# CARUS WATER



Municipal Drinking Water Treatment for Arsenic Removal

CAIROX® POTASSIUM PERMANGANATE
CARUSOL® LIQUID PERMANGANATE
TECHNICAL BRIEF

## TECHNICAL SUMMARY

Potassium permanganate is used to remove arsenic (As) in ground water treatment systems that employ filtration. Permanganate oxidizes arsenic ($As^{3+}$) to $As^{5+}$ that can adsorb to insoluble precipitates such as hydros manganese hydroxides or ferric hydroxide. The precipitates are then removed from the water supply in the clarification and filtration processes. Permanganate can also be used for arsenic removal in surface water plants that have filtration.

Factors that affect removal efficiency include water chemistry, pH, temperature, contact time, and application point. Reaction times are rapid under normal conditions of temperature and pH. However, temperatures <35° F, and pH values <5.5 require reaction times longer than two minutes. In most cases, 5 to 10 minutes of reaction time is sufficient.

It has been demonstrated that the presence or addition of iron ($Fe^{2+}$) will enhance the efficiency of As removal. A ratio of Fe to As of 20:1 is recommended.

## APPLICATION

Precipitates (e.g. $MnO_2$) are removed more easily in hard water than soft water. Sufficient time (approximately 30 minutes) is suggested for coagulation of the oxidation by-products. The preferred location for feeding permanganate is the point that gives the longest contact time ahead of coagulation, usually at the intake or well head of the plant.

## CHEMISTRY

$$3As^{3+} + 2MnO_4 = 4H_2O \rightarrow \mathbf{2MnO_2 + 3As^{5+} + 8OH}$$

## DOSAGE

1 part of soluble arsenic requires 1.26 parts of potassium permanganate

## FACILITY REQUIREMENTS

Proper feed equipment specially designed to handle potassium permanganate is recommended and available from Carus. For proper removal of As, the utility must have filtration or coagulation/filtration to remove the arsenic containing precipitates formed during oxidation. In addition, alkalinity and hardness >50 mg/L are recommended for proper coagulation of these precipitants.

## BENEFITS

Potassium permanganate quickly oxidizes $As^{3+}$ in most cases without pH adjustment. The freshly precipitated arsenic and manganese floc will further absorb metal ions and organic compounds while enhancing the effectiveness of the coagulation process.

Permanganate also:

- removes iron, manganese, hydrogen sulfide and other undesirable compounds,
- helps control tastes and odors, and
- acts as a substitute oxidant to chlorine in a disinfection by-product (DBP) control program.

## REFERENCES


1. Lauf, G. F., Waer, M .A. Arsenic Removal Using Potassium Permanganate, AWWA WQTC, 1993
2. Ficek, K. J., "The Potassium Permanganate/Greensand Process for Water Treatment" Water Quality Association Conference, 1994





CORPORATE HEADQUARTERS | 315 Fifth Street, Peru IL 61354 | Tel +1.815.223.1500 / 1-800-435-6856 | Fax +1.815.224.6697 | Web: www.caruscorporation.com | E-mail: salesmkt@caruscorporation.com
CARUS EUROPE | Calle Rosal 4, 1-B | Oviedo, Spain 33009 | Tel +34.985.785.513 / Fax +34.985.785.510




rev. 07/17
Form # CX 3707

CARUS
WATER



Municipal Drinking Water Treatment for Arsenic Removal

CAIROX® POTASSIUM PERMANGANATE
CARUSOL® LIQUID PERMANGANATE
TECHNICAL BRIEF

## OTHER APPLICATIONS

- Taste & Odor Control
- Iron & Manganese Removal
- Disinfection By-product Control
- 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. Carus offers custom-engineered feed systems , pre-engineered and prepackaged systems through an equipment partner. 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.

### ADDITIONAL TECHNICAL BULLETINS

CARUSOL Liquid Permanganate Fact Sheet (Form #LX 11001)
CAIROX Potassium Permanganate Oxidizes Manganese (Form # CX 3304)

### 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.

For further information on CAIROX® potassium permanganate or CARUSOL® liquid permanganate product characteristics and availability, contact Carus Corporation at 1-800-435-6856.



CORPORATE HEADQUARTERS | 315 Fifth Street, Peru IL 61354 | Tel +1.815.223.1500 / 1-800-435-6856 | Fax +1.815.224.6697 | Web: www.caruscorporation.com | E-mail: salesmkt@caruscorporation.com
CARUS EUROPE | Calle Rosal 4, 1-B | Oviedo, Spain 33009 | Tel +34.985.785.513 / Fax +34.985.785.510


rev. 07/17
Form # CX 3707