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ENVIRONMENTAL REMEDIATION OF COPPER IONS BY *MUCOR ROUXII*; AND THE COPPER-FUNGAL BINDING MECHANISMS

by

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DISSERTATION

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Center for Environmental Resource Management

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Dedicated to my husband Alberto, my son Alfredo and my daughter Alejandra, for their support, patience and understanding during the years required to complete this goal.

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Abstract

Copper is one of the metals widely generated as waste by industrial activities. Utilization of biomaterials for the removal and recovery of metals from aqueous solutions has been proposed by some researchers as an alternative and relatively inexpensive process.

Batch and flow laboratory experiments demonstrated that inactivated and immobilized *Mucor rouxii* biomass was an efficient process for copper removal and recovery from aqueous solution, as well as for biomass reuse.

Furthermore, these studies supported that the metal binding capacity increases and some morphological alterations are present when the fungi were grown at high concentration of this metal ion.

The amino, carboxyl, and sulfhydryl groups present in fungal cells play an important role in copper binding. *Mucor rouxii* biomass showed to be useful in the removal and recovery of other metal ions. Also calcium and magnesium ions did not interfere with copper or lead binding.

A copper-binding low-molecular-weight protein in copper-stressed *M. rouxii* cells was identified.

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INTRODUCTION

1.1 Metals in the Environment

Humans have modified the environment throughout their existence, since the time they developed agricultural means of subsistence. After the Industrial Revolution, natural resources were used in an irrational and excessive manner for the first time in an attempt to supply the new forms of production that emerged. Large amounts of metals are released into the environment each year from industrial wastewater through inefficiencies built into the technological activities used directly in the processing of metals (1). These contaminants also enter the environment through mill tailings, and landfill run-off. The metallic species released into the environment tend to be maintained there indefinitely, circulating and eventually accumulating throughout the food chain, posing a serious threat

to the environment and public health. The rise in modern industrialization and mining process, as well as the continuous use of metals-containing biocides, has resulted in the redistribution of available toxic metal ions into the environment. Consequently, the soils and waters in the surrounding areas have become reservoirs for concentrated levels of harmful metals, which pose a health threat to all living organisms. Currently, levels found in nature for many metals are considered to be toxic (2). Although a number of measures have been implemented in recent years to decrease or eliminate environmental contamination originated by industrial and agricultural process, more emphasis needs to be focused on restoring those areas already contaminated. Apart from the rather slow natural process of metal mineralization, the ultimate removal is attained only when the metal becomes concentrated to the point that it can be either returned to the process or reclaimed. This aspect of the operation deals with the potential recovery of the metal, which ideally should go hand in hand with the removal aspect, making the overall process an ultimately effective procedure for controlling the utiiization of metals by humans in their technological processes.