



## TECHNICAL SUMMARY

The National Primary Drinking Water Regulations for Radium 226 and Radium 228 have a Maximum Contaminant Level (MCL) of 5 pCi/L. The MCL for gross alpha emitters is 15 pCi/L. Potassium permanganate or sodium permanganate is used in combination with manganese sulfate to produce freshly precipitated Hydrous Manganese Oxides (HMO's). These hydrous manganese oxides have high surface area that is negatively charged which gives it the ability to adsorb positively charged ions, such as radium.

Factors that affect radium removal efficiency include water chemistry and pH. Removal efficiencies increase with increasing pH from 5 to 9. Removal efficiencies decrease with increasing levels of hardness (mg/L as calcium carbonate). Removal efficiencies range from 60-80 percent.

## APPLICATION

The hydrous manganese oxides are created by reacting manganous sulfate with permanganate.

## CHEMISTRY



It is recommended that the slurry of HMO then be pH adjusted to 8.0 (minimum) using NaOH.

1 mg/L of soluble manganese requires 1.92 mg/L of permanganate.

## DOSAGE

Typically dosages of 0.5 - 1.0 mg/L of HMO are effective for radium reduction.

## FACILITY REQUIREMENTS

Proper feed equipment specially designed to handle CAIROX® potassium permanganate or CARUSOL® liquid permanganate are recommended and available from Carus Corporation. There are also feed systems for the proper addition of CARUS® MnS or MnP Manganese Sulfates. For proper removal of the hydrous manganese dioxide, the utility must have filtration or coagulation/filtration to remove the Manganese Dioxide (MnO<sub>2</sub>). In many facilities the preformed HMO is aged for 24 hours and then fed via metering pumps.

Permanganate quickly oxidizes Mn<sup>2+</sup> to form hydrous manganese oxides. The freshly precipitated HMO will adsorb metal ions and organic compounds.

## BENEFITS

Permanganate also:

- Improves tastes and odors,
- Controls iron and manganese,
- Acts as an alternative pre-oxidant to chlorine in a trihalomethane control program, and
- Oxidizes and adsorbs arsenic.

## REFERENCES

Richard L. Valentine, Alan Kurt, John Meyer, Dave Walsh, and William Mielke. (1992) "Radium Removal Using Preformed Hydrous Manganese Oxides," American Water Works Association Research Foundation, 666 W. Quincy Avenue, Denver, CO 52242.

Ficek, K.J., "Potassium Permanganate/Manganese Greensand for Removal of Metals," Water Quality Association, Convention Paper, March 1994.

Tom Dumbaugh (2004) "Hydrous Manganous Oxide (HMO) Process for Radium Reduction Design and Practical Operating Experience." Water Quality Technology Conference.



Municipal Drinking Water  
Treatment for Radium  
Removal

CAIROX® POTASSIUM PERMANGANATE  
CARUSOL® LIQUID PERMANGANATE

TECHNICAL BRIEF

## OTHER APPLICATIONS

- Taste & Odor Control
- Disinfection By-Product Control
- Iron & Manganese Removal
- Arsenic & Radium Reduction/Removal

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

## 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.

### 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.

CARUS CORPORATION

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