

Municipal Drinking Water Treatment Pre-Oxidation for Disinfectant by-product Control

Technical Brief

Technical Summary

Trihalomethanes (THMs) and Haloacetic Acids (HAA's) are formed when chlorine reacts with the organic precursors in raw water. These precursors include humic and fulvic acids. Moving the point of chlorination from the raw water to later in the treatment and practicing effective coagulation of the precursors can result in a 40% to 70% reduction in trihalomethane levels. Current regulations limit THM concentrations in finished water to 80 µg/L and HAA concentrations in finished water to 60 µg/L.

Potassium permanganate is used in these systems as an alternate oxidant to pre-chlorination. Further reduction (5%-20%) in THM and HAA concentrations may result from permanganate addition. The primary purpose of permanganate treatment in these cases is as a substitute pre-oxidant for chlorine to oxidize organics causing tastes and odors, and to oxidize inorganic iron and manganese. Permanganate is not a substitute disinfectant for chlorine.

Application

Laboratory tests simulating plant conditions of time, addition of other treatment chemicals, etc., are conducted to determine the Permanganate Value (PV_t), where t is time. The procedure is described in Carus Form # 3353. This is the raw water permanganate demand in a given period of time.

Potassium permanganate is usually fed at the intake to allow the oxidant to react with the raw water before the addition of other treatment chemicals. A residual of 0.1 to 0.2 mg/L $KMnO_4$ should be maintained in the water entering the treatment plant. Control can be visual or monitored using residual permanganate analytical methods given in Standard Method 4500- $KMnO_4$.

Chemistry

Raw Water Organic Compounds + $KMnO_4$ \rightarrow MnO_2 + No Trihalomethanes Formed
No Haloacetic Acids Formed

Dosage

Normal dosages will range between 0.5 and 2.5 mg/L $KMnO_4$ depending on the degree of raw water contamination. The average dosage is ~1.0 mg/L $KMnO_4$.

Facility Requirements

Proper feed equipment specially designed to handle potassium permanganate is recommended and available from Carus. The product must be put into solution before being introduced into the system. Operators should be trained to monitor permanganate residuals and to exercise proper safety precautions when handling the oxidant.

Benefits

A cost-effective disinfectant by-product control program includes the application of potassium permanganate in place of raw water chlorination. Permanganate does not form trihalomethanes or haloacetic acids, oxidizes taste and odor producing compounds, and aids in the coagulation process.

References

Zawacki, J., $KMnO_4$ Contributes to Least Cost Treatment Solution, *Water Engineering & Management*, (May 1992). Form #3057

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Ma, J., Graham, N., Controlling the Formation of Chloroform by Permanganate Preoxidation-Destruction of Precursors, *J Water SRT-Aqua*, Vol.45, No.6, (1996)

Ficek K. J., Boll, J. E., Potassium Permanganate: An Alternative to Prechlorination, *Aqua*, No. 7, (1980). Carus Form #240

Standard Method 4500- $KMnO_4$ Potassium Permanganate, *Standard Methods for the Examination of Water and Wastewater*, 20th Edition, (1998). Carus Form CX #3353

For further information on CAIROX® potassium permanganate and 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
- Biosolids Odor Control
- Arsenic & Radium control

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

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.

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.

Carus Chemical Company
315 Fifth Street
P. O. Box 599
Peru, IL 61354
Tel. (815) 223-1500
Fax (815) 224-6697
Web: www.caruschem.com
E-Mail: salesmkt@caruschem.com



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