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DISSERTATIONS

Characterisation of Heavy Metals in Soils Using Magnetic Separation, Ruud Rickers, Technical University Delft, Delft, The Netherlands, Doctoral Thesis (March 1999), 170 pp., 228 refs. (ISBN 90-6464-809-3).

This thesis described laboratory and *in situ* studies of the characterisation of heavy metals (Fe, Cr, Ni, Zn, Pb, and Cu) in soil by magnetic separation. Instead of liquid density separation method, magnetic profiles and separators such as Magstream, Frantz isodynamic separator, HGMS as well as Jones-HIMS were investigated in details. The objective was to isolate heavy metals from soil materials. The results have shown that magnetic separation is capable of isolating heavy metals from soil and that magnetic susceptibility is an important characterisation for soil cleaning. Copper, lead and zinc can be removed from the soil matrix by the magnetic means since these heavy metal elements are bound to the Fe or Fe/Mn oxides. The particle size range of soil studied was mostly in the fractions from 63 to 1000 μm because major parts of heavy metals exist in this range except for lead. Magnetic separation has been confirmed to be a very attractive method for the characterisation of the heavy metals for soil cleaning. The thesis comprises nine chapters: (1) Introduction, (2) Sources of heavy metals, (3) Soil and metals, (4) The principle of physical soil washing, (5) Characterisation tools used for heavy metals in soil, (6) Characterisation of heavy metals in soil by HGMS, (7) Improved method for the prediction of heavy metal recoveries from soil using HISM, (8) *In situ* investigation of magnetic properties of pollution on a site in Haarlem, The Netherlands and (9) General discussion.

Movement of Mineral Particles in the Field of Permanent Magnets and its Application to the Design of Magnetic Separators and Separators with Magnetic Fluids, V.A. Solodenko, Moscow State Mining University, Moscow, Russia, Ph.D. (Candidate of Technical Sciences) Thesis (1998), Supervisor: Professor V.V. Karmazin.

The dissertation describes a new solution to the problem of determination of particle movement in the magnetic field generated by permanent magnets and in magnetic fluids. The understanding of principles of particle behaviour allows to design more efficient separators, as applied specifically to the treatment of gold-bearing slimes. Methodology and computer programs for the modelling of magnetic field of various systems of permanent magnets were developed. Analytical expressions for forces acting on particles in a magnetic field and in a magnetic medium were given. These results were then used to establish principles of motion of particles, including free motion and motion induced by vibrations.

Several types of magnetic separators based on permanent magnets were designed and built. The separators were then applied to the recovery of gold from slimes from the Amur and Khabarovsk districts. Commercial production of such separators was established.

The Enhancement of the Recovery of Gold through the Capture of Fine Particles in Ferromagnetic Flocs, N.N. Zakieva, Chita State Technical University, Chita, Russia, Ph.D. (Candidate of Technical Sciences) Thesis (1998), Supervisor: Professor V.V. Karmazin.

The dissertation describes a new technology of beneficiation of gold-bearing sands. This technology is based on mechanisms of magnetic-flocculation separation (MFS) which were investigated in this study. It was shown that the capture of gold particles occurs during the formation of flocs and during the filtration of slurry through the flocculated structure. During this process, the high-gradient magnetic field generated by the magnetic flocs almost completely extracts gold particles having magnetic properties. It was established that it was possible to recover fine fractions of gold from magnetite-containing sands during MFS. Slimes containing up to 3 g of gold in 1 kg of magnetite were obtained.

The industrial application of MFS in the Chita, Amur and Chukotka districts has shown that it is possible to increase the recovery of gold by 20–30% as a result of additional recovery of fine fractions of gold. Specifications for commercial production of MFS have been established.