Part I : General Description

**RED-OXY® TREATMENT**

**OXIDATION - ADSORPTION - FILTRATION**

Surface water + Ground water
- No Chlorine
- No Flocculent/alum
- No Acids
- No DBPs
- No Ozone

Disinfection

**RED-OXY- ADSORB** Dosing Solution
( 5% Strength )

Contaminants treatable by **RED-OXY**
- Metal Cations removed
- Anions removed
- Oxidation
- Disinfectant Oxidant
- Inorganic/organic Contaminants
- Endocrine Disrupting Chemicals (EDCs)
- Pharmaceuticals
- Pesticides

Wastewater from any source

Fig. 1
### Metal Cations Removed

<table>
<thead>
<tr>
<th>Element</th>
<th>Symbol</th>
<th>Charge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminum</td>
<td>Al</td>
<td>(III)</td>
</tr>
<tr>
<td>Arsenic</td>
<td>As</td>
<td>(III)</td>
</tr>
<tr>
<td>Barium</td>
<td>Ba</td>
<td>(II)</td>
</tr>
<tr>
<td>Cadmium</td>
<td>Cd</td>
<td>(II, III)</td>
</tr>
<tr>
<td>Calcium</td>
<td>Ca</td>
<td>(II)</td>
</tr>
<tr>
<td>Cerium</td>
<td>Ce</td>
<td>(III)</td>
</tr>
<tr>
<td>Cobalt</td>
<td>Co</td>
<td>(II)</td>
</tr>
<tr>
<td>Copper</td>
<td>Cu</td>
<td>(II)</td>
</tr>
<tr>
<td>Lead</td>
<td>Pb</td>
<td>(II)</td>
</tr>
<tr>
<td>Magnesium</td>
<td>Mg</td>
<td>(II)</td>
</tr>
<tr>
<td>Manganese</td>
<td>Mn</td>
<td>(II)</td>
</tr>
<tr>
<td>Mercury</td>
<td>Hg</td>
<td>(II)</td>
</tr>
<tr>
<td>Potassium</td>
<td>K</td>
<td>(I)</td>
</tr>
<tr>
<td>Silver</td>
<td>Ag</td>
<td>(I, II)</td>
</tr>
<tr>
<td>Thallium</td>
<td>Tl</td>
<td>(III)</td>
</tr>
<tr>
<td>Tin</td>
<td>Sn</td>
<td>(II)</td>
</tr>
</tbody>
</table>

### Anions Removed

<table>
<thead>
<tr>
<th>Anion</th>
<th>Formulas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arsenate</td>
<td>As (III)</td>
</tr>
<tr>
<td>Arsenite</td>
<td>As (V)</td>
</tr>
<tr>
<td>Ammonia</td>
<td>NH₃</td>
</tr>
<tr>
<td>Chromate</td>
<td>CrO₄²⁻</td>
</tr>
<tr>
<td>Fluoride</td>
<td>F⁻</td>
</tr>
<tr>
<td>Molybdate</td>
<td>MoO₄²⁻</td>
</tr>
<tr>
<td>Phosphate</td>
<td>PO₄³⁻</td>
</tr>
<tr>
<td>Selenite</td>
<td>SeO₃²⁻</td>
</tr>
<tr>
<td>Silicate</td>
<td>SiO₂⁴⁻</td>
</tr>
<tr>
<td>Sulfate</td>
<td>SO₄²⁻</td>
</tr>
<tr>
<td>Sulfite</td>
<td>SO₃²⁻</td>
</tr>
</tbody>
</table>

### Oxidation (inorganic & organic Contaminants)

1. - Diaminopropane
2. - Ethanediol
3. - Propanediol
4. – Butanetriol
5. – Propanediol
6. – Mercaptobenzoic acid
7. – Mercaptopethanesulfonic acid
8. – Amino-1-propanol
9. – Mercaptopropionic acid

- Acetaldehyde
- Acetone
- Alpha-Hydroxy-toluene
- Ammonia
- Aniline
- Benzenesulfinate
- Chloral
- Cyanide
- Cysteine
- Cysine
- Diethylamine
- Diethylsulfide
- Dimethylamine
- Dimethylglycine
- Dimethylsulfoxide
- Ethyl alcohol
- Ethyl ether
- Ethylene glycol
- Ferrocyanide
- Fornic acid
- Formaldehyde
- Glycerol
- Glycine
- Glycoaldehyde
- Glycolic acid
- Glyoxal
- Glyoxyllic acid
- Hydrazine
- Hydrogen sulfide
- Iminodiacetic acid
- Isopropyl alcohol
- Methionine
- Methyl alcohol
- Methylamine
- Methylhydrazine
- Neopentyl alcohol
- Nitriloacetic acid
- Nitrite
- Nitrosamines
- Methanol
**Oxidation**
(inorganic & organic Contaminants)

Continues...

