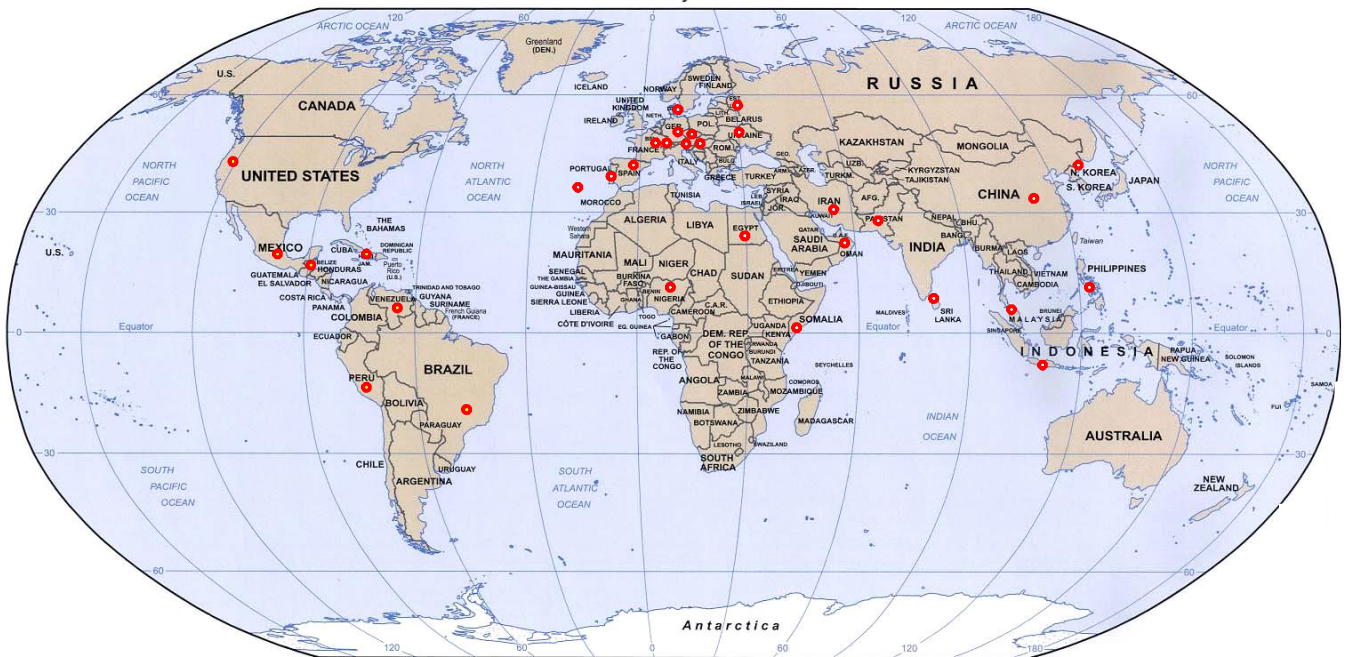
Overview

All Application Areas for REDO Disinfection



- **Public Water Supply / Utilities**
Waterworks, Rural Areas
- **Infrastructure**
Airports, Railways, Harbours
- **Buildings**
Hospitals, Hotels, Office and Residential Buildings, Schools
- **Live Stock Breeding**
Poultry Industry, Egg Production, Cattle Farming, Pig Farming, Fruit- and Vegetable Farming
- **Different Industries**
Beverage Industry, Food Industry, Bottling Plants, Water Tanker Services
- **Mobile Solutions**
Rural Areas, Military, Natural Disaster Areas, Charity Organisations

REDO References and Installations in 32 Countries and all Application Areas



4. REFERENCES AND CUSTOMER EXAMPLES



REDO[®]
watersystems

Customer Examples: Public Water Supply Waterworks with REDO Disinfection

Oman



Video Public Water Supply in Oman with REDO Disinfection:
<https://www.youtube.com/watch?v=n1eHw0dpew4&t=4s>



Customer Examples: Public Water Supply Waterworks with REDO Disinfection

Oman



Customer Examples: Public Water Supply Waterworks with REDO Disinfection

Oman



Customer Examples: Public Water Supply Waterworks with REDO Disinfection

Kiev, Ukraine



Customer Examples: Public Water Supply Waterworks with REDO Disinfection

Hungary



Waterwork Balmazújváros

Customer Examples: Public Water Supply Utilities using REDO Disinfection

Germany

A Mobile REDO Unit is used in Public Water Supply in Hessen / Germany for treatment of drinking water after construction works at the network or in emergency cases



Customer Examples: Public Water Supply Waterworks with REDO Disinfection

Egypt

The water treatment plant located in the city of Zagazig supplies approx. 50.000 people daily with about 17,5 million liters of drinking water. The water is obtained from the Nil.



