Editorial: Toward the use of biological endpoints for polluted site decontamination

Hilary I. Inyang*

African University of Science and Technolgy (AUST),
Km 10 Airport Road, Galadimawa,
PMB 681, Garki, Abuja, F.C.T, Nigeria
E-mail: hiinyang@uncc.edu
*Corresponding author

Bian Zhengfu

China University of Mining & Technology,
Xuzhou 221008, Jiangsu Province, China
Fax: +86 516 83885057
E-mail: zfbian@cumt.edu.cn

Sunyoung Bae

Department of Chemistry, Energy and Environmental Studies Program,
North Carolina A&T University,
Greensboro, NC, USA
E-mail: sbae@ncat.edu

Claudio Mahler

Federal University of Rio de Janiero, UFRJ, Brazil
E-mail:mahler0503@yahoo.com

Biographical notes: Hilary I. Inyang is the President of the African University of Science and Technology (AUST) based in Abuja, Nigeria. He has about two decades of technical and policy contributions as an Educator/Administrator, Researcher, Government Official and Corporate Leader. He is also the Duke Energy Distinguished Professor of Environmental Engineering and Science, Professor of Earth Science and Founding Director (since 2001) of the Global Institute for Energy and Environmental Systems (GIEES) at the University of North Carolina-Charlotte. He has authored/co-authored more than 210 research articles, book chapters, federal design manuals and the textbook, *Geoenvironmental Engineering: Principles and Applications*, published by Marcel Dekker (ISBN: 0-8247-0045-7). His research and professional focus are in contaminant leaching and dusting from materials, containment systems and materials for barriers, energy systems and geohazards.

Bian Zhengfu is the Executive Dean of Graduate School, at China University of Mining and Technology (CUMT) based in Xuzhou, Jiangsu Province, China. He has been the Chairman of the Institute of Land Resources, CUMT since 1998, and during 2000 to 2004, he took the position of Chairman of the Department of Land Resources Management, School of Environmental Science

and Informatics Engineering, CUMT. He has authored/co-authored more than 150 research articles, book chapters, federal design manuals and the textbook, *General Surveying*, published by China Agricultural Publishing House. His research and professional focus are on contaminated land remediation, mined land reclamation, the application of GIS and RS, land use planning, mine environmental protection and restoration.

Sunyoung Bae is an Assistant Professor at the Department of Chemistry and the Energy and Environmental Systems and PI at the NOAA-Interdisciplinary Scientific Environmental Technology (ISET) Cooperative Science Center in the North Carolina A&T State University. She has authored/co-authored several technical publications in various conferences and peer-reviewed journals. Her research activities focused on physicochemical interactions of atmospheric particulate matters with various chemicals in environment system and renewable energy converted from waste and biomass.

Claudio Mahler, a Professor, PhD, PE, specialised in Geotechnical and Geoenvironmental Engineering, DSc at the Federal University of Rio de Janeiro (UFRJ), Dr. Habil. University of São Paulo, studied also numerical methods at the University of Stuttgart; Pos doc at the University of São Paulo and at the Institute of Research of Environmental Systems, University of Osnabrück. He is a member of ASCE/USA and ISSMFE. He also advised 15 PhD theses, 44 MSc dissertations and published more than 350 papers in national and international conferences and/or journals. He is now the Director of Administration and Financing from the State Foundation of Financing Research Projects of the State Rio de Janeiro. He is the President of the Technical Commission of Landfill from the Brazilian Association of Soil Mechanics (ABMS). He is also a Professor at the Federal University of Rio de Janeiro.

By classification in the USA, hazardous wastes are identified as solid substances that possess unacceptable levels of any of the following characteristics: corrosivity, ignitivity, reactivity and toxicity. Non-solid substances can also pose serious health and environmental risks, depending on their chemistry and exposure conditions. Sites that are contaminated with substances that meet these criteria abound in virtually every country. Often, they result from operations of industrial and civil facilities. While regulations and policies have been developed and enforced to different levels of success, to control the emission of hazardous substances into the environment in all countries, some countries have adopted largely remedial approaches to the control of risks posed by contaminant emissions. This remedial approach, which is undoubtedly more expensive in terms of direct and social costs, typically involves decontamination of polluted sites using one or a combination of available technologies and techniques.

Regardless of whether the target contaminant is a solid or a liquid, environmental and health hazard reduction through polluted site decontamination, poses significant socioeconomic and technical challenges to private and public environmental management organisations. First, there is the cleanup standards issue of 'how clean is clean?' and then the uncertainty of attaining the specified clean up level with the selected technology, within the available time and budget. Such technologies must apply one or a combination of reduction in contaminant mass/volume; changes in contaminant chemistry/toxicity; and changes in the characteristics of the medium through which the contaminant can travel to sensitive locations. Many fundamental physico-chemical and biological

mechanisms form the bases of the treatment technologies that have been developed during the past four decades for soil decontamination. Specification of the endpoint concentration to which decontamination is carried is very critical with respect to both the technical and financial feasibility of optional technologies. Intuitively, for every polluted site, each contaminant has a concentration level at which it may cease to pose significant risk to human health and the environment. It can be fairly argued that the endpoint concentration for decontamination of the site should be the identified negligible risk concentration. Considering that contaminant concentration does not solely determine risk and that other factors such as contaminated media characteristics, climatic factors and even receptor characteristics, are significant, adoption of biological endpoints to polluted site decontamination, in which risks to human health and ecology of each site would serve as the basis of specified maximum concentration, would need to be done on site-by-site and contaminant-by-contaminant bases. The desirability of this approach is negated by the cumbersome and expensive analytical processes that would be performed for several sites within each jurisdiction. The approach that is almost universally adopted by regulatory agencies is specification of endpoint concentrations on a contaminant-by-contaminant basis but at the same level for each contaminant for all sites within the jurisdiction. It is possible that while such standards meet human/ecological (biological) risk reduction levels for some sites, they are inadequate for other sites. The difficulty associated with specification of biological endpoints can be reduced through implementation of regional site monitoring and data management systems. In this case, data on sites and associated risk factors would be archived and given spatio-temporal coordinates in geographic information systems (GIS) such that biological risk models can be applied system-wide. The configuration of this system would make it easier to screen available site decontamination technologies and make other decisions more efficiently.