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Influence of red mud on remediation of heavy metal polluted soil

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Abstract
As the problem of solid wastes removal has now attained multifaceted dimensions, it becomes crucial either to find appropriate ways for the safe and sound disposal of these wastes or to suggest novel uses, considering them as by-products. Bauxite refining is a typical case of chemical processing, which yields red mud, a solid waste by-product with concomitant problems and costs in handling, storage and a search for further uses. Red mud is produced during digestion of pulverized bauxite with sodium hydroxide at elevated temperatures and pressures, according to the Bayer method. It will generally issue from the washing thickeners as a highly alkaline (PH 10-12.5) slurry at approximately 15-30 % solids, and be pumped to whom correspondence should be addressed to a disposal lake. Iron impurities impart the brick red colour of the mud. Red mud is a waste product from bauxite processing : it is principally composed of fine particles of silica and Fe- Al-Ca-Ti oxide and hydroxides which are responsible for its high surface reactivity. The aim of this paper was to investigate, the efficacy of red mud in reducing the release of contamination from a complex waste material (Heavy metal).

Keywords: red mud, remediation of heavy metal, polluted soil

Introduction
Global modernization is responsible for industrialization, urbanization and several other anthropogenic activities, which involves the huge application of heavy metals. In recent years, increasingly more soils are found to be contaminated with organic and inorganic toxins globally due to waste emissions from industrial production, mining activities, waste (i.e., biosolids and manures) application, wastewater irrigation, and inadequate management of pesticides and chemicals in agricultural production. Pollutants in soils are not only harmful to ecosystems and agricultural production but also a serious threat to human wellbeing.

In the last few decades, millions of contaminated sites have been discovered all over the world. Most of the developed and developing countries are facing the problem of land scarcity, especially in urban areas, due to contamination. India is also one of them. Till date, there are a total of 557 sites identified as contaminated in India, with total area of about 175 million hectares. Considerable efforts have been made to remediate polluted soils, as shown in the increasing literature information on the amendment of soil pollutions (Bolan and Duraisamy 2003; Naidu *et al*. 2008) [7, 10]. Physical/chemical remediation, bioremediation, and integrated remediation were used to manage contaminated soils (Mullainathan *et al*. 2007; Lee *et al*. 2008; Mendez and Maier 2008) [9, 8].

The main problem associated with HM contamination is that, in contrast to organic contaminants, they cannot be degraded. This fact increases their relevance as one of the most serious groups of environmental contaminants. Therefore, reclamation of soils contaminated with HM is only possible by using techniques that extract or stabilise the contaminants. Extraction techniques are generally carried out ex situ, and imply soil structure deterioration and high costs, which limit their use on vast contaminated areas. Stabilization techniques are carried out in situ and are less expensive. These techniques are based on the use of amendments and/or plants and their associated microorganisms to alter the physical form of HM, reducing their mobility and bioavailability Reclamation of heavy metal-polluted soils often requires the addition of organic matter (OM), as it can promote plant growth and the activity of soil microorganisms by improving the poor physical and chemical properties (e.g. poor structure and a lack of nutrients) of these soils. The aim of this review paper was, therefore, to compare the effects of red mud their water-soluble fractions on soil heavy metal availability, in order to optimize their potential use as organic amendments in reclamation strategies for heavy metal contaminated soils.

Table 1: Chemical Composition of the Red Mud Samples

Major Constituent	Content (%)
Al_2O_3	19.94
Fe_2O_3	34.14
Cao	13.2
Sio_2	6.95
TiO_2	4.97

Role of Red mud in removing heavy metal toxicity

The potential uses of red mud have been classified into: (a) recovery of major constituents, (b) recovery of by-products, (c) direct uses, and (d) incorporation into products. It is apparent from the great number of publications that there has been no lack of effort given to the utilization of these wastes, but that no consistent use has been maintained on a scale sufficiently large to consume current output and diminish the stockpiles. Red mud, due to high aluminium, iron, and calcium content has been suggested as a cheap adsorbent for pho~phates or toxic metals removal (e.g. As, Cr, Pb, Cd) as well as for water or wastewater treatment. The basic advantage of red mud is its versatility, since it is comprised of a mixture of useful adsorbents and flocculants, all of which can be used for treatment of several effluents. It is worth noting also that for the majority of red mud applications only limited information is available, as the obtained results have usually been patented.

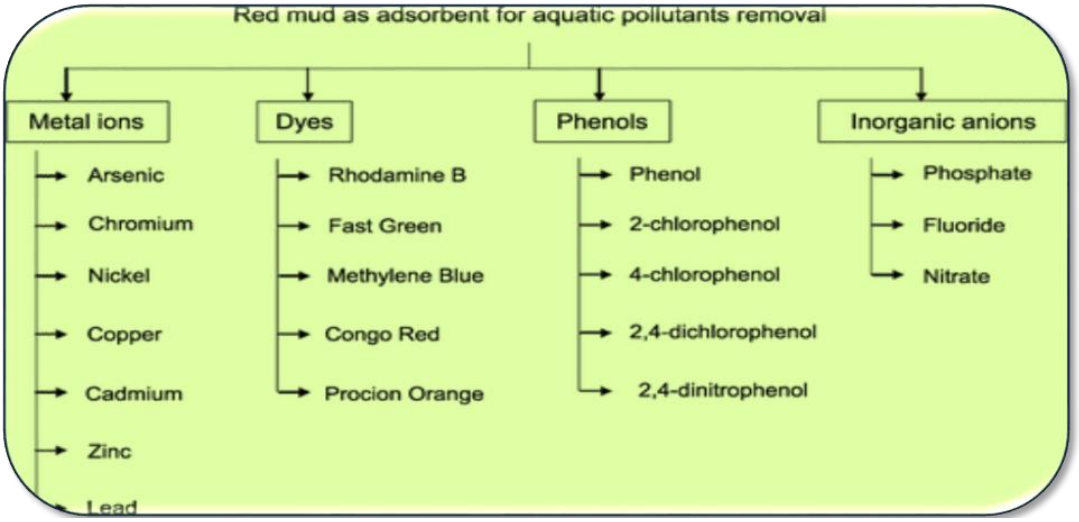

Fig 1: Red mud as adsorbent for the removal of aquatic pollutants from water and Soil

(a) Slurry type of red mud (b) Dried red mud

Future prospect

In the present paper simple, fast and promising method for the treatment of toxic metal cations-bearing wastewaters is suggested. The appropriate addition of red mud was found to lead to the almost complete removal of heavy metal and it was found to be an effective scavenger for these ions, causing the precipitation of heavy metals and aiding the flocculation/sedimentation of the species. Thus use of red mud is an promising technology to remediate the heavy metal toxicity in polluted soil and water.

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