Key words trace element; rare-earth element; contaminated river; sewage discharge; Taihu Lake

The treatment of wastewaters with high phosphorous and high ammonia loadings using modified bauxite refinery residues

Malcolm W. Clark[1], Frank Gnanam[2], David M. McConchie[1,2], Lee Fergusson[1]

[1] *Environmental Science and Management, Southern Cross University, PO Box 157, Lismore, NSW 2480, Australia*

[2] *Virotec Global Solutions, Building 50B Pinewood Drive, Sanctuary Cove, Queensland 4212, Australia*

Bauxsol(TM) is a trade marked name for a modified bauxite refining residue where Ca and Mg are used to transform carbonate and hydroxide alkalinity from soluble to insoluble forms within the bauxite refinery residue (red mud), This leads to a pH reduction from >13 to ≈8.5 and reduces soluble Al and Na contents. The concentration ratios of Ca and Mg in the treatment brine can be manipulated to provide neo-formational mineral assemblages dominated by either Mg, or Ca end members; hydrotalcite and brucite (Mg-rich), or hydrocalumite, para-aluminohydrocalcite, aragonite and portlandite (Ca-rich). The Bauxsol(TM) raw material (BRM) has excellent metal binding capacity (>1500 meq/kg), good P binding capacity (>2% by mass) and a good acid neutralising capacity (3.5-7 M/kg), however the BRM can be further blended with other mineral additives to enhance the geochemical properties and improve specific performance. This paper reports on the use of a high-Mg Bauxsol(TM) blend to treat waters that have high P, NH_4^+ and polyacrylamide (flocculant) loadings in Biological Nutrient Reduction (BNR) plant digested sewage sludge centrates. Initial analysis of the centrate indicated it contained 325 mg/L total-P (225 mg/L P as ortho-P), 767 mg/L N as NH_4^+, suspended solids loads (TSS) of 683 mg/L and chemical oxygen demand (COD) of 480 mg/L (although the day to day variability in nutrient loadings can be as much as 25%). This was then treated using 1.7 g/L of a high-Mg Bauxsol (TM) blend to yield a water with <1.8 mg/L total-P (ortho-P is <0.5 mg/L), NH_4^+ <460 mg/L N, <60 mg/L TSS, and <300 mg/L COD. Small additions of ferric chloride post Bauxsol (TM) addition reduced the soluble ortho-P load by about 50% and about 30% of the COD, but these additions appear largely unnecessary. Analysis of the solid residue indicates it contains 11.5% P, 0.39% N, 21% Mg, and 2.44% crude protein making the solid residue a potentially useful fertilizer. It is likely that P and NH_4^+ is affected by the formation of $MgHPO_4$ and Mg $(NH_4)PO_4$ (Struvite) within the solids. Calculations from the solids indicate that 85% of the P removal is as $MgHPO_4$, which appears consistent with literature on the formation geochemistry of struvite around pH 8.0. Further manipulation of the geochemistry of waters and kinetics of crystal growth may allow for a greater struvite recovery, and further enhanced ammonia removal. The treated centrate is then reported back to the head of works and solids are removed with the sludge at the primary and secondary clarifier. In addition, to the NH_4^+ removal as struvite the anecdotal evidence from the BNR plant operators suggests that these high-Mg Bauxsol (TM) blends have reduced polymer use in the centrifuges, reduced alum dosing rates for P removal at the tertiary clarifier, and eliminated hydrated-lime additions (an OH and S hazard) to maintain pH.

Key words sewage; nutrient; removal technology; Bauxsol (TM); waste utilization

Non-point source pollution of Wujiang River watershed in Guizhou Province, SW China

Congguo TANG[1,2], Congqiang LIU[1]

[1] *State Key Laboratory of Environmental Geochemistry, Institute of Geochemistry, Chinese Academy of Sciences, Guiyang 550002, China*

