

# ENVIRONMENTAL MANAGEMENT AND STEWARDSHIP Dr Terry Mudder

John Chadwick, Founder and Publisher of International Mining: “I am very pleased to nominate a colleague who worked tirelessly with me (for no financial reward) in the 1990s and early 2000s to keep the publication *Mining Environmental Management* alive and relevant. Dr Terry I. Mudder did this because of his passion for good environmental management and for ‘spreading the word’.”



Mudder is co-owner with Dr Karen Hagelstein, of Times Ltd, an environmental science and engineering consulting firm located in Wyoming (USA). He was formally a partner, office manager and corporate consultant in the Seattle, Washington office of SRK, an international mining consulting firm. Prior to consulting, he served as Chief Environmental Engineer and Chief Research Chemist at the Homestake mine in Lead, South Dakota, where he

developed a full-scale process for the microbial degradation of cyanide in process wastewater. The full-scale process, which operated for 20 years before closure of the mine, was featured in a biotechnology feature article in *National Geographic*.

Mudder has been instrumental in the development and application of many chemical, physical, and biological treatment processes for cyanide and metals, for which he has received both national (USA) and international awards, including the prestigious Philip Morgan Medal of the Water Environment Federation. He has also obtained several worldwide patents for these processes as well. These processes include the original biological treatment process developed for Homestake, the Cyanisorb Process for cyanide recovery from metallurgical circuits, and the Biopass System, the first large scale process for passive *in-situ* treatment of spent heap leach pad solutions, waste rock drainage, and tailings impoundment seepage - an underground anaerobic passive treatment system for removal of cyanide, metals, sulphate, and nitrate.

He is often considered the first to apply biotechnology in the mining industry. First was the development of the novel combined aerobic attached growth biological treatment process using rotating biological contactors at Homestake in the early 1980s. This was the first of its kind relying on bacteria to remove thiocyanate, cyanide, ammonia, and metals from process solution producing up to 15,000 m<sup>3</sup>/d of treated wastewater that was discharged into a permanent trout fishery. He aided in restoring a stream system that had been contaminated for nearly a century. This development led to the biological treatment facility at the Nickel Plate mine in Canada at which the original CIP/CIL circuit was converted into a two stage combined aerobic-anaerobic treatment facility removing very high levels of thiocyanate, cyanide, ammonia, and nitrate some of which reached hundreds of ppm.

He has been instrumental in the development and application of many chemical, physical, and biological treatment processes for cyanide, metals, and other constituents. He also along with his colleagues was one of the first to pilot test two chemical treatment processes including the

copper catalysed hydrogen peroxide process and ozonation for the destruction of cyanide. Along with these chemical treatment processes he was nearly the first to pilot test the use of ion exchange resins for the removal of cyanide from mine process solutions.

Mudder was involved in the development of use of granular activated carbon columns for the purpose of removing low levels of cyanide and metals from process solutions as a tertiary treatment or effluent polishing process.

Along with Adrian Goldstone, he developed the first modern cyanide recovery facilities used in New Zealand at the Golden Cross mine and at the Delamar Silver mine in the US. Two other cyanide recovery plants were then built using the patented Cyanisorb Process which not only exhibited environmental but also metallurgical advantages as well.

Mudder started the Closure Strategy Group in an attempt to modernize the process of mine closure with emphasis on long term strategies, sustainability, and passive treatment. He was involved with emergency preparedness and response and led the ground breaking investigation of the one of very first hazardous waste evaluations of mine tailings in the world in the early 1980's under the newly created, at that time, CERCLA legislation, also known as Superfund.

He has more than 30 years experience in the investigation of the chemistry, analysis, fate, aquatic toxicity, and disposal of mining and cyanide wastes. During that time he emerged as a leading environmental scientist and engineer in the mining industry internationally related to cyanide issues and has been instrumental in expanding the fundamental information and data base regarding the environmental effects of cyanide and its many related compounds.

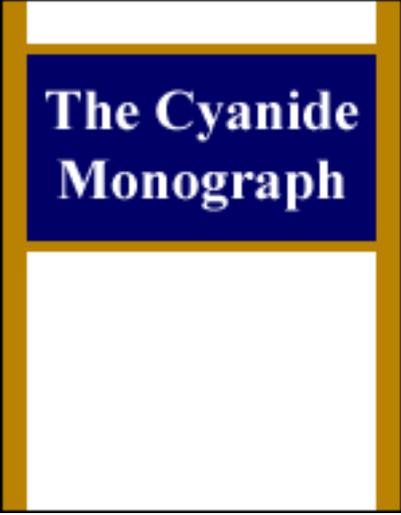
He along with his colleagues established weak acid dissociable or WAD cyanide as the most "toxicologically significant" and "ecologically important" forms replacing free and total cyanide. He aided in perfecting the analytical procedures for cyanide.

He developed, along with Mike Botz, a mathematical model to allow the prediction of the fate of total, WAD, and free cyanide in tailings and process solution ponds.

Mudder holds a B.S. and M.S. in organic and analytical chemistry, and a Ph.D. in environmental science and engineering from the University of Iowa. He has served as adjunct professor, graduate student and thesis advisor, and guest lecturer at several colleges and universities in Australia, Canada, and the US in the departments of biology, chemistry, environmental engineering, geology, soil science and reclamation, mineral processing, and metallurgy. Mudder received the prestigious Guy March Medal from his Alma Mater, the South Dakota School of Mines and Technology, as an Outstanding Alumnus.

He has worked on well over 200 mining and industrial projects on six continents including in Australia, Bulgaria, Canada, Chile, France, Ghana, Greece, Guatemala, Indonesia, Mali, Mexico, New Zealand, Peru, Romania, Russia, South Africa, Turkey, and the USA. Clients have included aboriginal and native peoples, citizen groups, mining companies, NGOs, and regulatory agencies. He has also served on corporate audit teams assessing mine closure strategies, as well as cyanide and overall environmental management practices.

He has provided expert advice to the International Council on Metals and the Environment (ICME), The Gold and Silver Institutes and International Cyanide Management Institute. He has been a technical advisor and consultant not only to industry but also to the British Columbia Ministry of Environment, Environment Australia, the Peruvian Environmental Protection Service, the USEPA, the United States Forest Service, various State agencies, the United Nations Environmental Program (UNEP), the World Bank/IFC mining group on issues related to cyanide and environmental management and the European Bank for Reconstruction and Development on issues related to global cyanide management. He participated on the original UNEP working group involved with development of the International Code for Management of Cyanide in the Gold Mining Industry known as the Cyanide Code.



## The Cyanide Monograph

He has written nearly 100 papers and given numerous technical presentations and lectures. He has written over 80 papers and given numerous technical presentations and lectures. He has been involved with many short courses and workshops on cyanide, acid mine drainage, and closure held in Australia, Peru, and the USA. He has co-authored over 15 manuals, pamphlets, and books, including *The Chemistry and Treatment of Cyanidation Wastes*, *The Cyanide Monograph* and the CD entitled the *Cyanide Compendium*. These publications form the definitive literature resource on cyanide in mining.

He has been the member of many national and international scientific organisations and associated professional committees including the American Chemical Society (ACS), Standard Methods for the Examination of Water and Wastewater, the American Water Works Association, the Water Environment Federation, and the American Society for Testing of Materials. He has been involved as a reviewer of manuscripts submitted for publication in professional journals including The AIME/SME Mining Journal and the ACS publication Environmental Science and Technology. He was a frequent editorial contributor and Technical Advisor to Mining Environmental Management. He maintains the internationally recognised Internet website for cyanide information located at [www.cyantists.com](http://www.cyantists.com)