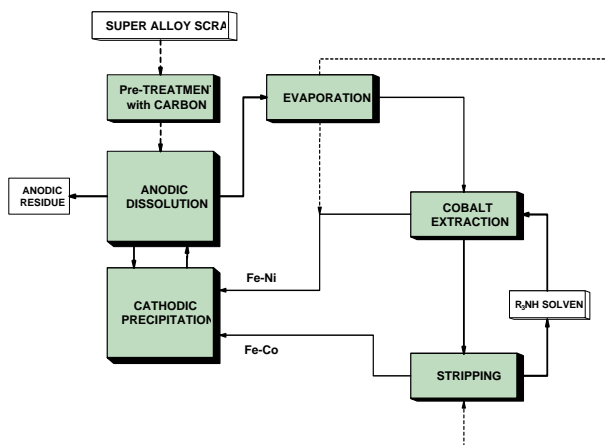


The Gullspang Process

Separation of Iron, Cobalt and Nickel from Scrap Alloy

The raw material, scrap containing Mo, W, Cr, Fe, Co and Ni, is pretreated in a furnace with graphite to transfer the high melting metals (Mo, W etc.) into carbides. The melt is granulated and the granulate is charged into titanium baskets.

Diaphragm type electrolytic cells are used for anodic dissolution of the granulate. Fe, Co, Ni and small amounts of Cr are brought into a CaCl_2 solution by the current. The metal carbides are not dissolved and remain as anodic residue in the baskets. The anolyte, containing about 50 g/l Cl^- , is fed to a solvent extraction operation for separation of the metals, based on their tendency to form metal chloride complexes in the solution.



Block diagram:
Separation of Iron, Cobalt and Nickel from Super Alloy Scrap by a Solvent Extraction – Electrochemical procedure

In a first mixer-settler arrangement, iron (as Fe^{3+}) is nearly quantitatively extracted to an organic solution containing 25 % Alamine 336 and 15 % dodecanol in kerosene. At the actual chloride ion concentration, the iron chloride complex is much stronger than the cobalt one and therefore, iron prevents cobalt from being extracted from the solution. Using the same composition of the organic solution, cobalt and a small amount of iron (as Fe^{2+}) is extracted in a second mixer-settler arrangement at a chloride ion concentration of >200 g/l. The high chloride iron concentration is obtained by evaporation of the raffinate solution from the iron extraction.

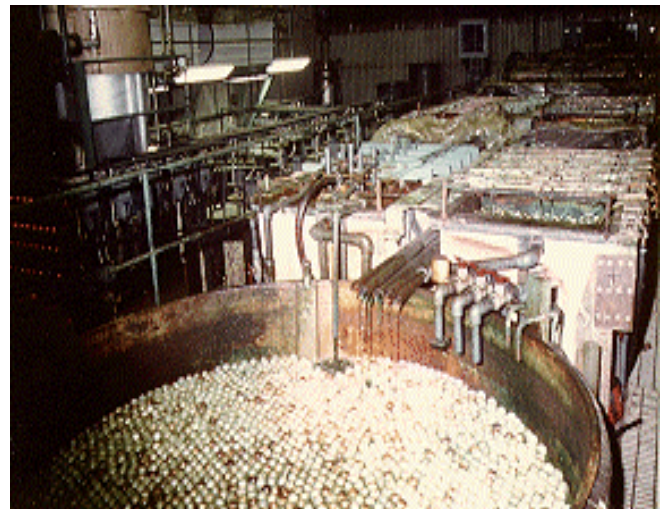
The organic solutions from the iron and the cobalt extraction are stripped with the slightly acid (pH 2-3) condensate and are then pumped into cathodic compartments of the diaphragm electrolytic cells, separate cells for iron and cobalt. The chloride ion concentration is 30-40 g/l in both solutions. The metals are deposited on iron-wire nettings.

The raffinate from the cobalt extraction is diluted with condensate so that the resulting chloride ion concentration is 120-150 g/l. Nickel is then recovered electrochemically, similarly as iron and cobalt.

MEAB

The process described has been running in pilot plant scale operation for about half a year and the advantages of the process can be summarized:

- Using diaphragm-type electrolytic cells, electrical energy is used in an optimal manner for dissolution and deposition
- The amine-chloride system is well suited for the separation of the metals
- Using an evaporator for raffinate concentration and production of strip solutions, a closed wet cycle is obtained and no aqueous waste pollute the environment
- The low consumption of chemicals and energy indicate an economic advantage over similar open cycle processes



Reference.

Separation of Iron, Cobalt and Nickel from Scrap Alloy by a Solvent-Extraction Process

Proc Int Solv Extr Conf, Haag 1971.