QUALITY PERFORMS.

Monopersulfate Compound
General Technical Attributes.

Oxone™

QUALITY WORKS.

LANXESS
Energizing Chemistry

MONOPERSULFATE COMPOUND
PRODUCT INFORMATION

What is Oxone™?

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.

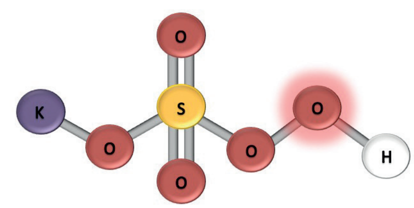
The active ingredient of Oxone™ is potassium peroxymonosulfate, $KHSO_5$ commonly known as potassium monopersulfate, which is present as a component of a triple salt with the formula $2KHSO_5 \cdot KHSO_4 \cdot K_2SO_4$ (pentapotassium bis(peroxymonosulphate) bis(sulphate), [CAS 70693-62-8]).

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).

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
- Other uses, where its combination of powerful oxidation and relative safe handling properties are of value

*As with any product, use of Oxone™ in a given application must be tested (including field testing, etc.) by the user in advance to determine suitability.



Standard Potential

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

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

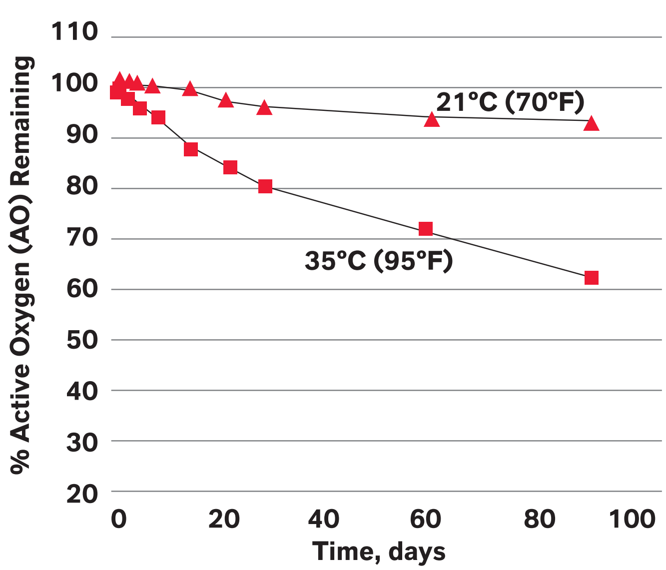
The thermodynamic potential is high enough for many room temperature oxidations, including:

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

Stability

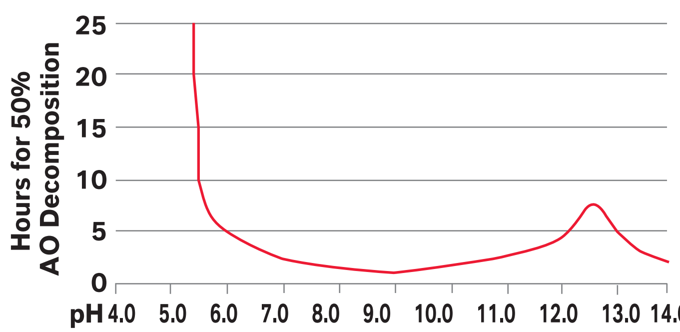
Oxone™ is a very stable peroxygen in the solid state and loses less than 0.5% (relative) of its activity per month when stored under recommended conditions. However, like all other peroxygens, Oxone™ undergoes very slow disproportionation with the liberation of heat and oxygen gas.

Figure 1: Effect of Storage Temperature on Long-Term Stability of Acidic Oxone™ Solutions (120 g/L, pH 1.6)



*Liquid availability is region-dependent.

Figure 2: Effect of pH on Oxone™ Solution Stability (3 wt% Solution at 32°C [90°F])



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. Because 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^{2-} (Figure 2). Cobalt, nickel, iron 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 the metal ion.

Product Grades

Oxone™ is available in both granular and liquid* forms. By screening, grinding, or compaction/granulation processing, several granular grades (MPS CMP, PS - 16, and CG) are produced that differ in particle size distribution (Table 3). Liquid products are specially formulated to optimize active oxygen stability. Please contact LANXESS 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.

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
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 (140°F), 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•ft/h•ft^2•F	0.093
Purity, %	90.3

* These items are provided as general information only. They are approximate values and are not considered part of the product specifications.

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

* These items are provided as general information only. They are approximate values and are not considered part of the product specifications.

Table 3: Typical Bulk Density* and Particle Size Specifications of Oxone™ Product Grades

	MPS CMP	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
Particle size, % Pass Thru (or % Retained, where specified)			
# 14 (1410 µm)	–	–	0 – 4 (% Retained)
# 16 (1180 µm)	–	99 - 100	–
# 20 (850 µm)	100	80 - 100	–
# 30 (600 µm)	95 - 100	63 - 100	–
# < 70 (210 µm)	–	–	0 – 4
# 100 (150 µm)	5 - 35	5 - 33	–
# 200 (75 µm)	0 - 10	0 - 10	–
# 325 (45 µm)	0 - 5	0 - 3	–

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, which will turn deep blue. Immediately continue the titration to a colorless endpoint that persists for at least 30 seconds.
5. Calculations

   $$\%\text{ active oxygen} = \frac{\text{mL thio} \times \text{N thio} \times 0.008 \times 100}{\text{specimen weight (g)}}$$

   % 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 3330-01). Taylor (Model K-1518) is a titrimetric test kit, whereas Taylor (Model K-1520) and Lamotte (Model 3330-01) 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.

Health and Safety Information: Appropriate literature has been assembled which provides information concerning the health and safety precautions that must be observed when handling the LANXESS products mentioned in this publication. For materials mentioned which are not LANXESS products, appropriate industrial hygiene and other safety precautions recommended by their manufacturers should be followed. Before working with any of these products, you must read and become familiar with the available information on their hazards, proper use, and handling. This cannot be overemphasized. Information is available in several forms, e.g., safety data sheets and product labels. Consult your LANXESS Corporation representative or contact the Product Safety and Regulatory Affairs Department at LANXESS.

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The manner in which you use and the purpose to which you put and utilize our products, technical assistance and information (whether verbal, written or by way of production evaluations), including any suggested formulations and recommendations are beyond our control. Therefore, it is imperative that you test our products, technical assistance and information to determine to your own satisfaction whether they are suitable for your intended uses and applications. This application-specific analysis must at least include testing to determine suitability from a technical as well as health, safety, and environmental standpoint. Such testing has not necessarily been done by us. Unless we otherwise agree in writing, all products are sold strictly pursuant to the terms of our standard conditions of sale. All information and technical assistance is given without warranty or guarantee and is subject to change without notice. It is expressly understood and agreed that you assume and hereby expressly release us from all liability, in tort, contract or otherwise, incurred in connection with the use of our products, technical assistance, and information. Any statement or recommendation not contained herein is unauthorized and shall not bind us. Nothing herein shall be construed as a recommendation to use any product in conflict with patents covering any material or its use. No license is implied or in fact granted under the claims of any patent.

Note: The information contained in this publication is current as of May, 2018. Please contact LANXESS Corporation to determine if this publication has been revised.

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