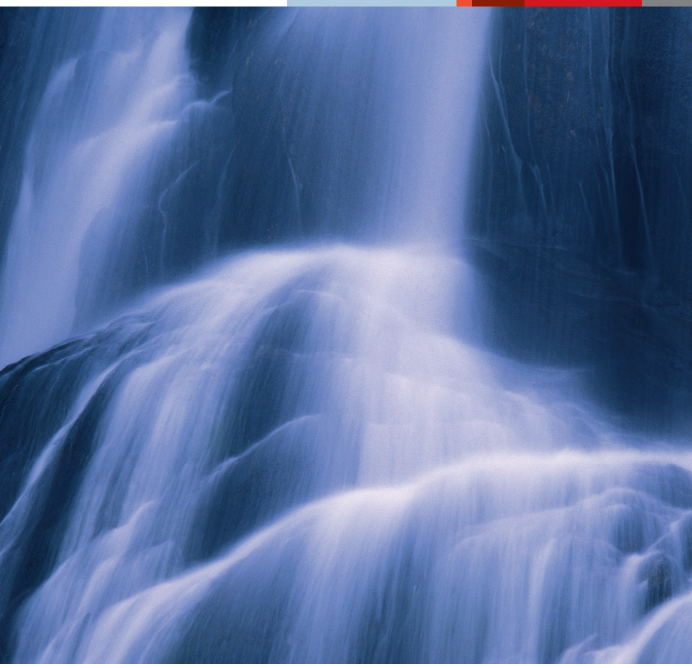
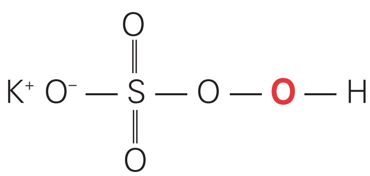
DuPont™ Oxone® Monopersulfate Compound

GENERAL TECHNICAL ATTRIBUTES



$2KHSO_5 \cdot KHSO_4 \cdot K_2SO_4$

Monopersulfate (MPS) = Peroxymonosulfate



(**O** = active oxygen)

DuPont™ Oxone® monopersulfate compound is a white, granular, free-flowing peroxygen that provides powerful non-chlorine oxidation for a wide variety of industrial and consumer uses.

Applications

- Swimming pool shock oxidizer
- Printed wiring board microetchant
- Repulping aid for wet-strength-resin destruction
- Odor control agent in wastewater treatment
- Bleach component in denture cleanser and laundry formulations
- Activator in antimicrobial compositions
- Other uses where its combination of powerful oxidation and relative safe handling properties are of value

The active ingredient of Oxone® is potassium peroxymonosulfate, $KHSO_5$ (CAS 10058-23-8), commonly known as potassium monopersulfate, which is present as a component of a triple salt with the formula $2KHSO_5 \cdot KHSO_4 \cdot K_2SO_4$ potassium hydrogen peroxymonosulfate sulfate (5:3:2:2), [CAS 70693-62-8]).

The oxidizing power of Oxone® is derived from its peracid chemistry; it is the first neutralization salt of peroxymonosulfuric acid H_2SO_5 (also known as Caro's acid).

Standard Potential

The standard electrode potential (E°) of $KHSO_5$ is given by the following half cell reaction:

$$HSO_5^- + 2H^+ + 2e^- \longrightarrow HSO_4^- + H_2O \quad E^0 = 1.85V$$

The thermodynamic potential is high enough for many room temperature oxidations including:

- Halide to active halogen
- Oxidation of reduced sulfur and nitrogen compounds
- Cyanide to cyanate
- Epoxidation of olefins
- Baeyer-Villigar oxidation of ketones
- Copper metal to cupric ion
- Ferrous to ferric ion
- Manganous to manganic ion

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DuPont™ Oxone® Technical Attributes

Stability

DuPont™ Oxone® is a very stable peroxygen in the solid state and loses less than 0.5% (relative) of its activity per month when stored under recommended conditions. However, like all other peroxygens, Oxone® undergoes very slow disproportionation with the liberation of heat and oxygen gas. If a decomposition is associated with high temperature, decomposition of the constituent salts of Oxone® may generate sulfuric acid, sulfur dioxide, or sulfur trioxide.

The stability is reduced by the presence of small amounts of moisture, alkaline chemicals, chemicals that contain water of hydration, transition metals in any form, and/or any material with which Oxone® can react. Since the decomposition of Oxone® is exothermic, the decomposition can self-accelerate if storage conditions allow the product temperature to rise (see Product Safety and Handling bulletin).

