

# HYDROGEN PEROXIDE

## A POWERFUL, ENVIRONMENTALLY FRIENDLY OXIDIZING AGENT

With environmental regulations on contaminated waste becoming increasingly more stringent, Arkema develops innovative solutions based on **Albone®**, a concentrated hydrogen peroxide solution, for the environmental market.

**Albone®** hydrogen peroxide is among the most versatile, effective and environmentally friendly oxidizing agents. It is used to treat a large number of pollutants:

		Wastewater	Air pollutant	Soil / Groundwater
Organic Compounds	COD / BOD / TOC	◆		◆
	Phenol	◆		◆
	Formaldehyde	◆		
	Hydrocarbon	◆		◆
	Organohalogen	◆		◆
Inorganic Compounds	Hydrogen sulfide	◆	◆	
	Mercaptan	◆	◆	
	Sulfur dioxide		◆	
	Available chlorine	◆		
	Nitric oxide		◆	
	Nitrogen dioxide	◆	◆	
Others	Sludge reduction	◆		
	Odor	◆	◆	
	Color	◆		

◆ Use of Hydrogen Peroxide

### Albone®: Benefits

This is an environmentally friendly oxidizing agent as its breakdown products are water and oxygen. Therefore, its decomposition produces no other pollutant in the environment:



It is easy to implement, and requires little equipment, hence minor investment only, making it cost-effective compared to competing technologies.

The safety rules applying to the handling and storage of **Albone®** are no more stringent than those governing other reagents used in chemical plants or in wastewater treatment plants (caustic soda, bleach, etc.).

## Desulfurization

Pollution	Process	Market
<b>Hydrogen sulfide (H<sub>2</sub>S)</b> <b>Mercaptan (R-SH)</b>	<b>Low sulfur concentration</b> The direct oxidation of sulfide occurs very fast in liquid phase. Sulfides in gaseous phase are transferred to liquid phase using caustic soda prior to treatment. ○ Above pH 7: $S^{2-} + 4 H_2O_2 \rightarrow SO_4^{2-} + 4 H_2O$ The resulting product is sulfate, which is inert and soluble in water. ○ Below pH 7: $H_2S + H_2O_2 \rightarrow 1/8 S_8 + 2 H_2O$ The resulting product is colloidal sulfur. This is a straightforward and economical process.	- Municipal wastewater treatment: in the network or in the treatment plant - Industrial wastewater treatment: Refineries, as backup or to replace a stripper, Paper industry, Tanning industry, Rendering
	<b>High sulfur concentration Gaseous phase</b> ○ Above pH 7: $H_2S + H_2O_2 \rightarrow 1/8 S_8 + 2 H_2O$ Arkema has patented the conversion process of H <sub>2</sub> S into solid recyclable sulfur.	- Petrochemical and chemical industry: used during Claus maintenance
<b>Sulfur dioxide (SO<sub>2</sub>)</b>	Gas treatment using a chemical and physical washing process: $SO_2 + H_2O_2 \rightarrow H_2SO_4$ SO <sub>2</sub> oxidation is a very fast exothermic reaction. Its only reaction product is sulfuric acid, which is obtained directly and can be reused as a raw material.	- Incinerators - Iron and steel industry - Chemical and pharmaceutical synthesis - Production of graphite, titanium dioxide, sulfuric acid, etc.

## Chlorine removal

Pollution	Process	Market
<b>Available chlorine (ClO<sup>-</sup>, Cl<sub>2</sub>)</b>	In alkaline conditions, H <sub>2</sub> O <sub>2</sub> is a reducing agent: $ClO^- + H_2O_2 \rightarrow Cl^- + O_2 + H_2O$ The hydrogen peroxide process produces no additional salinity in the environment, unlike other reducing agents. Arkema has patented a system controlling foaming due to oxygen production.	- Effluents in the chemical industry - Incinerators

