

The NIFE Process

Recovery of Nickel and Cadmium from Accumulator Scrap



Cadmium Carbonate Precipitation Equipment

Nickel and cadmium are used in the production of NiFe rechargeable batteries. Using the AmMAR concept, the main leaching procedure to dissolve these valuable metals from worn-out accumulator scrap and production waste is performed in a two-step procedure. First with an ammonium carbonate solution and, secondly, with diluted sulfuric acid to obtain very high leaching

efficiency.

Due to chemical passivation in "old" waste materials, subsequent leaching of the leach residue with sulfuric acid, with perhaps some oxidation, is necessary to achieve very high yields. If the pH in this second treatment is kept about 3, leaching of iron is negligible. Also, to reduce iron in the leach solution, spent potassium hydroxide electrolyte from discarded batteries, can be used for iron hydroxide precipitation.

The procedure has several advantages; iron will remain in the leach residue, nickel and cadmium are almost completely leached and form metal-amine complexes in solution and, finally, the buffer capacity of the solution facilitates solvent extraction of metals with hydrogen ion exchange reagents. Thus, nickel is extracted from the leach solution using such an extractant with significant amounts of co-extracted ammonia and cadmium. Scrubbing is therefore performed, first with an ammoniacal carbonate solution and then with very diluted sulfuric acid. Nickel is then stripped with strong sulfuric acid to produce a nickel sulfate solution, containing 90 - 100 g/l nickel. This solution is used directly in the production of new accumulators.

The presence of carbonate in the ammoniacal system offers a possibility of controlling the conditions for the formation of cadmium carbonate. After separation of nickel in the

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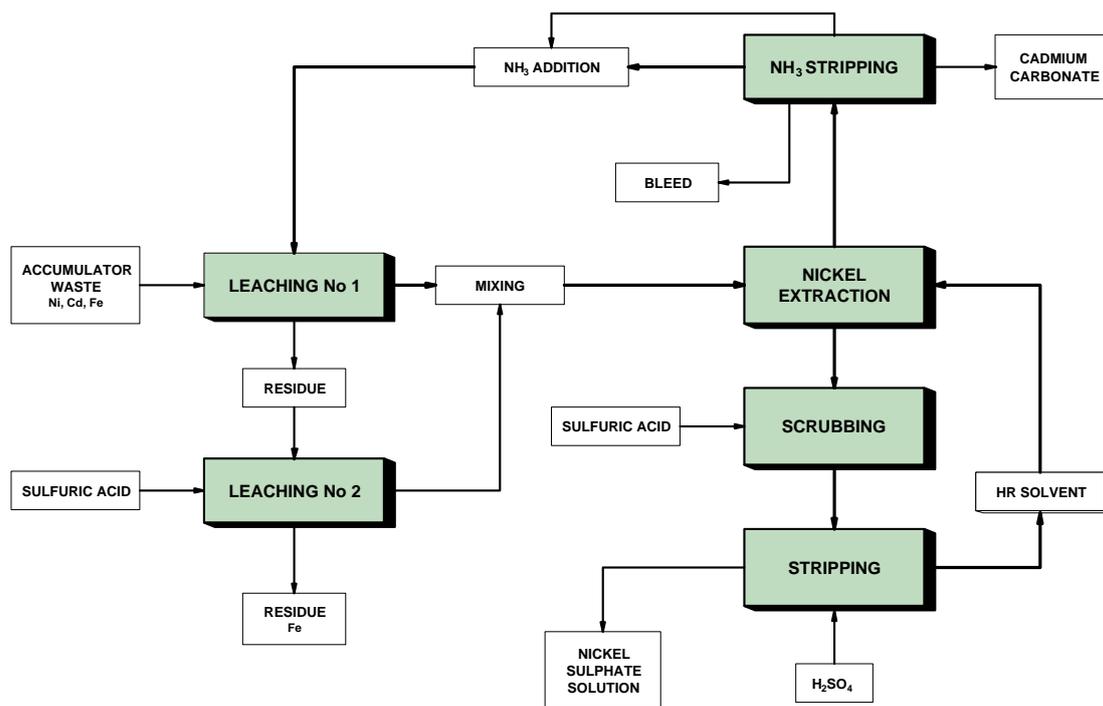
solvent extraction loop, cadmium is precipitated from the raffinate as carbonate.

Thermal stripping reduces the ammonia concentration. Some carbon dioxide will also be evaporated. The precipitation is made complete by cooling the solution and by addition of a carbon dioxide purge. After filtration of cadmium carbonate, the filtrate is used for absorption of the stripped ammonia and the resulting solution is recycled to leaching. The cadmium carbonate precipitate is directly used in the main production.

It is necessary to bleed about 25 % of the filtrate from the carbonate precipitation to

keep the material balances. This large bleed is due to the sulfate added in the sulfuric acid leach and to the fact that the waste material contains considerable amounts of alkali (KOH) and water. The bleed needs special treatment to recover ammonia and to produce an environmentally acceptable effluent.

The process has been tested in pilot plant scale with good technical results. At that time, however, the amount of waste material available was not enough to justify the feasibility of a full scale plant..



Block diagram:
Recovery of Nickel and Cadmium Accumulator Scrap

Reference.

Nickel and Cadmium Recovery from Accumulator Scrap and Production Waste

Some Problems in Metal Waste Recovery Using Solvent Extraction, Soc Chem Ind Meeting, Plenar Lecture, Manchester 1981.