

Effect of amendments on modifying physical, chemical and microbial properties of seawater neutralized bauxite processing residue for revegetation

Yaying Li¹, Richard J Haynes¹

¹ School of Agriculture and Food Sciences/CRC CARE, The University of Queensland, St Lucia, Queensland 4072, Australia

Abstract: Bauxite processing residue is the alkaline, saline, sodic waste produced during the refining of alumina (Xue et al., 2016a) and for every tonne alumina produced, 1-2 tonnes of this residue is also produced (Jones and Haynes, 2011). Seawater neutralization is usually used to reduce the alkalinity of the residue before transporting to disposal area. However, no research yet published on how to revegetate seawater-neutralized bauxite residue mud. Thus, in this research seawater neutralized bauxite residue mud was amended with residue sand (25% v/v), gypsum (1% w/v), poultry manure (6% w/v) and biosolids (6% w/v) and associated with leaching of 6-pore volumes of water. Then the chemical, microbial and physical properties were characterized. In a second experiment, the effects of 1% and 5% gypsum application on chemical properties after leaching were measured and compared. After seawater neutralization, the pH of unamended residue was 9.3 but during leaching it rose to 9.6. Addition of 1% gypsum arrested this increase while with 5% gypsum, the pH was lowered 9.0 after leaching. The major ions in leachates were Na⁺ and Cl⁻ and gypsum application increased the quantities of Na⁺, Ca²⁺ and SO₄²⁻ leached. Addition of biosolids increased concentrations of Na⁺, Ca²⁺, K⁺ and Mg²⁺ in leachates and poultry manure those of K⁺ and Mg²⁺. Exchangeable and soil solution Ca were increased by addition of gypsum and exchangeable Ca and Mg were also increased by poultry manure and biosolids additions. Exchangeable Na, ESP and SAR were reduced by the addition of gypsum and to a lesser extent by addition of both poultry manure and biosolids. Addition of amendments had small effects on physical properties with sand causing an increase in bulk density, a decrease in total porosity and an increase in macroporosity and poultry manure causing a decrease in bulk density and an increase in macroporosity. While organic C content was increased more by biosolids than poultry manure the reverse was the case for soluble organic C, microbial biomass C and basal respiration. It was concluded that even after seawater neutralization, exchangeable and soluble Na, ESP and SAR in residue mud were very high and application of gypsum at least 5%, and subsequent leaching, will be required prior to revegetation.