

# 附件 7

Heavy Metal Removal from Industrial  
Wastewater Using Green Glass  
Adsorbents Transformed from Waste  
LCD Panel Glass 論文摘要

# **Heavy Metal Removal from Industrial Wastewater Using Green Glass Adsorbents Transformed from Waste LCD Panel Glass**

## **1. Introduction**

Thin film transistor liquid-crystal displays (TFT-LCD) is among the most significant technical advancements which have changed visual communication and colorization of human life. However, the disposal of huge amounts of waste display panel glass has become a major challenge worldwide. Paradoxically, TFT-LCD contains complex metal oxides and can be reused in a positive and innovative way. They could be transformed into multifunctional green glass adsorbents with ion-exchange, electrostatic attraction and nano-porous active sites for the adsorption of metal ions. The specific surface area and average pore size of green glass adsorbents achieved were 175 m<sup>2</sup>/g and 9.9 nm, respectively, and showed excellent adsorbing capacity of 20-50 mg/g for metal ions including Pb, Zn, Cu, Ni, Cr and Cd. Green glass adsorbents are suitable for processing heavy metal contaminated wastewater due to its low cost and impressive adsorbing characteristics. We hope to provide a more eco-friendly way to treat heavy metal contaminated wastewater, contributing to solve the problem of waste display panel glass.

## **2. Experimental**

An Adsorption system is composed of four columns in series. Each column has an inner diameter of 35 cm and 100 cm in length and packed with 30 kilograms of green glass adsorbents. The Adsorption system is installed in an electroplating factory to process its heavy metal contaminated wastewater. Two streams of wastewater have been tested. One stream is copper wastewater with a concentration of 30 to 70 ppm and pH value of 2 to 4. Another stream is nickel wastewater with a concentration of 5 to 25 ppm and pH value of 7 to 8. Wastewater flow rate is controlled at 7L/min. ICP/OES is used to analyse metal ion concentration in wastewater and effluent water.

## **3. Results and Discussion**

### **3.1 Copper Wastewater**

The concentration of copper ion in effluent water is lower than 1ppm, which complies with industrial effluent standards (3 ppm). Removal efficiency is more than 98%. After processing 20 tons of wastewater, green glass adsorbents in first columns is getting saturated and its copper ion adsorption capacity is 40.3 mg/g.

### **3.2 Nickel Wastewater**

The concentration of nickel ion in effluent water is lower than 1ppm, which complies with industrial effluent standards (1 ppm). Removal efficiency is more than 95%. Until now, this adsorption unit has processed over 80 tons of waste water without getting saturated.

## **4. Conclusions**

Green glass adsorbents synthesized from waste TFT-LCD glass are applied to process heavy metal contaminated wastewater. Adsorbents are packed into an adsorption system installed in an electroplating factory to test on real heavy metal contaminated wastewater. Green glass adsorbents shows great performance in adsorbing metal ion from copper wastewater and nickel wastewater. The removal efficiency of copper ion and nickel ion are 98% and 95% respectively. This adsorption system is able to process at least 20 tons of copper wastewater or 80 tons of nickel wastewater. Both wastewater can be treated to comply with industrial effluent standards.