Aqueous solutions of Oxone® are relatively stable when made up at the unmodified pH of the product (*Figure 1*). The stability is adversely affected by higher pH, especially above pH 7. A point of minimum stability exists at about pH 9, at which the concentration of the mono-anion HSO_5^- is equal to that of the di-anion $SO_5^=$ (*Figure 2*). Cobalt, nickel, and manganese are particularly strong catalysts for the decomposition of Oxone® in solution; the degree to which catalysis occurs is dependent on the concentrations of Oxone® and of the metal ion.

Product Grades

Oxone® is available in both granular and liquid forms. By screening, grinding, or compaction/granulation processing, several granular grades (Regular, PS16, and CG) are produced which differ in particle size distribution (*Table 3*). Liquid products are specially-formulated to optimize active oxygen stability. *Please contact DuPont Sales and Support or an Oxone® technical representative for more information and guidance about which grade of product is best suited for your specific application.*

Solubility

Oxone® is highly and readily soluble in water as shown in *Table 2*. At 20°C (68°F), the solubility of Oxone® in water is >250 g/L. At concentrations above saturation, potassium sulfate will precipitate, but additional active component, potassium peroxymonosulfate, will remain in solution.

Figure 1. Effect of storage temperature on long-term stability of acidic Oxone® solutions (120 g/L, pH 1.6).

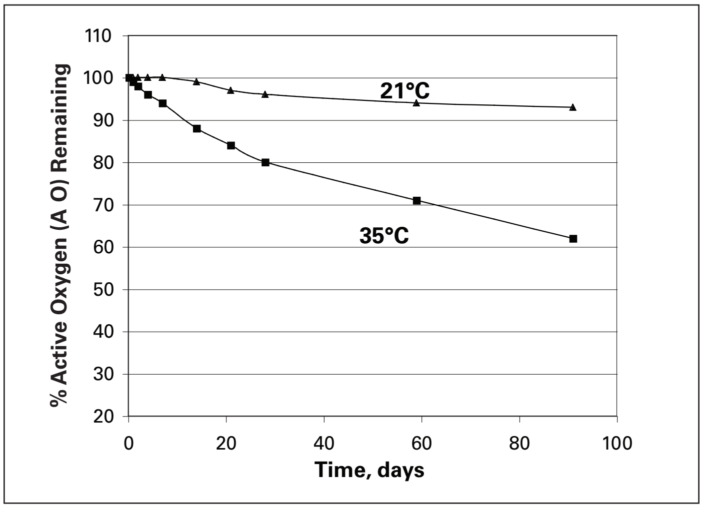
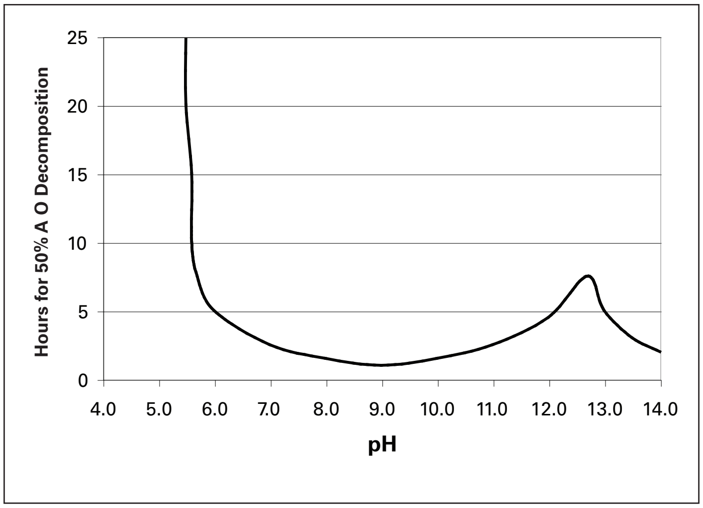


Figure 2. Effect of pH on Oxone® solution stability (3 wt% solution at 32°C)



DuPont™ Oxone® Technical Attributes

Table 1
Oxone® Physical Properties and Typical Analysis

Molecular Weight (Triple Salt)	614.7
Active Oxygen	
Min. %	4.5
Typical Analysis %	4.7
Theoretical % (Triple Salt)	5.2
Active Component $KHSO_5$	
Min. %	42.8
Typical %	44.7
Bulk Density	
g/cm^3 (kg/m^3)	1.15–1.40
lb/ft^3	72–87
Particle Size (PS16 Grade, see *Table 3*)	
% through U.S. Sieve #20	95
% through U.S. Sieve #200	4
pH, 25°C (77°F)	
1% solution	2.3
3% solution	2.0
Solubility, g/100 cc H_2O, 20°C (68°F)	29.8
Loss on Drying at 60°C, Max. %	0.1
Stability	
% Active oxygen loss/month	<0.5
Standard Electrode Potential (E°), V	+1.85
Heat of Decomposition	
kJ/kg	251
Btu/lb	108
Thermal Conductivity	
W/m·K	0.161
$BTU \cdot ft/h \cdot ft^2 \cdot F$	0.093

Tables show typical properties based on historical production performance. DuPont does not make any expressed or implied warranty that this product will continue to have these typical properties.