N-methyliminodiacetic acid
Oxylc acid
Phenol
p-Aminobenzoic acid
P-Hydroquinone
p-Nitroaniline
p-Toluidine
Sarcosine
Thioacetamide
Thiodiethanol
Thiosulfate
Thiourea
Thioxane
Trimethylaldehyde

**Disinfectant & Oxidants**

Aerobic spore-bearers
B. Cereus
Bryopsis sp.
Caulerpa taxifolia
Dasya baillouviana
Enteromorpha intestinalis
Escherichia coli (E. Coli)
F-specific RNA-coliphage QB
f2 Coliphage
S. aureus
S. bovis
S. globigii
S. facalis
S. fiexneri
Sphaerotilus
S. Typhumurium
Styela plicata
Sulfite-reducing clostiridia
Thermotolerant coliforms
Total coliform

1,1,2,2 – tetrachloroethane
1,1,2 – trichloroethane
1,1 – dichloroethane
1,2 – dichlorobenzene
1,2 – dichloroethylene
1,2,3 – trichlorobenzene
2 - Chlorophenol
2- Nitrophenol
2,4,6 – Trichlorophenol
2,4 – Dichlorophenol
Acenaphene
Anthracene
Bromodichloromethane
COD
Chlorobenzene
Dichloromethane
Diethylphthalate
Dimethylphthalate
Ethylbenzene
Hexachlorobenzene
Nitrobenzene
Naphthalene
Pentachlorophenol
Phenantheme
Toluene
Trichloroethylene

**Endocrine Disrupting Chemicals (EDCs)**

Bisphenol A
Estrone (E1)
17b-Estradiol (E2)
17 a-Ethynylestradiol (EE2)
16 a-Hydroxyestrone
4-Nonylphenol
4-tert-Octyphenol

**Pharmaceuticals**

Sulfamethoxazole
Ibuprofen

**Pesticides**

• 2,4 – Dichlorophenoxyacetic acid
• 2,4,5 - Trichlorophenoxyacetic acid
• Dursban
• EDB (Ethylene di-bromide)
**Red-Oxy® Process**

**High Purity FERRATE**

Red-Oxy® process of mixing Hydrated ferric solution and strong OXY solution is the easiest method to produce pure Ferrate in the reaction tank. The purity of Ferrate is more than 99% in the mixed form. The Ferrate reduced is an exclusive process of Watch-Water Germany.

Red-Oxy® is the safest oxidant, inexpensive and "environmental friendly", especially for potable water and waste water treatment applications. Red-Oxy® is an ideal treatment for industrial and municipal effluent containing hazardous organic and inorganic compounds as explained on page no. 2-3. Using Red-Oxy® there is no need to dose poisonous and corrosive fesses like chlorine, hypochlorite or ozone. These oxidants have deleterious side effects. Additionally, the handling of chlorine, hypochlorite, HOCl, chlorine dioxide or ozone are potential danger to workers due to their high toxicity. And a major disadvantage of chlorine and chlorine dioxide or any other chlorine-containing oxidant produce, chloramines, chlorinated aromatics, chlorinated amines or hydrocarbons. All of these oxidants are potential mutagens or carcinogens, are for sure more toxic than the parent contaminants.

Red-Oxy® a new oxidant is designed to move away from chlorine, as well as ozone. Both of the compositions in red and oxy are oxidation products and 100% biodegradable. The Ferrate molecule precipitates out of solution as Fe(OH)₃ and now the adsorption process starts to collect cation as well as anions from the water. The iron containing sales can be easily filtered out by Katalox-Light leaving iron-free water containing innocuous by-products.

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**Fig. 2**

Contact Reaction Tank for adsorption
contact time 3 – 5 minutes
Red-Oxy® Generated Ferrate with Watch-Water® process is the most stable form of Ferrate (VI) because it is generated with Ferric Hexahydrate granules. The oxidant used in this process is a strong acid halogen which generated high voltage of oxidant without any DBPs. REDOX potential of the oxidant is as high as Hydroxyl Radicals. Watch-Water® has no doubt that its proprietary process will be commercialize world-wide with its own branches or through very close partners.

Watch-Water® understands chemistry. Generated Ferrate with its proprietary process of ONLY TWO COMPONENTS uses

\[
\text{Hexahydrate Granules} \quad \longrightarrow \quad \text{RED}^x
\]

\[
+ \quad \text{Acidic Halogen Oxidant} \quad \longrightarrow \quad \text{OXY}^x
\]

Red-Oxy® spontaneously decomposes in the presence of all contaminants listed on page 2 & 3, in any kind of water into strong oxygen and the most powerful Adsorbent based no ferric hydroxide with the surface area of 3500 m²/gram.

The chemical formation reaction is

\[
\text{Fe(OH)}_3 + \frac{3}{4}\text{O}_2 + 2\text{OH}^- \rightarrow \text{RED}^x
\]

This reaction is the strongest for the Oxidation-Adsorption of metals, non-metals and organic contaminants in water and wastewater treatment. These include ammonia, cyanide, thiocyanate and very high concentration of hydrogen sulfide. All other contaminants are listed on Page 2 & 3. As many of the reactions are pH based reaction it can be controlled in the process with OXYx (the most powerful oxidant and disinfectant against viruses and Coli-form Bacteria). Inactivation of viruses and all kind of bacteria occur faster as the pH drops, a phenomenon that has been attributed to mono-protonated form of HFeO₄⁻.

