



## TECHNICAL SUMMARY

CAIROX® potassium permanganate or CARUSOL® liquid permanganate is used in water treatment for the oxidation and removal of color caused by natural organic matter (NOM). Organic functional groups which cause color (by absorbing visible light) include carbon-carbon double bonds, aromatic structures, and groups that complex trace metals. Carbon-carbon double bonds and phenolic-type groups are particularly amenable to oxidation by permanganate. Hydrous manganese oxides, formed as a co-product of oxidation by permanganate, are removed from the water in the clarification and filtration processes.

Water quality parameters that affect removal efficiency include pH, temperature and application point. Removal efficiency is generally higher when a longer reaction time (>60 minutes) is available before coagulation.

## APPLICATION

Sufficient time is required for oxidation and/or coagulation of reaction products. The preferred location for feeding permanganate is the point that gives the longest contact time ahead of coagulation, usually at the intake of the plant or at the well field. The permanganate feed is usually placed just after the aerator when aeration is used to remove sulfide.

## CHEMISTRY

Permanganate oxidizes color-causing functional groups present in the NOM. Carbon-carbon double bonds and phenolic-type groups are particularly amenable to oxidation by permanganate.

## DOSAGE

The correct dosage depends on the water chemistry and application point. Please contact Carus for technical assistance in this area.

## FACILITY REQUIREMENTS

To effectively introduce potassium permanganate into the system, proper feed equipment is necessary and available from Carus. For proper removal of solids, the utility should employ filtration or coagulation/filtration. Operators should be properly trained to handle permanganate and be aware of safety and emergency procedures.

## BENEFITS

Permanganate has been shown to reduce color. The freshly precipitated manganese oxide floc can further help improve water quality by adsorbing metal ions and organic compounds.

Permanganate also:

- Helps control tastes and odors

- Acts as a substitute oxidant to chlorine in a disinfection by-product (DBP) control program.

## REFERENCES

Water Quality & Treatment: A Handbook of Community Water Supplies, AWWA, McGraw Hill, Inc. New York, 1999.

Stewart, R., Oxidation by Permanganate, reprinted from Oxidation in Organic Chemistry, Part A, Academic Press, New York, 1965.

Christman, R. F., Johnson, J.D. et. al. Chlorination of Aquatic Humic Substances, Report No. EPA-600, University of North Carolina at Chapel Hill, Jan. 1981.

Vlastnik, E., Evaluation of CAIROX® KMnO<sub>4</sub> Feed for Color Removal, Tech #8441, Carus Corporation, 2001



Municipal Drinking Water  
Treatment for Color  
Removal

CAIROX® POTASSIUM PERMANGANATE  
CARUSOL® LIQUID PERMANGANATE  
TECHNICAL BRIEF

## OTHER APPLICATIONS

- Taste & Odor Control
- Biosolids Odor Control
- Iron & Manganese Removal
- Arsenic & Radium Removal

## CARUS VALUE ADDED

### LABORATORY SUPPORT

Carus Corporation has technical assistance available to answer questions, evaluate treatment alternatives, and perform laboratory testing. Our laboratory capabilities include: treatability studies, feasibility studies, and analytical services.

### FIELD SERVICES

As an integral part of our technical support, Carus provides extensive on-site treatment assistance. We offer full application services, including technical expertise, supervision, testing, and feed equipment design and installation in order to accomplish a successful evaluation and/or application.

### EQUIPMENT SERVICES

Standard feeders are designed specifically for CAIROX® potassium permanganate. Various options and accessories are available to meet a wide range of applications. Custom-engineered feed systems are complete, pre-engineered and prepackaged systems. They provide efficient, dust-free methods of storing, mixing, and feeding CAIROX potassium permanganate. System designs are customized to meet specific applications and customer needs.

### CARUS CORPORATION

During its more than 100 year history, Carus' ongoing reliance on research and development, as well as its emphasis on technical support and customer service, have enabled the company to become the world leader in permanganate, manganese, oxidation, and base-metal catalyst technologies.