UNIVERSITATEA DE VEST DIN TIMIŞOARA

DOMENIUL FIZICA

CERCETĂRI ȘI STUDII PRIVIND METODE FIZICE PENTRU RECUPERAREA MATERIALELOR UTILE DIN DEȘEURILE SOLIDE ȘI SUSPENSII FLUIDE

RESEARCHES AND STUDIES ON PHYSICAL METHODS FOR RECOVERY OF USEFUL MATERIALS FROM SOLID WASTES AND FLUID MEDIA SUSPENSIONS

REZUMATUL TEZEI DE ABILITARE

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This thesis refers to researches and studies of the author regarding physical methods for manipulation and separation of particles for the recovery of useful or harmful materials from various heterogeneous types of solid wastes and fluid media particulate suspensions, watching the two main ways: separation based on electrical and/or magnetic properties of materials contained in solid wastes or electrical manipulation of micro/nanoparticles in fluid media suspensions. The essence of separation processes consists in the action on different components of heterogeneous mixtures solid wastes of electric and/or magnetic forces or electric forces on fluid media particulate suspensions, in competition with weight, inertial forces, friction, and forces from the hydrodynamic interactions. They depend on as value and orientation of the physical properties of the bodies subjected to the separation mixture and thus provides concurrent selective action. Depending on the values and orientations of all the forces that act, the components of interest achieve different trajectories and are deflected and collected differently, leading to splitting and separation of a solid mixture or leading to different concentrations inside a fluid media suspension.

Thesis structure:

The work shows the author's own contributions, both theoretical and practical issues related to electrical and magnetic separation and is divided into several chapters: the introduction setting out the reasons for approaching the subject; the first chapter presents the main physical quantities characteristic of a separation process; the second chapter refers to electrical separation of plastic materials using the triboelectric effect; the third chapter presents separation in non-uniform electric field using dielectrophoresis, both for the separation of particles from solid heterogeneous mixtures, as well as the manipulating of micro / nanoparticles in fluid media suspensions. The fourth chapter is dedicated to the presentation of several original types, designed, made and tested by author of magnetic separators based of eddy currents action upon conductive nonferrous particles from electrotechnical wastes.

Main contributions of the author:

1. Recovery with good results of useful minerals (rare metals) from waste minerals with very low concentration of useful materials (Au: 1.3 g/t, Ag: 2.5 g/t) using electrical gradient forces (dielectrophoresis). Creating a new theory, confirmed by experimentally in terms of the expression of dielectrophoretic forces acting on dielectric and metallic particles from the surface mineral sterile placed in an AC electric field.

2. Electrical separation of some plastic materials (polymers) using the triboelectric effect. As an innovating aspect: the theory about the mechanism of charge transfers in the triboelectric loading of dielectric particles in the presence of humidity and corroborate these hypotheses with the experimental results obtained.

3. Theoretical and practical aspects regarding manipulation of nanoparticles in fluid media using dielectrophoresis, having as main goal the filtration of flue gas by entrapment of nanoparticles in microfluidic devices, finalized with promising results.

4. Recovery of useful materials from electrotechnical wastes by using eddy-current separation in several original types of separators, of which we mention:

- A new concept in the field of Eddy-Current Separation, where the feeding is achieved at the lower part of the magnetic drum. In this way the rotation of the conductive particle contributes positively to the translational acceleration, increasing the effect of separation. The new device was used for the separation of Al from a mixture of milimmetric Al-Cu wires,

- Separation of the small metallic nonferrous particles from two component nonferrous mixtures using a new type of dynamic eddy-current separator with permanent magnets consisting of a horizontal rotary drum covered with permanent magnets, alternately N-S and S-N oriented, placed oblique, under the superior part of a horizontal conveyor belt, coplanar with its surface. The separator functions on the basis of the jump effect of the strongly conducting particles which assume different trajectories in the active zone of the field, the device being successfully used for separation of Cu-Pb and Cu-Al mixtures.

- Separation of the small metallic nonferrous particles from two component nonferrous mixtures using a new type of dynamic eddy-current separator with permanent magnets consisting of a horizontal rotary drum covered with permanent magnets, for which the separation process takes place in two stages: first the strongly conducting particles are separated on the upper part of the drum, and then the remained undecided and poorly conducting particles are separated at the lower part of the magnetic drum. The device was used for separation of electrotechnical wastes consisting in Cu-Pb and Cu-Al mixtures.

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