Red-Oxy® treatment can be done without investing on the equipments as in most of the systems worldwide the dosing equipment can be used from existing feed pumps which will bring substantial improvements in finished water quality, especially as regards to trace organic contaminants and DBPs. Most water treatment systems, regardless of their size, use a coagulant which in future is RED and a chemical disinfectant which in future is OXYx and the sand filter in future are Katalox-Light systems. However only adding ISOFT Corrosion Control chemicals may be necessary if after treatment corrosion-control is needed. Watch-Water has developed this technology in INSTANT form of RED & OXYx to save transportation cost of chemicals.

Solutions for all contaminants problem just got much easier. How to approach come thousand so of communities, municipalities to use this innovative treatment: Red-Oxy® - Oxidation and Adsorption represents an improved Multiple Applications.
Oxidant and Adsorption Equipments

First : Dosing Equipment for RED\(^x\)

In order to get the best results and to ensure the necessary Ferric Hydroxide production, the operator should take into account the „Total Contaminants“ to be removed.

Total contaminants and dosing ratio is 1 to 1. The dosing tank with mixer and the dosing pump should make the solution for one week. The flow control equipment to dose should be proportional. Watch-Water recommends the use of water-meters with contact cables.

Example:

<table>
<thead>
<tr>
<th>Cations (mg/L)</th>
<th>Anions (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iron</td>
<td>As (III)</td>
</tr>
<tr>
<td>Lead</td>
<td>As (V)</td>
</tr>
<tr>
<td>copper</td>
<td>Phosphate</td>
</tr>
<tr>
<td></td>
<td>silicate</td>
</tr>
</tbody>
</table>

| Value1           | Value2        |

Total \( B = \text{Value1} + \text{Value2} \). Select dosing \( 1 \times B \) amount of the prepared 5% OXY\(^x\) dosing solution with combination with \( 0.5 \times B \) amount of the prepared 5% RED\(^x\) dosing solution.

E.g. to neutralize 80 mg/L of phosphate dose 80 mg/L of OXY\(^x\) & 40 mg/L of RED\(^x\) dosing prepared solution. This would treat 1250 m\(^3\) of water with dosing solution prepared from 5 kg of OXY\(^x\) and 2.5 kg of RED\(^x\).

Second : Dosing Equipment for OXY\(^x\)

In order to achieve the best oxidation results to treat mixture of one or more impurities such as Biological impurities the same amount of oxidant to be used as in the process of Adsorbent production in the reaction tank. Biological impurities are those materials having biological origin. Thus any cells, bacteria, viruses, tissues or components thereof, whether from plants or animals can be considered to be biological impurities. This process will destroy sulfur-containing impurities and compounds containing sulfur atom including nitrogen-containing impurities, radioactive impurities etc. All other impurities as listed on the “contaminant list” (page 2 & 3).

Note:
- If ferrate dosing is low the results may not satisfactory and on the other hand if ferrate yield is too high, the pressure drop in the Katalox-Light unit will be high.
- There is virtually no limits of BOD or COD including TOC.

Third : Reaction Tank

Simple reaction tank should be chosen to provide a internal contact time of 3 to 5 minutes.
Katalox-Light Filtration

Water is fed to the Katalox-Light units for the filtration stage after Contact Reaction Tank. For Katalox-Light sizing please check Katalox-Light Technical Datasheet.

All salts and impurities captured by adsorbent are easier to filter out with Katalox-Light media, leaving iron free water containing none of the toxic byproducts.

In addition the nature of Katalox-Light can be utilized in urban or any industrial water treatment plants. Since the technology is the highest effective and disinfectant technology, it is possible to replace every Chlorinated drinking water equipment.

Therefore, any water, wastewater, irrigation water, surface water or ground water mixed with organic, inorganic or biological impurities in water can install Adsorption/Disinfection equipment.

Watch-Water® is proud to announce the newest addition to the Oxidation and Adsorption in One process, Red-Oxy® Treatment

Message from the Leader board

Our partners will build
• Laboratory pilot Scale
• On-site Pilot Scale

We will be using any kind of water samples. This will allow us to prove the technology.

If you ask, is FeO₄²⁻ the solution for
• Disinfection
• Oxidation and
• Adsorption followed by KL filtration
- for water treatment in future ?

The answer is YES!

99% purification/separation can be achieved using Red-Oxy® (Ferrate Hexahydrate) Technology.

Packaging:
• 4 x 5 kg bags of REDX (Hydrated Iron in solid form) in a box
• 4 x 5 kg bags of OXYX (oxidizer chemical in solid form) in a box
• 4 x 5 kg bags of ADSORBX (adsorbent chemical in solid form) in a box

Manufactured by:

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Mannheim, D-68165, Germany
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Email: info@watchwater.de

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