Processing of spent ZINC-MnO2 DRY cells in various acidic media

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This paper describes a route for recovering manganese and zinc from spent zinc-MnO_2 dry cells via acid leaching. Sulfuric, hydrofluoric and formic acids were used as leachants. Hydrogen peroxide was added as reductant, except for formic acid since it is itself a reductant. Experiments were run at 25-40 ^oC for 1-3 h. Under the best optimal conditions, over 95 wt.% of zinc and manganese were leached irrespective of the leachant. Leaching of contaminants was strongly dependent on the leachant due to the insolubility of salts or complexing reactions. Zn(II) was best extracted with D2EHPA diluted in n-heptane at pH > 1, particularly from the leachates of weak acids. Mn(II) was much more co-extracted from sulfuric leachates, but was easily scrubbed with dilute leachant (~2 mol L^{-1}). Zn(II) striping was possible using 5 mol L^{-1} H_2SO_4. Manganese was isolated as MnO_2 carrying the leached contaminants. High-purity sodium salts of the anions of the leachants were recovered after slow evaporation of the final solution [1-15].

Over 95 wt.% of zinc and manganese were leached from the electroactive components of spent zinc-MnO_2 dry cells under mild experimental conditions in the presence of a weak acid and a reductant. Formic acid effectively served the dual role of leachant and reductant as HF or H_2SO_4 + H_2O_2 mixtures. Leaching was fastest in the presence of hydrofluoric acid. Precipitation and complexation reactions influenced leaching of minor elements present in the electroactive components. The insoluble matter corresponded to carbon and non-leached elements except for formic acid, where an additional volatile mass was found.

More than 95 wt.% of Zn(II) was extracted by D2EHPA in one stage (6 vol.%, A/O = 1 v/v, 25 ^oC) at pH 2 following the order HF > HCOOH > H_2SO_4. Mn(II) extraction from leachates of weak acids was the lowest. Therefore, hydrofluoric or formic acids are alternative leachants for processing spent zinc-MnO_2 dry cells. The effect of pH and D2EHPA concentration on Zn(II) extraction were the same regardless of the leachant. Extracted Mn(II) was easily scrubbed with 2 mol L^{-1} leachant. Zn(II) stripping was only possible using a strong acid (5 mol L^{-1} H_2SO_4). High purity crystalline sodium salts of the anions of the leachants were obtained after precipitation of Mn(II) and pH adjustment of the final solution followed by slow evaporation. Recovery of these salts reduced the amount of final wastes.

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