Table 2
Aqueous Solubility of Oxone® Monopersulfate Compound

°C	°F	g/100 cc H_2O	wt%	g/L
0	32	11.0	9.9	106
5	41	15.1	13.1	144
10	50	20.8	17.2	197
20	68	29.8	23.0	277
30	86	34.0	25.4	307
40	104	42.0	29.6	357
50	122	43.6	30.4	375
60	140	46.0	31.5	387

Table 3
Typical Bulk Density and Particle Size Analysis of Oxone® Product Grades

	Regular	PS 16	CG
Bulk Density			
lb/ft^3	72–79	75–87	56–75
g/cm^3	1.15–1.27	1.20–1.40	0.90–1.20
U.S. Sieve, μm			
–14 (1400)			>99
–16 (1180)		100	
–20 (850)		95	
–30 (600)	100	82	
–70 (212)	—	—	<1
–100 (150)	20	24	
–200 (75)	5	4	
–325 (45)	3	1	

DuPont™ Oxone® Technical Attributes

Analytical Test Methods

Active Oxygen/Active Component

1. Obtain a representative sample by riffling, quartering, blending, or other means.
2. Carefully weigh (to at least three decimal places) at least two specimens of 0.3 ± 0.05 g each.
3. Add to a 250 mL beaker or Erlenmeyer flask containing a magnetic stir bar: 75 mL deionized water, 10 mL 20% (v/v) sulfuric acid, and 10 mL 25% (w/w) potassium iodide solution. (Deionized water and all reagents should be <20°C [≤68°F].) Add a weighed specimen of Oxone®, and stir until dissolved.
4. Immediately titrate the specimen with 0.1 N sodium thiosulfate solution to a pale yellow color. Add 2–3 mL starch indicator solution, and the solution will turn deep blue. Immediately continue the titration to a colorless endpoint that persists for at least 30 seconds.
5. Calculations

$$\%\ \text{active oxygen} = \frac{\text{mLthio X Nthio X 0.008 X 100}}{\text{Specimen Weight (g)}}$$

% active component ($KHSO_5$) = % active oxygen/0.1053

6. Report the average of specimens analyzed.

Loss on Drying

1. Using the sampling procedure described above, weigh at least two 10 ± 0.1 g specimens in tared, approximately 10.2 cm (4 in) diameter, shallow aluminum weighing dishes.
2. Dry for 4 minutes in a Halogen Moisture Analyzer such as the Mettler Toledo HG63 at 60 ± 0.5°C (140 ± 1.0°F).
3. At the completion of the drying program, the percent loss on drying will be displayed.
4. Remove the specimen and cool to room temperature. Repeat measurement on second specimen. Report the average of specimens analyzed.

Other Testing Methods for Oxone®

Low concentrations of Oxone® (approx. 0–20 ppm), which are commonly used in swimming pool treatments can be measured in the presence of active chlorine by special test kits offered by Taylor (Model K-1518 , Model K-1520) and Lamotte (Model 3360). Taylor (Model K-1518) is a titrimetric test kit whereas Taylor (Model K-1520) and Lamotte (Model 3360) are colorimetric.

In the absence of active chlorine, low concentrations of Oxone® can be measured with a standard DPD-4 test kit; the result must be multiplied by 5.0 to obtain the correct Oxone® concentration in ppm.

In higher concentrations, Oxone® can be measured by addition of a known quantity of ferrous ammonium sulfate (in excess), followed by back-titration with standardized potassium permanganate or ceric sulfate solution.

For further information, please visit our website at www.oxone.dupont.com

To speak with a Customer Service Representative, call 1-888-243-4608 North America, 302-892-7536 International

For medical emergencies call 1-800-441-3637 within the United States. For those outside of the United States, call 302-774-1139

For transportation emergencies call 1-800-424-9300 within the United States. For those outside of the United States, call 703-527-3887

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