

Batch Equilibrium Adsorption of Cyanides from Aqueous Solution onto Copper- and Nickel-Impregnated Powder Activated Carbon and Clay

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Abstract

The present paper reports the removal of cyanide ions from aqueous solutions using Cu/PAC, Ni/PAC, Cu/Clay and Ni/Clay adsorbents at pH=11. At this pH, the cyanide is completely dissociated into its ions. Equilibrium data fitted Langmuir and Freundlich isotherms well. The applicability of the isotherm equation to describe the adsorption process was judged by the correlation coefficients, R^2 , values. The Langmuir model yielded the best fit with R^2 values equal to or higher than 0.960, as compared to the Freundlich model. The fact that $1/n$ values range from 0.20 to 0.58 indicates that the adsorption of cyanide ions onto these metal supported adsorbents is also favored by the Freundlich model.

Keywords: Adsorption, metal-cyanide complex, correlation coefficient, activated carbon, clay

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1. Introduction

Waste waters from industrial operations transport many chemicals that have adverse effects on the environment. Ammonia and amine compounds from carcass-processing, and sewage-treatment plants [1], phosphates and nitrates from paper mills, fertilizer plants, and detergent industries [2], cyanide and its compounds from electroplating and mining (extraction of gold, silver, etc.) industries [3, 4] end up in lakes, creeks, and rivers. These chemicals may be toxic and are more so when they are associated with heavy metals (Cd, Cu, Ni, Zn, Co, Au, Fe, Ag, etc.) leached from the earth [5-7]. These, of course, will adversely affect aquatic and land biota. It is therefore necessary to develop new technologies for the pre-treatment of these harmful chemicals at their point source before they are released into the environment.

Cyanide and its compounds from electroplating and mining industries are responsible for the contamination of lakes, creeks, and rivers. From the environmental and economic point of view, the

management of such a contaminating but valuable resource is very important.

Cyanide is a highly toxic species. Short-term exposure can cause rapid breathing, tremors, and other neurological effects. Long-term exposure can cause weight loss, thyroid deficiency, and nerve damage [8]. The mean lethal dose for the human adult is 50-200 mg/L, but for freshwater invertebrates it is only 0.028-2.295 mg/L [8]. Thus, cyanide-contaminated effluents should not be discharged into the environment without detoxification to meet cyanide statutory limits.

In the literature, treatment methods for cyanide removal from wastewater containing cyanide compounds comprise physical, adsorption, complexation, and/or oxidation methods [9]. The physical process and adsorption methods are used to purify effluents by separation processes, which consist of concentrating and recovering the cyanide. On the other hand, oxidation processes are used to destroy the cyanide and include various biological,

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