RED-OXY TREATMENT

OXIDATION – ADSORPTION – FILTRATION

REDOXY® is an **Advanced Oxidation Process** based on radical chemistry. The core technology lies in the generation of highly reactive **hydroxyl, sulfate, carbonate radicals** along with **Ferrate (VI)**. The normal reactions happening during the REDOXY® process are simplified in the below steps and illustrated visually in image 1 on next page.

STEP 1A // RED^{X} and OXY^{X} Dosing

In the first stage, our proprietary products RED^{X} (Catalyst) and OXY^{X} (strong acid halogen) are used to generate **Ferrate (VI)**, along with other radicals (refer to STEP 2). This Ferrate is generated by leveraging the power of iron being a transition metal. This form of Iron is highly unstable and difficult to generate. Thanks to RED^{X} developed by Watch Water®, Ferrate (VI) can be easily generated on-site.

Ferrate (VI) reacts vigorously with both organic and inorganic pollutants and remove suspended/colloidal particle materials. Both the chemicals RED^{X} and OXY^{X} are generally diluted at 5% concentrated solution and dosed at the same time.

$[FeO_4]^{2-}$ + Pollutant X (Organic) + Pollutant Y (Inorganic) ⟶ Degraded Pollutants (X′ + Y′)

The degradation of contaminants by Fe(VI) can occur through various pathways, including electron transfer to form **radicals, dimer formation, or through oxygen atom transfer.** Additionally, Fe(VI) can self-decompose, and reduce down to Fe(V), Fe(IV), Fe(III), and so on, which further contribute to pollutant breakdown.

Fe(VI)	+	X	—1 e- transfer→	Fe(V)	+	$X^{\bullet}$
Fe(VI)	+	X	—2 e- transfer→	Fe(IV)	+	$2X^{\bullet}$
Fe(VI)	+	X	—2 e- transfer→	Fe(IV)	+	X_2
Fe(VI)	+	X	—Oxygen atom tranfer→	Fe(IV)	+	XO

Ferrate (VI) i.e. [FeO4]2- is an inorganic compound which is the most effective water soluble oxygen species. Unlike other advanced oxidation methods, Ferrate (VI) produces minimal sludge, making it a highly efficient and versatile water treatment option for various applications. It can be used at as an oxidant, adsorbent, flocculant or even as a coagulant aid. With a redox potential of 2.20 V, it surpasses many common oxidizers.

One of the by product generated though this self-decomposition of Ferrate(VI) is Ferric Hydroxide $Fe(OH)_3$, which generally have very high surface area and act as a catalyst for ADSORB^{X} (refer to STEP 3).

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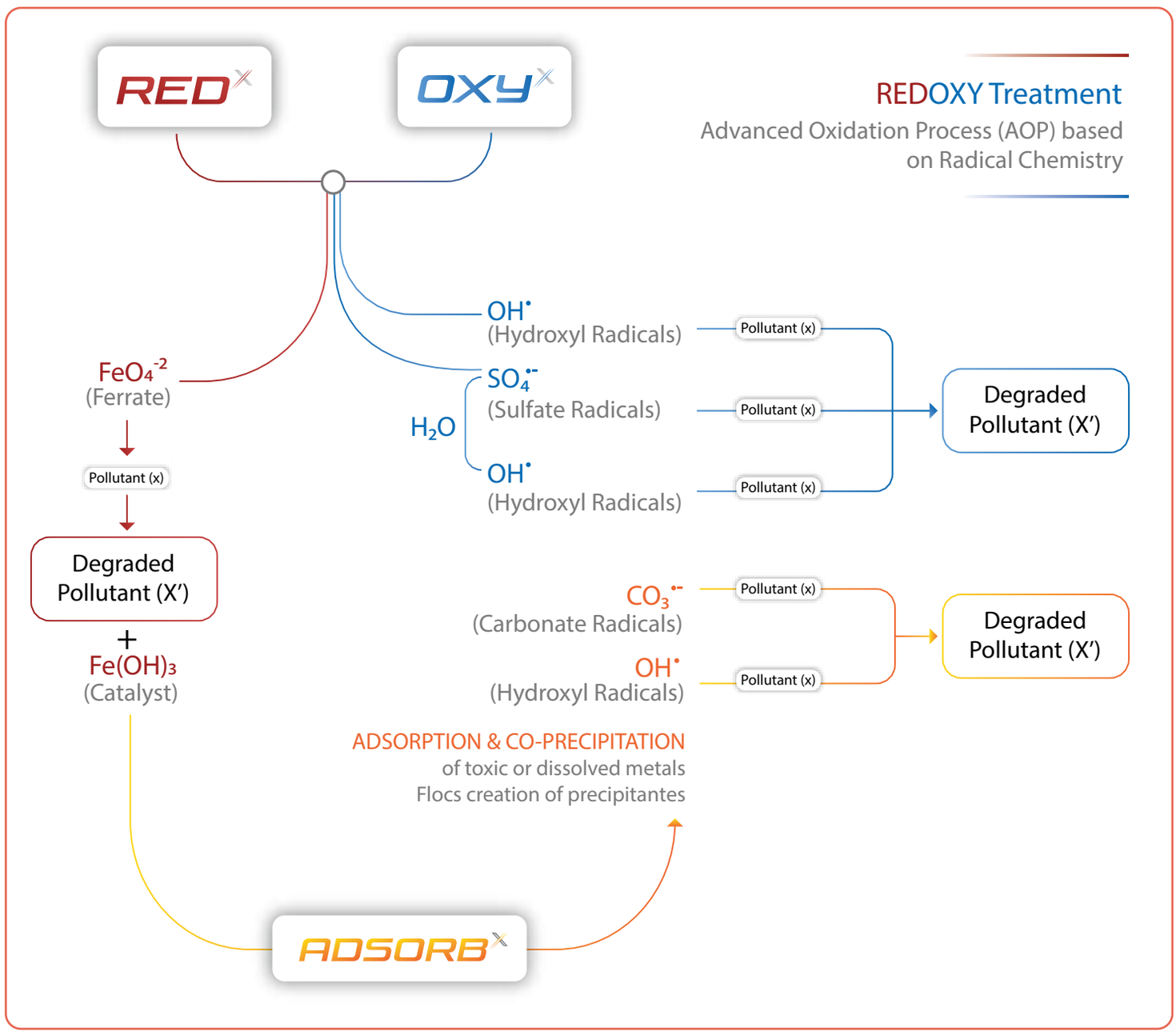
REDOXY TREATMENT