Customer Examples: Public Water Supply Waterworks with REDO Disinfection

Iran - Yazd City

Part of the REDO installations in Yazd City, Iran:
Complete disinfection for a water production plant
with 20 million liters per day.



Customer Examples: Public Water Supply Waterworks with REDO Disinfection

Further installations in waterworks Iran



Customer Examples: Public Water Supply Waterworks with REDO Disinfection

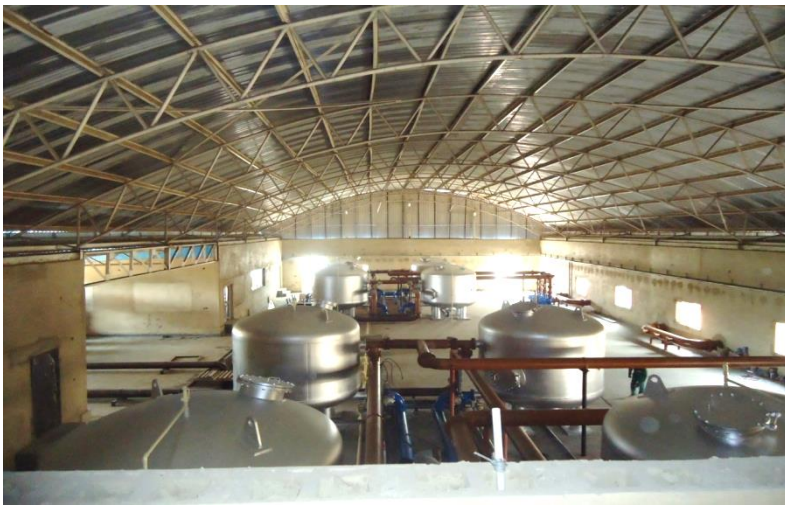
Ota Ikosi, Nigeria

The Plant Ota Ikosi in Lagos treats daily more than 18 million liters of water.



Customer Examples: Public Water Supply Waterworks with REDO Disinfection

Ota Ikosi, Nigeria



Customer Examples: Public Water Supply Waterworks with REDO Disinfection

Pyongyang, North-Korea



Customer Examples: Public Water Supply

Desalination Plants with REDO Disinfection



Customer Examples: Infrastructure Airports and Airline Industrie



Airbus

After a long and strict appraisal according to

- various international and
- company specific

health and safety regulations, corrosion protection analysis, etc. Airbus is today and since 2005 using REDO Technology for the disinfection of its planes in all international production sites, before delivery to the customer.



Customer Examples: Infrastructure Airports and Airline Industrie



Boeing

In 2015 also Boeing decided to use REDO disinfection at its production sites in the United States.

Now both market leaders in aircraft construction rely on REDO technology for water disinfection.



Customer Examples: Infrastructure Airport Frankfurt Hahn uses REDO since 2004



German Television on REDO Disinfection
at the Airport Frankfurt Hahn

<https://www.youtube.com/watch?v=WfUO3P0jQQU>



Customer Examples: Infrastructure Shipping

REDO Disinfection has been installed on a 100 meter nobel yacht, manufactured by a renowned German shipyard.

Besides the supply of potable water, a variety of other water disinfection applications can be realized with REDO on ships, e.g.

- Disinfection of balast water or wastewater
- Water disinfection in the kitchen area
- Water disinfection for food and beverage production (e.g breweries)
- Water disinfection of pools, hot tubs, sauna and plunge pools