[2] *Graduate School, Chinese Academy of Sciences, Beijing 100049, China*

The amount of pollution from non-point sources flowing in the streams of the Wujiang River watershed in Guizhou Province, SW China, is estimated by a GIS-based method using rainfall, surface runoff and land use data. A grid of cells, 100 m in size, is laid over the landscape. For each cell, mean annual surface runoff is estimated from rainfall and percent land use, and expected pollutant concentration is estimated from land use. The product of surface runoff and concentration gives expected pollutant loading from that cell. These loadings are accumulated going downstream to give expected annual pollutant loadings in streams and rivers. By dividing these accumulated loadings by the similarly accumulated mean annual surface runoff, the expected pollutant concentration from non-point sources is determined for each location in a stream or river. Observed pollutant concentrations in the watershed are averaged at each sample point and compared to the expected concentrations at the same locations determined from the grid cell model. In general, annual non-point source nutrient loadings in the Wujiang River watershed are seen to be predominantly from the

agricultural and meadow areas. The total annual loadings through the outlet of the watershed are 40309 ton and 2607 tons for total nitrogen (TN) and total phosphorus (TP), respectively. For TN, the observed concentrations at two locations (Xiangjiang and Guiyang) significantly exceed predicted levels. These discrepancies suggest that the urban areas of Guiyang and of Zunyi appear to be significant point source contributors. The observed concentrations at other locations are actually lower than the predicted values. This trend indicates that either (a) the expected mean concentration assigned to the specific land use is too high or (b) there is some loss of nitrogen that occurs along the stream network, possibly as the result of sedimentation or decay. For TP, the results are similar to those of the TN except that the observed TP level is greatly higher than the expected values at Sinan.

Key words non-point source pollution; watershed; grid model; loading; GIS

As (V) adsorption characteristics of iron oxide coated sands

Kyung-Seok Ko[1], Jae Gon Kim[1], In-Suk Oh[2], Joo Sung Ahn[3], Heejun Suk[4], Hyoung-Soo Kim[4]

[1] *Korea Institute of Geosciences & Mineral Resources (KIGAM), Geological & Environmental Hazards Division, Daejeon, Korea*

[2] *Kongju National University/Department of Geoenvironmental Sciences, Kongju, Korea*

[3] *Korea Institute of Geosciences & Mineral Resources (KIGAM), Groundwater & Geothermal Division, Daejeon, Korea*

[4] *Korea Institute of Water and Environment (KIWE), Dam Engineering Research Center, Daejeon, Korea*

The presence of arsenic has been great concern because of its toxicity for human health. Generally As forms stable solids in the presence of Ba and has strong affinity for sulfur. The purpose of the study is to compare the As (V) adsorption capacities of iron oxide coated sand (IOCS) and sulfate-modified coated sand (SMIOCS) which are used as water treatment materials for As removal. To describe the As (V) adsorption behaviour of IOCS and SMIOCS, the batch and kinetic experiments were conducted. The results of acid and alkali resistance tests for two iron oxide coated sands, IOCS and SMIOCS, showed that they were appropriate for the usage of water treatment material. From the XRD analysis by freeze-drying technique, the coated materials of IOCS and SMIOCS are proved to be goethite and barite. The batch and kinetic experiments showed that SMIOCS had higher adsorption capacity for As (V) than IOCS and it is caused by the higher surface area of SMIOCS than that of IOCS. The adsorption capacities of IOCS and SMIOCS were decreased by the lowering of pH. From the kinetic experiments, the removal time needed for 90% of As is less than 1 hour at any pH and initial concentration of As (V) used in the experiments.

Key words As (V) adsorption; iron oxide coated sand; batch and kinetic

Water quality evolvement from Huangpu River, Shanghai, China

Hui ZHANG

School of Environmental Science and Engineering, Shanghai Jiaotong University, 800 Dongchuan Rd., Shanghai 200240, China

The Huangpu River supplies eighty percent of daily water used for life and industry for about 20 million people in Shanghai, China. Industry and domestic sewerage from the metropolis is mainly released into the Huangpu River, which flows through the Shanghai City area. The pollution caused by city life and production in the Huangpu River has occurred for years. In this paper, the contents of heavy metals (Cu, Pb, Cr, Cd, and Hg), total organic carbon (TOC), and polynuclear aromatic hydrocarbons (PAHs) in the Huangpu River are studied. Data from environmental monitoring from 1991 to 2002 are compared to understand the variation and trends of the pollution. Results indicate that metals have been reduced efficiently, but organic pollutants develop in an aggravating trend as domestic sewage increases. The variation of the organic pollutant concentrations, which are lower than those of other similar rivers of China, US, and Canada, in the Huangpu River, suggests that the organic pollution maybe a problem of water quality evolvement in metropolis river protection, which should be accentuated in the world today.

Key words trend of water quality evolvement; metropolis river; Shanghai

Environmental geochemistry of arsenic in sediment-water interface of Poyang Lake, China

Mengxia LIAO[1], Tianlong DENG[1,2]

[1] *College of Chemistry and Chemical Engineering, Chengdu University of Technology, Chengdu 610059, China*