INTRODUCTION

Whether using basic aeration (O2) or applying powerful commercial oxidants, environmental professionals have long recognized the importance of oxidation chemistry for the elimination of unwanted impurities in water, soil and air. The potential for oxidants to break-down organic pollutants into carbon dioxide and water make them a valuable tool to include in many treatment programs. Specifically, permanganate is an effective oxidant for odor control applications because it reacts with a wide variety of organic functional groups and molecular structures that give many compounds their characteristic odor. Permanganate will also rapidly oxidize inorganic hydrogen sulfide, H2S, eliminating its distinctive “rotten egg” odor. For over 100 years permanganate ion, with its unique reactive capabilities, has played an important role as one of several successful oxidants.

LIQUID PERMANGANATE PRODUCTS

Permanganate is manufactured by most suppliers as the potassium salt (KMnO4), a stable crystalline powder of high purity (minimum 95%). Since the late 1990s, Carus has also manufactured permanganate as a concentrated liquid. In this form (NaMnO4), permanganate chemistry is available for immediate, convenient use.

PERMANGANATE CHEMISTRY

CARUSOL® liquid permanganate contains 20%, by weight, active sodium permanganate while CARUSOL® C is stronger, containing 40%, by weight, active ingredient. With either product, the active ingredient is the same, the permanganate ion (MnO4-). They will react in the same way under the same conditions. While the system pH can influence the rate and completeness of permanganate reactions, within the pH range typical of water treatment, pH 3-9, there will be a 3-electron transfer resulting in the precipitation of manganese dioxide (MnO2).

There are two important visual clues to observing permanganate oxidation reactions. First, MnO4-1 ion, when dissolved in water, has a distinctive pink to purple color. This color indicates that permanganate ion is available for the treatment process. Second, when permanganate reacts, it precipitates as MnO2. This solid particle is yellow-gold to brown in color. When MnO2 is freshly made via a permanganate reaction, it has a very high surface area that attracts positively charged metal ions and can participate as a seed particle for flocculation of other suspended solids.

\[
\text{NaMnO}_4 + 2 \text{H}_2\text{O} + 3 \text{e}^- \rightarrow \text{MnO}_2 (s) + \text{NaOH} + 3 \text{OH}^- 
\]

The advantage of using liquid permanganate products is their high aqueous solubility. There is no mixing required and it is ready to be fed with little handling. CARUSOL products can be accurately metered using a small dosing pump constructed of compatible materials. They can be added directly as a concentrated solution or diluted with water to transport the permanganate to the point of application.

SOLUBILITY IS THE DIFFERENCE

The information contained herein is accurate to the best of our knowledge. However, data, safety standards and government regulations are subject to change, and the conditions of handling, use or misuse of the product are beyond our control. Carus Corporation makes no warranty, either expressed or implied, including any warranties of merchantability and fitness for a particular purpose. Carus also disclaims all liability for reliance on the completeness or confirming accuracy of any information included herein. Users should satisfy themselves that they are aware of all current data relevant to their particular use(s).

Copyright 2015
Form # LX 11017
## Summary

The summary chart is a quick reference guide for comparing liquid permanganate products.

<table>
<thead>
<tr>
<th></th>
<th>CARUSOL® Liquid Permanganate</th>
<th>CARUSOL® C Liquid Permanganate</th>
</tr>
</thead>
</table>
| **Chemistry**        | Active ingredient is permanganate ion \((\text{MnO}_4^-)\)  
Assay – 19.5-21.5%  
Specific gravity – 1.15-1.17  
Density – 9.7 lb./gallon  | Active ingredient is permanganate ion \((\text{MnO}_4^-)\)  
Assay – 39.5-41.0%  
Specific gravity – 1.36-1.39  
Density – 11.4 lb./gallon  |
| **Packaging**        | Bulk deliveries – 3,000-4,200 gallon  
IBCs – 262 gallon  
Drums – 55 gallon  
Jerrican – 5 gallon  | Bulk deliveries – 3,000-3,800 gallon  
IBCs – 262 gallon  
Jerrican – 5 gallon  |
| **Water Solubility** | 50%, by weight, maximum at room temperature  
CARUSOL is manufactured as a 20% aqueous solution, by weight  | 50%, by weight, maximum at room temperature  
CARUSOL C is manufactured as a 40% aqueous solution, by weight  |
| **Transportation and Shipping** | Hazard label “Oxidizer”;  
Packaging Group II  | Hazard label “Oxidizer”;  
Packaging Group II  |
| **Storage**          | Stable for 3 years when stored under proper conditions  
Product segregation and containment are necessary  | Stable for 3 years when stored under proper conditions  
Product segregation and containment are necessary  |
| **Handling and Feeding** | Can be dosed directly as delivered product from the product package  
When feed rates require small volumes, it may be necessary to dilute the concentrated liquids to better match available dosing pump sizes  
Aggressive oxidant requires careful handling and selection of equipment materias of construction  | Can be dosed directly as delivered product from the product package  
When feed rates require small volumes, it may be necessary to dilute the concentrated liquids to better match available dosing pump sizes  
Aggressive oxidant requires careful handling and selection of equipment materias of construction  |
| **Housekeeping**     | This product is a strong oxidant, handle with care.  
Protective equipment during handling should include a face shield and/or goggles, rubber or plastic gloves, chemical resistant clothing. Spontaneous ignition can occur with cloth or paper. Spills must be diluted with water to 6% concentration or less and then reduced using bisulfate or ferrous salt solution  | This product is a strong oxidant, handle with care.  
Protective equipment during handling should include a face shield and/or goggles, rubber or plastic gloves, chemical resistant clothing. Spontaneous ignition can occur with cloth or paper. Spills must be diluted with water to 6% concentration or less and then reduced using bisulfite or ferrous salt solution  |

Permanganate products are not registered as a pesticide under the Federal Insecticide, Fungicide and Rodenticide Act administered by U.S. EPA or similar state laws. Use as a pesticide is not government approved.