ADVANCED OXIDATION PROCESS

OXIDATION - ADSORPTION - FILTRATION



NOTES

1. The figure shows graphical representation for understanding. There might be intermediate reactions involved, which are not simplified & shown here.
*2. STEP 1 (Ferrate Generation) & STEP 2 (Radical Chemistry) occur **simultaneously** followed by STEP 3 (Reaction with ADSORBX) and then STEP 4 (Filtration with KATALOX LIGHT®) and STEP 5 (Polishing with CATALYTIC CARBON®)*

STEP 2 // RED^{x} and OXY^{x} Dosing

In the reaction process involving generation of Ferrate(VI), other strong radicals like Sulphate Radicals and Hydroxyl Radical are also generated. These two radicals increase the overall redox potential of the reaction manifolds which is un comparable to any other conventional oxidation method. These radicals are highly reactive in nature with a very short lifespan (a fraction of a second). They destroy majority of the organic pollutants, as they are extremely oxidizing in nature.

The Sulphate radicals provide the electrons and attack highly complicated and unsaturated chemicals bonds of contaminants. It generates the intermediates of degradation, which coupled with ability of other radicals or sulphate radical itself help in complete degradation of organic contaminants. Furthermore, sulphate radicals react with water (hydroxide ions) which leads to generation of more hydroxyl radicals. This further increases the oxidation power of the process.

The Hydroxyl radicals on the other hand work on the principle of fourfold destruction of any organic contamination, i.e. **Radical addition, hydrogen abstraction, electron transfer and radical combination**. This leads to chemical **degradation or even mineralization** of the organic pollutants.

STEP 3 // ADSORB^{X} Dosing

To scale up the efficiency even further and leverage full potential products generated in the previous steps, ADSORB^{X} is dosed to water or wastewater. The Iron Hydroxide generated previously act as a catalyst and generates **Carbonate and Hydroxyl radicals**. Like other reactive species, carbonate radicals also have an affinity to degrade several organic contaminant groups.

The adsorptive nature of ADSORB^{X}, help in removal of organic contaminants. It also adsorbs and co-precipitates the toxic inorganics or dissolved metals. At the same time, the high surface area of Iron Hydroxide flocs generated in the process further expands the adsorption capacity of the process.

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STEP 4 // KATALOX LIGHT® Filtration

Filtration is a very important step before performing any test on the treated water. It is very essential to remove the catalyst generated in process along with all the precipitates, non-dissolved contaminants etc. To perform this task, KATALOX LIGHT® filtration unit receive the water after the RED^{x} + OXY^{x} + ADSORBx contact reaction tank. Because of its high surface area, KATALOX LIGHT® captures all the precipitates, suspended solids and other impurities. Its catalytic surface provides filtration up to 2-3 micron. It's versatile nature allows utilization in urban and industrial water treatment plants.

Please Note: Proper dosing of RED^{x} is essential for satisfactory results, as excessive dosing may generate very high ferrate leading to pressure drops in the KATALOX LIGHT® unit.

STEP 5 // CATALYTIC CARBON® Polishing

Water at outlet of Katalox Light filtration is itself sufficiently clean. For further cleaning CATALYTIC CARBON® is used as the polishing filter. CATALYTIC CARBON® has a catalytic Metal Hydroxide coating and is one of the only such carbons with a catalytic surface available in the market. Polishing is used for better taste, odour and to remove traces of any targeted contaminations. CATALYTIC CARBON® technology can solve all the problems of trace toxic contaminants prior to discharge and provide the best quality **re-usable water**.

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