## Treatment of NOx fumes

Pollution	Process	Market
<b>Nitrite solution (NO<sub>2</sub><sup>-</sup>)</b>	In aqueous phase: $\text{NO}_2^- + \text{H}_2\text{O}_2 \rightarrow \text{NO}_3^- + \text{H}_2\text{O}$ This treatment can take place within the liquors in which the nitrites are produced.	- Thermal power plants - Municipal waste incinerators - Chemical industry:
<b>NOx fumes (NO, NO<sub>2</sub>)</b>	In gaseous phase: ○ $\text{NO} + \text{H}_2\text{O}_2 \rightarrow \text{NO}_2 + \text{H}_2\text{O}$ ○ $2 \text{NO}_2 + \text{H}_2\text{O}_2 \rightarrow 2 \text{HNO}_3$	Treatment of metals, Fertilizers, Glass

## Treatment of contaminated soil and groundwater

Pollution	Process	Market
<b>Organic residues</b>	Advanced oxidizing agent: ○ FENTON (H <sub>2</sub> O <sub>2</sub> catalyzed with Fe <sup>2+</sup> ) ○ H <sub>2</sub> O <sub>2</sub> / UV ○ H <sub>2</sub> O <sub>2</sub> / O <sub>3</sub>	- Treatment of contaminated soil, elutriation and leaching water, and groundwater
<b>Anaerobe</b>	H <sub>2</sub> O <sub>2</sub> is used as a source of oxygen in « bioremediation ».	- Treatment of contaminated soil

## Water treatment

Pollution	Process	Market
<b>Anaerobe</b>	H <sub>2</sub> O <sub>2</sub> is a source of oxygen. By adding H <sub>2</sub> O <sub>2</sub> in the environment, sulfides are no longer produced by sulfate-reducing bacteria.	
<b>BOD, COD, TOC</b> (phenols, alcohols, aldehydes, amines)	Advanced oxidizing agent : ○ Fenton (H <sub>2</sub> O <sub>2</sub> catalyzed with Fe <sup>2+</sup> ) ○ H <sub>2</sub> O <sub>2</sub> / UV ○ H <sub>2</sub> O <sub>2</sub> / O <sub>3</sub>	- Municipal and industrial wastewater treatment plants
<b>Filament-forming bacteria</b>	Continuous hydrogen peroxide injection eliminates these bacteria.	
<b>Sludge volume reduction</b>	Oxidative stress of the bacteria in activated sludge helps reduce sludge volumes.	

## Arkema: Research and Development

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With over 1,400 researchers around the world, Arkema allocates more than 3% of its annual sales to R&D. The Company's main R&D facility in Europe is the *Centre de Recherche Rhône Alpes* (CRRA, Lyon, France).

With its high-performance test equipment together with engineers specialized in a wide range of chemical fields, Arkema is well placed to assist its customers, in particular with new developments.

## Project Management

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- Site audit and analysis of the problem with the customer
- Physical and chemical analysis of effluents to be treated
- Prevention plan, process study, feasibility tests
- Cost analysis, profitability study
- Information on the safe handling and storage of **Albone®**
- Assistance with process implementation
- Support with industrial trials

## Logistics

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The Arkema teams advise their customers on storage and container stripping facilities, as well as on the type of equipment that should be used to ensure the safe handling of the product.

## Contacts

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CRRA  
Philippe ZYDOWICZ  
Technical Support Manager  
Tel : (33) 4 72 39 80 04  
philippe.zydowicz@arkemagroup.com

Rue Henri Moissan - BP 63  
69493 Pierre Bénite - France

Marketing Department  
Pierre BRAUD  
Market Manager  
Tel : (33) 1 49 00 73 93  
pierre.braud@arkemagroup.com

4-8 cours Michelet – La Défense 10  
92091 Paris La Défense Cedex - France

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Head Office  
4-8 cours Michelet – La Défense 10  
92091 Paris La Défense Cedex - France  
www.arkemagroup.com

[www.albone.arkemagroup.com](http://www.albone.arkemagroup.com)