Abstract

One of the main concerns in the land disposal of sludge is the presence of toxic heavy metals which concentrate during various physico-chemical and biological interactions occurring in sludge treatment. Other factors that heighten the concern over the presence of these heavy metals in the environment are their nonbiodegradability and consequent persistence. This study investigated the potential of utilizing pineapple wastes as a source of citric acid in the extraction of cadmium (Cd), chromium (Cr), copper (Cu), lead (Pb), nickel (Ni) and zinc (Zn) from anaerobically digested sewage sludge for land application. Leaching experiments were done to determine optimum conditions of metals removal using citric acid, unfermented, naturally fermented, and *A. niger* fermented raw liquid from pineapple wastes. Chemical speciation studies using sequential chemical extraction procedure (SCE) were also done to understand how the metals are bound to the sludge and their effect on extraction efficiency as well as their mobility in the soil after land application.

Results of lab-scale studies revealed the high potential of raw liquid from pineapple wastes as extractant in the removal of heavy metals from sewage sludge, with the best removal of Cd (64.6%), Cr (83.4%), Ni (82.4%) and Zn (100%) achieved by leaching with *A. niger* fermented liquid at optimum conditions, though effectivity of removal seemed to be less apparent for Cu and Pb. Removal of heavy metals seemed to be affected by pH, contact time as well as the nature of the sludge sample and the forms of metals in the sludge. Moreover, the treated sludge being low in faecal coliform (almost pathogen free for *A. niger* treated sludge), low in heavy metals, high in nutrient content (2% for N, 3.5% P), high in organic matter content and dominant in residual fractions for most metals, has also a high potential for land application. Furthermore, this study demonstrated a novel and sustainable way of managing contaminated sewage sludge by utilizing one form of wastes (pineapple wastes) to treat another form of wastes (sewage sludge), with practically no wastes produced.