

Municipal Drinking Water Treatment for Arsenic Removal

Technical Brief

Technical Summary

Potassium permanganate is used to remove arsenic (As) in ground water treatment systems that employ filtration. Permanganate oxidizes arsenic (As³⁺) to As⁵⁺ that can adsorb to insoluble precipitates such as hydrous 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.

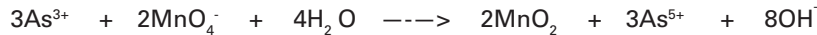
Factors that affect removal efficiency include water chemistry, pH, temperature, contact time, and application point. Reaction times are rapid under normal conditions of temperature and pH. However, temperatures <35°F, and pH values <5.5 require reaction times longer than two minutes. In most cases,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

It has been demonstrated that the presence or addition of iron (Fe²⁺) will enhance the efficiency of As removal. A ratio of Fe to As of 20:1 is recommended.

Application

Precipitates (e.g. MnO₂) 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 potassium permanganate is the point that gives the longest contact time ahead of coagulation, usually at the intake or well head of the plant.

Chemistry



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 As³⁺ in most cases without pH adjustment. The freshly precipitated arsenic and manganese floc will further adsorb 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.

Lauf, G. F., Waer, M. A., Arsenic Removal Using Potassium Permanganate, AWWA WQTC, 1993

Ficek, K. J., "The Potassium Permanganate/Greensand Process for Water Treatment" Water Quality Association Conference, 1994

References

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

CARUS CHEMICAL COMPANY

Other Applications

- Taste & Odor Control
- Iron & Manganese Removal
- Disinfection By-product Control
- Radium Removal

Carus Value-Added

LABORATORY SUPPORT

Carus Chemical Company has technical assistance available to answer questions, evaluate treatment alternatives and perform laboratory testing. Our laboratory capabilities include; Feasibility Studies, Treatability 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 & ENGINEERED SYSTEMS

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 pre-packaged 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.

A recyclable container system using a Carus CYCLE-BIN™ is available for the delivery of large quantities of potassium permanganate with minimal operator involvement. CARUSOL® Liquid Permanganate eliminates the need to prepare potassium permanganate solutions and can be fed with simple dosing pumps.

ADDITIONAL TECHNICAL BULLETINS

CARUSOL® Liquid Permanganate Fact Sheet (Form # LX 11001)
Carus Chemical Company-Who we are and what we do (Form # CC100)
CAIROX® Potassium Permanganate Oxidizes Manganese (Form # CX 3304)
Equipment Selection and Application Guide (Series 2000)

CARUS CHEMICAL COMPANY

During its more than 90-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.




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Form # CX 3707

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