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CHARACTERIZATION OF SPENT Ni-MH BATTERIES

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Spent Ni-MH batteries are not considered too dangerous for the environment, but they have a considerable economical value due to the chemical composition of electrodes which are highly concentrated in metals, requiring suitable management solutions namely the recycling and valorization of contained materials. Ni-MH batteries are complex multi-component products, having diverse assembling designs, sizes and shapes, which will complicate recycling.

This paper presents the physical and chemical characterization of spent cylindrical and thin prismatic Ni-MH batteries, contributing to a better definition of the recycling process of these spent products. The structure of electrodes is highly porous having a large surface area to provide a low internal resistance and a capability for high-rate performance. Usually in cylindrical batteries, the electrodes are separated by a fibrous polymer sheet impregnated with a KOH solution (as electrolyte), wrapped in a spiral. Thin prismatic batteries are basically composed of three-five cells connected in series inside a plastic case. Each cell is constituted by an external metallic case, electrode materials, the plastic insulators and metallic terminals.

The electrode materials, containing essentially nickel, rare earths and some cobalt, manganese and aluminium, correspond to more than 50% of the batteries weight. The remaining components are the steel parts from the external case and supporting grids (32% in average) containing Fe and Ni, electrodes mixture (2% in average) and the plastic components (<10%).

The cathode is made of nickel coated with nickel hydroxide while the anode is a hydrogen storage alloy based on mischmetal (mainly lanthanum, cerium, praseodymium and neodymium) and nickel with substitutes such as cobalt, manganese and aluminium.

The cathode is constituted by 9.6% metallic Ni, 61% $Ni(OH)_2$, 4.3% $Co(OH)_2$ and the anode consists in 53% $LaNi_5$ and 25% of substitutes and/or additives such as Ce, Co, Mn and Al. The morphology of the electrode materials was observed by scanning electronic microscopy and the particles shape of nickel hydroxide and metal alloy was clearly distinguished. In both type of batteries the euhedral and spherical shapes were identified for the alloy and hydroxide particles, respectively. In the thin prismatic type some other hydroxide particles also presented a matrix composed by filamentary crystals with a unique three-dimensional petal shape.

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Keywords: Ni-MH batteries; Recycling; Waste; Characterization.