Synthesis of magnetite nanoparticles and using them for separating toxic elements from the wastewater of sulphuric gold mines

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Arsenic is a toxic element that the maximum allowable concentration for it in drinking water is about 0.5 mg/lit. Arsenic Inorganic compounds include As_2O_3, FeAsS, AsS and As_2S_3. Although arsenic has a multi allotrope element with yellow, gray and black colors, but only the gray ones that are solid metalloid, crystalline and fragile, are persistent in the nature. Approximately 100, 000 tones arsenic are produced per year in the world because of excavating metals such as copper, lead, cobalt and gold. It causes cancer because of impairing synthesis of DNA and RNA.

One of the most essential problems in Zarshouran gold mine, in northwest of Iran, is existence of too much arsenic in wastewater of mining. Different methods are presented to remove arsenic from the wastewaters such as: Arsenic can be removed by composite of graphene oxide and ion exchange method, but these methods are so high expense that has limited using them. We prepared magnetic nanoparticles with different methods in laboratory. These nanoparticles were less than 50 nanometers in diameter that we used it for removing arsenic as a very light expense method from Zarshouran wastewaters. A natural bond creates between arsenic and magnetic nanoparticles. After separating of arsenic, nanoparticles can be separate from the solution with a simple magnet. We succeed to remove arsenic with over 99 percent in volume by this method.

Mobility of nitrogen and heavy metals in biosolid amended soil

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The potential leaching and availability of nitrogen and heavy metals in biosolid-amended soil were investigated using batch and column studies. The mobility of heavy metals were assessed with SPLP and TCLP tests while the availability of nitrogen with a KCl extraction test. In addition semi-continuous column studies were conducted to assess the leachability of nitrogen and heavy metals from biosolid-amended soil under simulated-unsaturated soil conditions. One type of biosolids, a compost derived from municipal solid waste recycling of the organic fraction together with a clayey soil typical of Crete were used in this study. Two application rates of 100 and 200 t/ha were tested. The results were compared with soil lysimeter measurements of a parallel experiment in an olive grove.

Results

The total input of N was 1160 and 2320kg/ha for the two amendments. KCl extraction showed that 15 and 96 kg/ha of N ($N\text{-}NO_3$+$N\text{-}NH_4$) was bio-available which correspond to 1.3% and 4.2% of the total N input for the 100 and 200t/ha application rates respectively. Columns packed with soil amended with 200t/ha compost and receiving synthetic rain released 34 kg/ha of N ($N\text{-}NO_3$+$N\text{-}NH_4$). Using lysimeter measurements the average release of N in olive grove compost amended soil was estimated to be 16kg/ha N. The results from all measurements were consistent.

Heavy metal mobility from compost-amended soil was assessed with the SPLP and TCLP batch tests, semi-continuous column studies and field measurements with lysimeters. All results were consistent and orders of magnitude lower than EPA standards [1]. Zn was shown to be the most mobile metal in all measurements. Results suggest that one-time application of biosolids at agronomic rates will not impact the groundwater.

[1] EPA (1996) *Soil Screening Guidance,* Document 540/R-96/018.