CAIROX® POTASSIUM PERMANGANATE & CARUSOL® LIQUID PERMANGANATE

Municipal Drinking Water Treatment for Radium Removal Technical Brief

TECHNICAL SUMMARY

The National Primary Drinking Water Regulations for Radium 226 and Radium 228 have a Maximum Contaminate Level (MCL) of 5 pCi/L. The MCL for gross alpha emitters is 15 pCi/L. CAIROX potassium permanganate or CARUSOL liquid permanganate is used in combination with manganese sulfate to produce freshly precipitated Hydrous Manganese Oxides (HMOs). 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 60-90 percent.

APPLICATION

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

CHEMISTRY

$$3MnSO_4 + 2MnO_4^- + 2H_2O \longrightarrow 5MnO_2 + 4H^+ + 3SO_4^{2-}$$

1 mg/L of soluble manganese requires 1.92 mg/L of potassium permanganate.
1 mg/L of soluble manganese requires 1.71 mg/L of sodium 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 or CARUSOL are recommended and available from Carus. 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 MnO_2. In many facilities the preformed HMO is aged for 24 hours and then fed via metering pumps.

Permanganate quickly oxidizes Mn^{2+} to form HMOs. The freshly precipitated HMO will adsorb metal ions and organic compounds.

BENEFITS

Permanganate also:

- Improves tastes & odors
- Controls iron & manganese
- Acts as an alternative pre-oxidant to chlorine in a dis-infection by-product control program
- Oxidizes & adsorbs arsenic

REFERENCES

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

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