CARUS
WATER



Phenol Problem Solved
at Wastewater Facility

CAIROX® POTASSIUM PERMANGANATE
CASE STUDY

SITE

An industrial user of phenolic resins and organic dyes that processes approximately 40,000 gallons of wastewater per day. The phenol concentrations can be as high as 7,000 mg/L. The phenol levels must be reduced to <50 mg/L prior to discharge.

PROBLEM

The facility operates 24 hours per day and seven days per week processing a tremendous amount of phenolic resins. The high resin usage requires the facility to clean phenolic resin containers daily for reuse. The facility uses concentrated sodium hydroxide to effectively clean the resin container. The resulting wastewater is sent to the internal wastewater treatment facility. However, resin cleaning with sodium hydroxide does not destroy the phenol and creates several wastewater treatment problems. First, phenol levels at the wastewater treatment facility can be as high as 7,000 mg/L. The plant is required to reduce the phenol to below 50 mg/L. Second, because sodium hydroxide is a strong caustic, the pH of the influent wastewater is around pH 12 and must be adjusted to a pH range between 5.5-9.0 before discharge. Finally, the high volume of manufacturing requires the wastewater treatment system to be in continuous operation six days per week. Therefore, the facility desired a simple and safe wastewater treatment system.

Several wastewater treatment options including chlorine dioxide, hydrogen peroxide + Fenton's reagent(Fenton Reaction), and CAIROX® potassium permanganate were considered. Because the phenol concentration was over 100 ppm, the use of chlorine dioxide was the first to be ruled out for cost reasons. Hydrogen peroxide, in combination with Fenton's reagent had been tried; however, operators considered handling concentrated hydrogen peroxide as being too dangerous because concentrated hydrogen peroxide is extremely corrosive on contact with skin. The complex Fenton Reaction had the additional disadvantage of requiring the pH to be adjusted from pH 12 to pH 4 before catalyst and chemical addition, and then the pH would have to be further adjusted back to pH 5.5-9.0 before wastewater discharge. Because of the problems and complexity associated with the Fenton Reaction, this facility was eager to find a simpler treatment method.

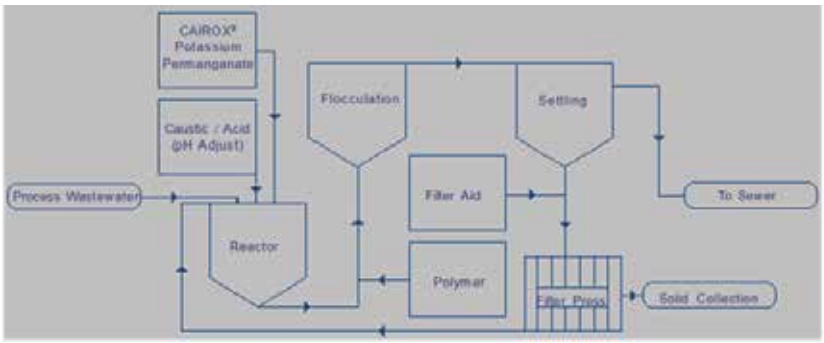

Figure 1: Diagram of Wastewater Treatment Plant

SOLUTION

A diagram of a wastewater treatment plant is shown above in figure 1. The pH of the waste stream is adjusted from approximately 12 to the discharge requirement (pH 5.5-9.0) before the CAIROX potassium permanganate addition. Plant personnel liked the ease, simplicity, and effectiveness of the permanganate system. Permanganate is not as dangerous to handle as concentrated hydrogen peroxide, nor does permanganate require catalyst addition or additional pH adjustment. Unlike hydrogen peroxide that can be catalytically deactivated, permanganate was able to consistently reduce the phenol from 7,000 mg/L and other residual organic compounds to <50 mg/L. Since the permanganate reaction is much faster than hydrogen peroxide, permanganate treatment had the added benefit of shortenting treatment time by several hours.

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SOLUTION

As the permanganate reacts with phenol, an insoluble manganese dioxide is formed. This manganese dioxide provides two advantages in the removal of phenol and other organic contaminants from the wastewater. First, because of the large surface area and usually negative charge, the manganese dioxide acts as a sorbent, particularly for metal ions. Experience has shown, in many cases, as little as 50% of the theoretical amount of potassium permanganate required for oxidation is necessary to remove contaminants from the wastewater. The rest of the removal is attributed to the sorption by the precipitated manganese dioxide. Second, manganese dioxide also acts as a coagulant or coagulant aid, speeding up floc growth, and weighing down the floc to improve sedimentation rates. Depending on local regulations, the sludge can be fed to the city waste system or landfilled. In this particular case, the manganese dioxide and other solid wastes were concentrated in a filter press and landfilled. Also, in many cases, the amount of by-product solids produced by using permanganate is less than the amount produced with Fenton Reaction, if total solids creates plant issues.

RESULT

For over five years, this company has found CAIROX® potassium permanganate to be the fastest, safest and most economical method of controlling phenol in wastewater. CAIROX potassium permanganate provides the following benefits over other treatment methods:

- Up to 28% less expensive than other treatment options.
- Can cost effectively treat high levels of phenol, unlike chlorine dioxide.
- Consistently reduces phenol concentrations in the wastewater by over 99%, unlike other treatment methods.
- Can produce fewer solids than hydrogen peroxide + Fenton's reagent.
- Does not require pH adjustment beyond discharge requirements, unlike hydrogen peroxide.
- Fast reaction shortens treatment time.
- Considered safer than other treatment methods by plant personnel.

OTHER APPLICATIONS

- Resin Manufacturers
- Oil Refineries / Waste Oil Reprocessors
- Aluminum Casting Plants
- Chemical Processing Wastes
- Sandpaper Manufacturers
- Pharmaceutical Waste Treatment

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