Management of Pb-Contaminated Sediment in Khli Ti Creek, Thailand

Paweena Panichayapichet[1,*], Nitisoravut Suwanchai[2] and Arpa Wangkiat[3]

[1*] The Joint Graduate School of Energy and Environment, King Mongkut's University of Technology Thonburi, 91 Pracha-Uthit Road, Bangmod, Tungkru, Bangkok, 10140, Thailand, Tel: (662) 4708309-10, Fax: (662) 8729805, E-mail: muaypaweena@yahoo.com

[2] Sirindhorn International Institute of Technology, Thammasart University, P.O.Box 22, Thammasat-Rangsit Post Office, Klong Luang, Pathumthani 12121, Thailand.

[3] Faculty of Engineering, Rangsit University, 52/347 Muang-Ake, Phaholyothin Road, Lak-Hok, Pathumtani, Thailand 12000.

Khli Ti creek, a headwater stream, is located in Lam Khlong Ngu National Park in the western part of Thailand. The creek has been contaminated since 1967 by large quantities of Pb discharged from a tailing pond of the Pb-ore concentrator, which lies adjacent to the creek, 21 km upstream from the outlet. Breaching of the pond in April 1998 contaminated 17,540 m^3 of river bank sediment with 833 ton Pb content (Pollution Control Department, 2001). Prohibition of consumption of water, aquatic plants and fauna in the creek since 1998 has caused difficulties for rural people in making ends meet in their daily lives. After the event, the Pb-ore concentrator was ceased and the tailings pond was renovated. In 1999, within 2.5 km from the floatation plant 3,753 metric tons of contaminated sediment was excavated. In 2001, 2 rock check dams were built across the creek to entrap the transportation of remaining contaminated sediment for later excavation and landfill, one locates at 4.18 km and the other is at 7.71 km downstream from the discharge point of the tailing pond (Paijitprapapon, 2003). The dam was designed to slow down water velocity and precipitate particulate matter. At the present time (2006), the trapped sediment has not been dredged because of the fear that dredging will resuspend the contaminated sediment into the water column. Natural remediation by deposition of fresh sediment during periods of high flow was expected to cover the contaminated sediment. However, without dredging, contaminated sediments can become secondary sources of pollution due to resuspension. Clean up must be done since the concentrations of Pb in all sediment samples previously collected and analyzed by all agencies exceed 530 mg kg^{-1} which is the sediment cleanup screening level/minimum clean up level of the chapter 173-204 of Washington Administration Code (WAC) for Pb. The aim of this study was to propose the appropriate method for managing Pb-contaminated sediment in Khli Ti Creek.

Previous monitoring data was analyzed as to identify the potential source and level of contamination. The data showed that sediment, within 11.5 km from the floatation plant, was highly contaminated. Pb concentrations were decreased at the sampling stations downstream from the Khli Ti Lang village. This means that Pb concentrations in water can be raised up during high flow regime due to resuspension and impact the quality of life of people in the area. Sequential extractions of sediment samples collected in June 2004 were done following the procedure of Tessier (1979) as to determine the metal speciation before consideration of the appropriate treatment method. The sediment samples were wet sieved to less than 63μ m, dried and sequentially extracted. Pb concentrations of samples were analyzed by using ICP-MS, Agilent

7500. The results showed that Pb was dominantly bound to Fe-Mn oxides. Fe-Mn oxides are excellent scavengers for trace metals and are thermodynamically unstable under anoxic conditions (low Eh and pH). Abundant of Pb in Fe-Mn oxide phase ensure that exposure of sediment to air during dredging does not much increase the solubility of Pb and sediment washing should be done by using reducing agent. Sediment can be dredged by mechanical or hydraulic method. Hydraulic and pneumatic dredge causes lower resuspension than mechanical dredges (Cleland, J., 2000). However, pretreatment is usually required to remove debris and dewater the dredged sediments. Sediment density and production rate, water depth, current and site access must be determined as to control the resuspension. Dry excavation using sheet piling or stream diversion must be the most appropriate method for dredging sediment in shallow stream like Khli Ti creek. Dredged sediment must be treated and dispose in landfill in consideration of the amount of sediment, contaminant concentrations in dewatered sediment, landfill construction and maintenance costs, transportation costs, site availability, protection of human health and the environment and community acceptance.

References

- *Cleland, J. 2000, Results of Contaminated Sediment Cleanups Relevant to the Hudson River: An Update to Scenic Hudson's Report Advances in Dredging Contaminated Sediment,* Science Hudson, New York.
- Mulligan, C. N., Yong, R. N., Gibbs, B. F. (2001), *An evaluation of technologies for the heavy metal remediation of dredged sediments,* Journal of Hazardous Materials **85**: 145-163.
- Paijitprapaporn, A. (2003), *Environmental and Public Health Effects due to Contamination from Mining Industries in Thailand,* Water Resources Journal ST/ESCAP/SER.C/215: 26-35.
- Pollution Control Department (2001), *Lead Contamination in Klity Creek, Amphoe Tong Pa Pume, Kanchanaburi Province,* Pollution Control Department, Bangkok. (in Thai)
- Tessier, A., Campbell, P. G. C. and Bisson, M. (1979). *Sequential Extraction procedure for the Speciation of Particulate Trace Metals.* Analytical Chemistry **51**(7): 844-851.