### Technical Brief

**Technical Summary**

During the refining of crude petroleum, the sulfur component of the crude oil reacts with the specialty alloy steel processing equipment producing iron sulfide scale. Pyrophoric iron sulfide scale, when exposed to air, reacts exothermically and can result in a fire. Toxic sulfide odors can also be formed during these turnarounds.

Permanganate oxidizes pyrophoric iron sulfide to iron sulfate eliminating the potential for exothermic reactions and fires or explosions during shut downs for maintenance of refinery process equipment. Permanganate treatment also controls toxic odors by oxidizing the sulfides to odorless sulfates.

Permanganate (NaMnO$_4$ or KMnO$_4$) is added to the process equipment as a 0.1% to 1.0% aqueous solution. The units are filled with the permanganate solution and the solution is recirculated, or agitated depending on the design of the process. Control is visual. As the solution turns from purple to brown, the permanganate is being used up. The spent permanganate solution can be discharged directly to the sanitary sewer.

**Chemistry**

FeS + 2MnO$_4$ → Fe SO$_4$ + MnO$_2$¯ + H$^+$

**Dosage**

Due to the variability of the amount of iron sulfide present on the equipment, an exact dose of permanganate cannot be calculated. It is recommended that the permanganate solution be fed until a faint purple to pink color is observed in the finished water.

**Facility Requirements**

Proper mixing tanks and feed pumps compatible with a permanganate solution are required. Operators should be trained in making up the permanganate solution and in monitoring permanganate residuals. Operators should be given appropriate safety and emergency training.

**Benefits**

- Complete, effective control of pyrophoric iron sulfide
- Lower overall costs of vessel cleaning
- Reduced danger of toxic gas release
- Reduced danger of fire or explosion
- Visual indication when reaction is complete
- Safer employee working conditions
- No pH adjustment necessary
- Spent solution can be discharged safely
- No special materials of construction needed

**References**


For further information on CAIROX® potassium permanganate or ECONOX® agent characteristics and availability, contact Carus Chemical Company at 1-800-435-6856.
Other Applications

- Drinking Water Treatment
- Wastewater Treatment
- Organic Oxidation
- Industrial Wastewater Treatment

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.