Chemical washing of contaminated soils and photocatalytic treatments of spent soil washing effluent

Candidate:	Marco Race *
Supervisor:	Roberto Andreozzi, Ph.D.**
Co-Supervisors:	Massimiliano Fabbricino Ph.D. *
	Raffaele Marotta Ph.D. **
	Francesco Pirozzi, Ph.D. *

*Department of Civil, Architectural and Environmental Engineering, University of Naples Federico II, Via Claudio, 21, 80125 Naples, Italy
**Department of Chemical, Materials and Industrial Production Engineering, University of Naples Federico II, P.le Tecchio 80, 80125 Napoli, Italy

Abstract

This dissertation has been addressed to study the reclamation of heavy metal contaminated soils by soil washing, and to investigate the feasibility of photocatalytic processes for the treatment of the spent soil washing solution (SSWS). Indeed, the collected SSWS, containing the extracted metals and chelating agents, represents one of the main drawbacks of the washing technique, as it has to be submitted to further treatments for a complete detoxification before being discharged into the environment.

The soil washing using EDDS as chelating agent has been demonstrated to be an efficient soil remediation technique to remove Cu and Zn from real polluted soils. Only Cu and Zn present as exchangeable and reducible fractions have been extracted by EDDS. The intra-particle diffusion was the main rate controlling step in the extraction of heavy metals from the solid matrix.

Different contributions have been found by applying the Weber and Morris intra-particle diffusion model due to the different roles of superficial and intra-particle diffusive processes. The diffusion coefficients of the Cu/EDDS and Zn/EDDS complexes in real contaminated soils have been estimated using simplified diffusive models.

The simultaneous removal of EDDS and metals (Cu, Fe and Zn) from both synthetic solutions and real contaminated soil washing mixtures at neutral pH has been investigated to assess the possibility of applying TiO2 based photocatalytic processes for the treatment of SSWS and identify the sequence of photocatalytic processes required to optimally decontaminate the liquid wastes. The photocatalytic tests have demonstrated that the sequence of treatment constituted by two steps, TiO2-photocatalysis with oxygen followed by TiO_2-sacrificial photocatalysis, is required to completely

detoxify the SSWS. In particular, the results show that Fe and Zn are mainly removed by precipitation as insoluble hydroxides during the first step whereas the second step is necessary to reduce cupric ions to zero-valent Cu, which precipitates from the solution.