Customer Examples: Hospitals

All state hospitals of Hungary are supplied with REDO Disinfection

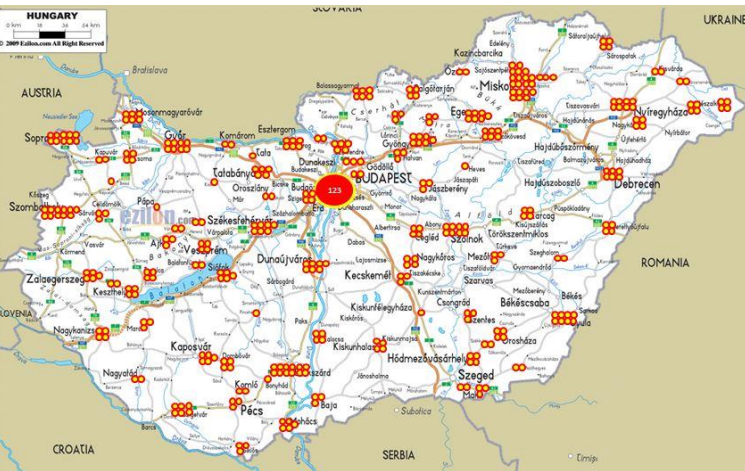


Semmelweis University Budapest uses REDO Disinfection



Supply of All State Hospitals in Hungary with REDO Disinfection

In 2017 all main Hungarian University Hospitals decided for REDO disinfection. In 2018 and after an EU wide tender, all state hospitals of Hungary, consisting of round about 450 building, were supplied with REDO disinfection.



Press Conference University Hospital Pecs after REDO installation



University Hospital Debrecen uses REDO Disinfection

Customer Examples: Buildings Hotels and Office Buildings



With a REDO installation, hotel guests in a hotel or employees in an office building can enjoy best drinking water quality from the tap.

Unlike with other disinfection methods, the water will stay germ-free in the pipe network for days. In addition plastic pottles can be replaced.

E.g. Hotels from Steigenberger Group, Ritz Carlton and the „German Bank for Doctors“ use REDO.



THE RITZ-CARLTON[®]
HOTEL COMPANY, L.L.C.



Customer Examples: Food-Processing Industry



Customer Example: Salad Production

REDO Technology for water disinfection has been installed in this food processing plant from a European market leader in the production of convenience salads

Customer Example: Fruit Production Company Portugal

According to FAO estimates, 20-75% of the produced food is lost on the way from production to consumption. A great part of this tremendous loss is caused by food degradation or fear of bacterial contamination.

The fruit production company GANFER, Portugal uses REDO for disinfection of apples, pears and peaches, prior to packaging and transportation.



Customer Examples: Livestock Breeding and Agriculture Projects



Layer Farm Philippines

Higher income through healthier animals and significantly lower use of antibiotics

REDO water causes a substantially lower mortality, a higher laying performance, a better feed utilization, therefore lower cost of feed, a better general health status and a higher vitality.

Livestock Breeding Projects Indonesia

With containerized REDO plants – preinstalled and ready for „plug and play“



Dairy Farm Portugal

The effects of REDO water on dairy farms:

The general health status of cows improves significantly, germ content and somatic cell count of the milk decrease.

This enables higher prices per litre and a reduction of the costs from diseases.

