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COMPARATIVE STUDIES ON THE USE OF FLY ASH AND SLUDGE IN THE REMEDIATION OF HEAVY METAL-POLLUTED SOIL

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Abstract

Often the remedial measures required to clean-up sites contaminated with heavy metals are so complex that their implementation becomes economically unsustainable. In this work, an investigation has been carried out to assess the potential use of fly ash from coal – fired power stations and sludge from oil palm in immobilizing heavy metals contained in soils from a severely contaminated battery dumpsite in Benin metropolis. Parallel experiments were carried out with soil amended with flyash and sludge at different levels. The amended soil was left for a stabilization period of eight weeks. The parent and the amended soils were analyzed for physicochemical properties using standard methods. The results of the physicochemical properties for parent soil showed the pH, organic carbon and CEC to be 3.0, 4.6% and 9.36meq/100g respectively. The pH, organic carbon and CEC for the fly ash and sludge were respectively 10.5, 0.8%, 4.27meq/100g and 5.2, 45.47%, 15.15 meq/100g. The pseudo metal concentration for the parent soil was 515mg/kg for Fe, 220.3 mg/kg for Zn, 130.15mg/kg for Cu, 48.19 mg/kg for Mn and 52.43 mg/kg for Ni. After amendment, the exchangeable fraction (bioavailable) was reduced to the non-available form. The parent soil was highly contaminated with Fe, Zn, Cu and Ni but was moderately contaminated with Mn. On amendment, fly ash and sludge reduced the level of contamination of metals. From the environmental risk factor, Fe, Zn and Mn posed no potential threat to living organism while Cu and Ni pose potential threat to living organism [FJPAS 1(1), 2016].

1.0 INTRODUCTION

The evaluation of heavy metals in contaminated soils as a means of monitoring the status of the environment for the good of the ecosystem is crucial because with increased exploitation of natural resources, industrialization and urbanization, most area of the Niger Delta region of Nigeria are facing increasing ecological problems arising from the release of pollutant into both the aquatic and terrestrial environments. Heavy metals constitute a significant group of these pollutants [1]. While many heavy metals are essential elements at low levels of concentration, they can exert toxic effects at concentration higher than permitted in the environment [2]. Mobile (bio) available metal concentration in contaminated soils can be minimized through biological immobilization and stabilization methods using a range of organic compounds such as fly ash and sludge. Sludge also known as biosolids, is one of the major solid organic waste produced by waste water treatment plants in cities around the globe. The application of sludge on agricultural land is a common practice around the world. Land application of sludge and municipal solid waste has been shown to benefit crop production and improve soil quality [3, 4, 5, 6]. However to realize this benefit, application of sludge must be conducted in an environmentally sustainable manner [8, 9]. Unlike fly ash, sludge characteristically contains high levels of the major plant nutrients, N and P, and is enriched in organic matter. Benefits of sludge application on soils however, have to be weighed against the potential hazards associated with certain sludge borne constituents (e.g. heavy metals and organic contaminants). Historically, the use of fly ash in agriculture has been based on its neutralizing potential and supply of essential elements such as Ca, S and Mo [11, 12]. . However, the use of fly ash as an