

## Synthesis and characterization of CdS yellow ceramic pigment from Cd of Ni-Cd batteries

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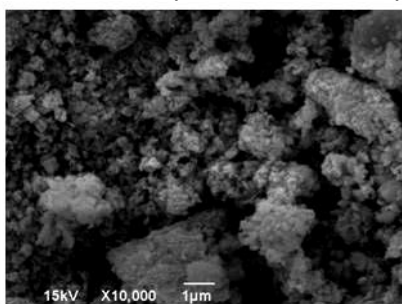
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**Abstract** – This work reports on the preparation and characterization of CdS yellow pigment from Ni-Cd batteries. Cd was chemically extracted with HCl and tributylphosphate (TBP) and reacted with H<sub>2</sub>S to form CdS. The obtained yellow powder is composed of agglomerates of particles with sub-micrometer sizes. It is proposed that these particles consist of a CdS layer that coats a CdCl<sub>2</sub> nucleus. The extraction of Cd from Ni-Cd batteries could be a low-cost and environmental solution for production of CdS pigment.

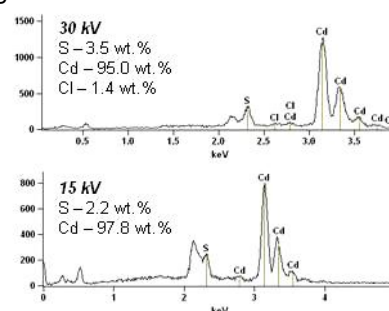
Ceramic pigments consist mostly of metallic oxides, due to their high thermal and chemical stability. Exceptions are cadmium-based pigments. Although oxide based pigments usually present high purity, low purity raw materials are cost effective and exhibit enough stability with adequate chromatic quality [1]. There is a crescent interest from the ceramic industry for the development of pigments with intense tonalities from low-cost alternative raw materials that fulfill technological and environmental requirements [2]. Recently, with new recycling methods, industrial residues and natural by-products have attained great interest for the development of ceramic products with high aggregate value such as inorganic pigments [3-5]. In this work, Cd from Ni-Cd batteries was chemically extracted and used to synthesize a yellow inorganic, non-oxide pigment (CdS). The discharged batteries were manually dismantled and the electrolytic paste was carefully removed and submitted to an acid treatment with concentrated HCl (12 mol/L) at 40°C under agitation for 4h. The leached liquid was vacuum filtered and the residue was dried at 40°C. The solute was extracted with tributylphosphate (TBP) dissolved in deodorized kerosene (25% v/v) during 5 min. This process was repeated for 3 times and the organic fractions contained Cd were collected. The Cd retained in the organic fractions was re-extracted with an HCl (6 mol/L) solution. The solution was then neutralized with NaOH (12 mol/L), which promoted the precipitation of Cd. Reaction with H<sub>2</sub>S resulted in the formation of CdS as an agglomerate yellowish powder (Figure 1). Nearly 100% of Cd could be separated and recovered with high purity. The microstructure of the obtained powder was evaluated by scanning electron microscopy (SEM), coupled with X-ray dispersive energy spectrometry (EDS). Most of the agglomerates are composed of particles with sizes in the sub-micrometer range (below 100 nm) (Figure 2). It is proposed that most of these particles consist of a CdS layer that coats a CdCl<sub>2</sub> nucleus, resulted from the reaction of precipitated Cd with HCl, as indicated by EDS surface analysis (Figure 3) using different accelerating voltages (15 and 30 kV). At 15 kV (surface layer) Cd and S appeared as the major elements. The extraction of Cd from Ni-Cd batteries could be a low-cost and environmental solution for production of CdS pigment.



**Figure 1:** Photograph of the obtained CdS powder.



**Figure 2:** SEM micrograph of the CdS powder.



**Figure 3:** EDS spectra of CdS pigment with 2 accelerating voltages.

### References

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