

Removal of Cyanide-Contaminated Water by Vetiver Grasses

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Abstract

Vetiver grass and its usages have been widely investigated in many researches as the preferred plant species due to its known efficiency, low cost, the ease of availability and spread. This research aimed to use four different vetiver grass (*Vetiveria zizanioides*) ecotypes to remove cyanide (CN⁻)-contaminated water for improve its quality. Growth capability, tolerance and removal efficiency were evaluated. The results showed that the vetiver grass had a 100% survival rate for one month after planting. Songkhlar3 had the longest leaves, followed by Surat-Thani, Sri Lanka and Monto, respectively. Root lengths of all ecotypes showed no significant differences ($p \leq 0.05$). All vetiver grass ecotypes could potentially purify CN⁻-contaminated water at lower concentrations of ≤ 35 mg CN⁻/L. The Monto ecotype had the highest CN⁻ removal efficiency at all CN⁻ concentration levels, showing 100% CN⁻ removal from the 5-45 mg CN⁻/L contaminated water samples within 2-5 weeks growth. The tolerance of vetiver grass to CN⁻ was a more important factor than growth rate when selecting a vetiver grass ecotype for CN⁻ phytoremediation.

Keywords: vetiver grass, phytoremediation, cyanide, Songkhlar3, Sri Lanka, Surat-Thani, Monto

1. Introduction

Cyanide (CN⁻) is a radical combination of carbon and nitrogen, which can be found in a wide variety of life forms and has a large-scale presence in the environment. It is attributed to manufacturing sources and is used extensively in industry (Dash, Gaur & Balomajumder, 2009). These industries utilize a combination of free CN⁻ and CN⁻ complex-based compounds in various operations, including: the beneficiation of metals, electroplating, case hardening, automotive manufacturing, circuitry board manufacturing, and in chemical industries (Patil & Paknikar, 2000). CN⁻ is also used in mining to extract gold and silver from ores, particularly low-grade ores and ores that cannot be readily treated through simple physical processes such as crushing and gravity separation (Logsdon, Hagelstein & Mudder, 1999). CN⁻ is commonly found as a contaminant in wastewaters through release from the CN⁻ leaching gold recovery (CLGR) process (Logsdon et al., 1999). This is a major factor contributing to the bulk of the occurrence of CN⁻ in the environment. Most of the CN⁻ used in industrial mining is handled without observable devastating environmental consequences, but in informal, small-scale mining, its use is poorly regulated and the waste treatment is insufficient (Elbel, Evangelou & Schaeffer, 2007). The unwanted extraction is often stored in open tailing ponds of areas equal to 150 ha or larger (Eisler & Wiemeyer, 2004). This waste contains up to 120 mg/L free CN⁻ and 400 mg/L total CN⁻, including various CN⁻-heavy metal complexes (Elbel et al, 2007). The environmental risk of CN⁻-contaminated wastewater is not limited to the effluent but also includes the possibility of emitted hydrocyanic gas. Hydrocyanic gas is slightly soluble in water and readily dissociates into hydrogen and CN⁻ at low pH in aqueous solutions (Santos, Ntwampe & Doughari, 2013).

Many countries have been faced with the environmental problem of CN⁻-contaminated effluence from gold