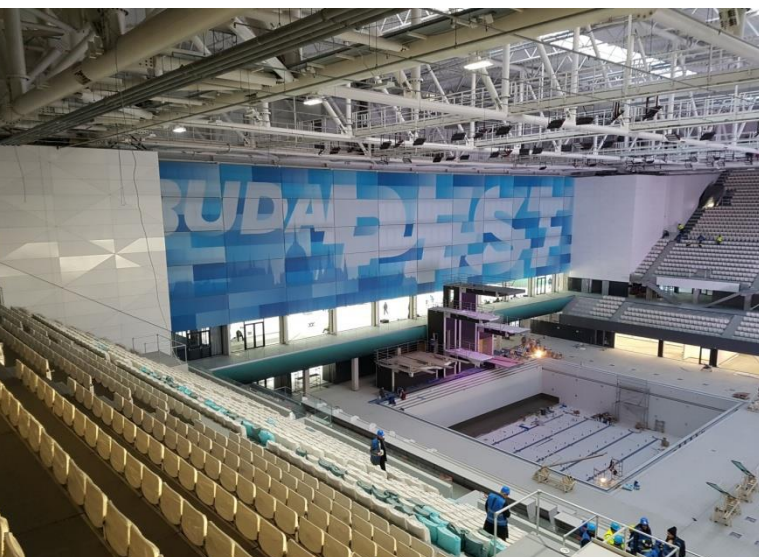
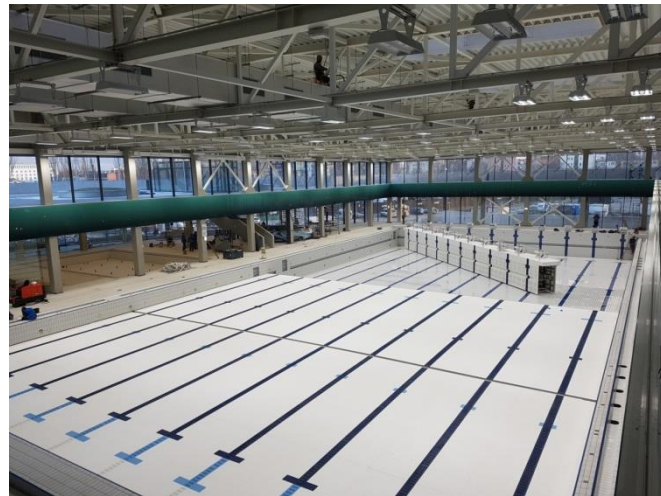
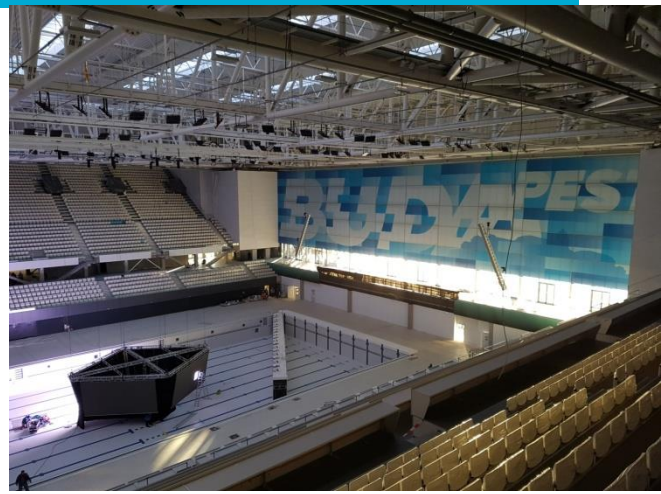
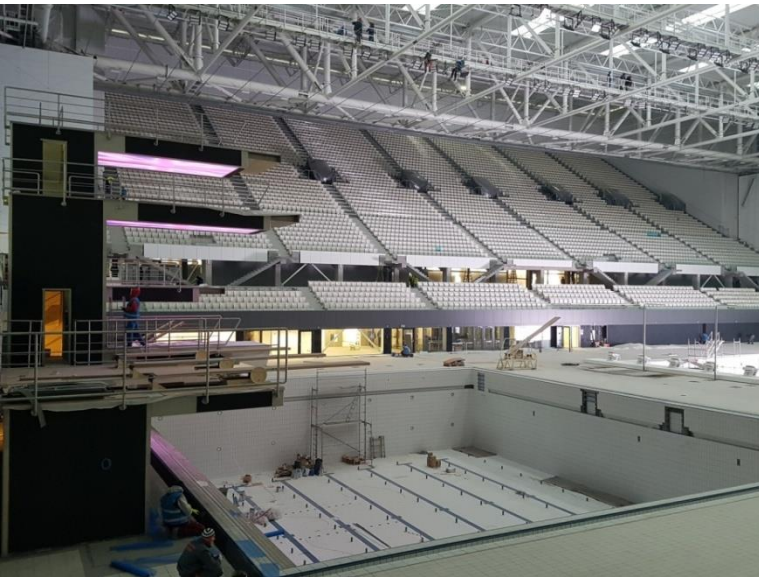
Agriculture Projects South America

With poultry and pig farms.



Customer Examples: Pools

Duna Arena Budapest



Mobile REDO Units

- for Rural and Remote Areas
- Disaster Relief and Crisis Areas
- and Military Applications



REDO Mobile Solutions – Disaster Relief



German Television on REDO Disinfection after Earthquake in Haiti
<https://www.youtube.com/watch?v=57hqHw8jfXg&t=3s>



Philippines



Sri Lanka



India



Sumatra

5. Contact India

**Intelligent Water Solutions GmbH
INWASOL**

Frankfurt / Germany
Zeppelinallee 21, 60325 Frankfurt
Germany

Pune / India
Opp.Vikas Weigh Bridge / Shivaji Chowk,
113 / 5, S Blowk / MIDC / Bhosari - Telco
Road / Pune 411026 / Maharashtra / India

CEO: Mareen Schneider
schneider@inwasol.de



www.inwasol.de

