## Technical Brief

### Denim Bleaching and Wastewater Treatment

### Technical Summary

Permanganate is one of the preferred color reduction agents for the production of “distressed” or “bleached” denim. These looks can range from very slight, random bleaching to almost complete white out of the blue indigo dye. Permanganate is widely used for denim bleaching due to its efficient removal of the indigo dye and its non-destruction of the Lycra® fibers commonly used in today’s materials. Permanganate is also used to treat wastewater to remove Indigo and other dyes.

### Application

Denim bleaching has taken on many different forms in the past, and will continue to evolve as new fashions are developed. Potassium permanganate is one of several agents used for this purpose. The permanganate solution is typically added as a liquid with or without pumic stone. Liquid can also be sprayed onto the garment. Additional applications may include dipping, screen printing, or any other inventive ways of applying permanganate to create new fashions.

### Chemistry

For Indigo oxidation:

\[
3C_{16}H_{10}N_2O_2 + 4KMnO_4 + 2H_2O \rightarrow 4MnO_2 + \text{Anthranilic Acid} + 4KOH
\]

(Indigo) (Permanganate)

The dosage of permanganate is driven by the “desired” look. In some cases where highly distressed garments are desired, concentrations as high as 10-12% permanganate can be applied. Where a mild bleaching action is desired, concentrations ranging from 0.5-2% may be used.

### Dosage

A reducing agent, such as sodium metabisulfite or hydroxylamine sulfate, is applied to neutralize the residual permanganate and the manganese dioxide, a product that results from the permanganate oxidation. The reducing agent is generally added at 2% of the total dry weight of the garments. When sodium metabisulfite is used, the temperature should be maintained at 130-140 F. If hydroxylamine sulfate is used, the temperature only needs to be 110-120 F. Two 8-10 minute reduction baths are used. After neutralization it is important to have several hot water washes. Hot water washes are necessary to help avoid yellowing of indigo dyed garments caused by the reaction of isatin and manganese dioxide. The rinsing helps remove these compounds from the garments.

### Neutralization

### Benefits

**For Denim Bleaching:**
- Efficient removal of indigo
- Non-destructive to Lycra® fibers
- Easily applied

**For Wastewater Treatment:**
- Oxidation of dye compounds
- Lower COD and BOD discharges
- Improved dewatering

### References


For further information on CAIROX® potassium permanganate product 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 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.