## Technical Brief

### Technical Summary

In the production of multilayer printed circuit boards, friction-melted resin (epoxy) known as smear, coats the surface of the conductive inner layers preventing good electrical connections between layers. Solutions of either potassium permanganate or sodium permanganate are used to desmear and etchback these through-holes. Electrolytic regeneration of the permanganate reduces chemical and waste treatment costs.

Permanganate is also used to treat wastewater to remove chelated cyanide and to reduce high Chemical Oxygen Demand (COD).

### Application

A typical permanganate desmearing bath contains 80 g/L permanganate (potassium or sodium), 45 g/L sodium hydroxide, and is heated to 80°C (176°F). The multilayer boards are immersed in this bath for about 10 minutes.

An etchback bath typically contains 160 g/L permanganate, 40-80 g/L sodium hydroxide, and is heated to 82°C (180°F). Time of immersion in the etchback bath is up to 20 minutes.

The permanganate bath is followed by immersion in a proprietary neutralization bath that typically contains dilute sulfuric acid and hydrogen peroxide.

### Chemistry

For Desmearing and Etchback:

\[
\text{Friction-melted epoxy} + \text{KMnO}_4 + \text{NaOH} \rightarrow \text{MnO}_2 + \text{Clean Holes}
\]

### Dosage

Due to the variability of the number of holes, the number of layers being processed, the amount of epoxy smeared in the holes, and electrolytic regeneration of the permanganate bath, an exact consumption rate of KMnO₄ cannot be calculated.

### Facility Requirements

A mild steel tank is suitable since the bath is not corrosive. The bath should not be heated with open steam. Operators should be trained to monitor permanganate and caustic concentrations. Temperature controls should be installed to maintain the temperature between 80°C and 85°C (175°F - 185°F). Operators should be trained in the proper methods for adding the chemicals to the bath and in all the safety and emergency precautions that should be followed.

### Benefits

**For Desmearing and Etchback:**
- Provides excellent microroughness for subsequent plating steps
- Easier to control than sulfuric acid or chromic acid methods
- Reduces incidents of voiding and hole wall pullaway
- Less capital intensive than plasma desmearing
- Lower environmental impact upon disposal than chromic acid

**For Wastewater Treatment:**
- Oxidation of EDTA chelates for heavy metal removal
- Lower COD and BOD discharges
- Oxidation of cyanides, sulfides, and mercaptans

### References

Colgan, T., Sodium and Potassium Permanganate for Plated-Through Hole Processing. Presented at the IPC Printed Circuits Expo (April 1998)

Carus Chemical Company, Printed Circuit Board Applications of Permanganate. Carus Form # CX 5535 (1998)

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 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.