BIOGEOCHEMICAL CHARACTERIZATION OF AGRICULTURAL SOILS POLLUTED BY INDUSTRIAL WASTEWATERS: IMPLICATIONS FOR BIOREMEDIATION

Siti K. Chaerun[2], and William B. Whitman

Abstract: Agricultural soils located in Rancaekek, Bandung, West Java, Indonesia have been heavily polluted by industrial effluents for many years. Recent efforts to remediate the heavily polluted sites have failed due to incomplete understanding of the site characteristics. Hence, this study dealt with the biogeochemical characterization of these soils to acquire a better understanding of the biogeochemical impacts and eventually improve their soil quality so that they would again be suitable for agriculture. The polluted soils contained much higher salt concentrations, higher salinity, and elevated levels of heavy metals (Cr, Mn, Co, Ni, Cu and Zn) than unpolluted soils at control sites. Both soils had pH values of 5.9 - 6.6. The polluted soils also had higher levels of maximum water holding capacity (MWHC: 0.8 g water/g soil), exchangeable sodium percentage (ESP: 27-51%), sodium adsorption ratio (SAR: 2.6-7.3) and swelling factor (0.4-0.6) than unpolluted soils (MWHC: 0.7 g water/g soil, ESP: 1.3-2.3%, SAR: 0.1-0.2, swelling factor: 0.03-0.04). The soil basal CO_2 respiration (as overall potential soil microbial activity) in polluted soils was significantly higher than that unpolluted soils ($P < 0.05$). BIOLOG analysis showed that the functional diversity of the microbial community in polluted soils was significantly greater than that in unpolluted soils. NCS and ED-XRF analyses revealed that polluted soils contained elemental sulfur, which was lacking from unpolluted soils. XRD analysis showed that both polluted and unpolluted sites contained important minerals and clay minerals that are essential for both plant and microbial growth. These results indicate that the industrial wastewater-polluted agricultural soils have major changes in their biogeochemical characteristics, therefore being informative to the development of bioremediation strategies of these soils.

Additional Key Words: ESP, Heavy metals, Salinity, SAR, Soil basal CO_2 respiration, BIOLOG.

---

[1] Poster was presented at the 2009 National Meeting of the American Society of Mining and Reclamation, Billings, MT, ***Revitalizing the Environment: Proven Solutions and Innovative Approaches*** May 30 – June 5, 2009. R.I. Barnhisel (Ed.) Published by ASMR, 3134 Montavesta Rd., Lexington, KY 40502.

[2] Siti Khodijah Chaerun is an Assistant Professor, School of Life Sciences and Technology, Bandung Institute of Technology, Ganesa 10, Bandung 40132, West Java, Indonesia; William B. Whitman is Professor of Microbiology, Department of Microbiology, The University of Georgia, Athens, GA 30602.