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METHOD FOR EXTRACTING METAL FROM A METAL SOURCE IN AN ELECTROLYTIC CELL

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ABSTRACT OF THE DISCLOSURE

A method of extracting metal from a metal source, such as plating, scraps or ores of tin, aluminum, zinc, lead, vanadium, chromium, manganese, molybdenum, nickel and silver, by charging the metal source into an electrolytic cell having an aqueous electrolyte containing sodium chloride and sodium carbonate, in connection with the anode of the cell, and extracting the metal from the metal source by an electrolytic reaction to form a metal salt.

BACKGROUND OF THE DISCLOSURE

The present invention relates to the extraction, recovery and refining of metals, and in particular to a novel electrolytic process for such purposes. This process is suitable for the extraction of metals from metal plating, scraps or ores. Typical metals include tin, aluminum, zinc, lead, chromium, manganese, molybdenum, copper, nickel, and silver.

The present process is related to my co-pending applications entitled Process for Extracting Metal from Metal Plating, Scrap or Ore in a Fused Electrolyte Cell, Ser. Nos. 77,536 and 77,537, filed Oct. 2, 1970.

DETAILED DESCRIPTION OF THE INVENTION

The present process involves a method for extracting metal from scrap metal, plate or ores, and obtains the metal in the form of its salt in an electrolytic cell. In particular the method is suitable for recovering tin from tin plate, scrap or tin cans, lead and zinc from galvanized materials, aluminum from aluminum scrap or ores, and other metals from similar metal sources.

In the process of extraction an aqueous electrolyte material, essentially comprising sodium chloride and sodium carbonate is used at a concentration to give a specific gravity between about 15 and 40° Bé. The extracting electrolytic cell is operated at about 30–90° C., 6–24 volts, and 40–80 amperes per sq. ft. The construction of the electrolyte cell may be in any suitable form, with the construction described in my co-pending applications referred to above being preferred and suitable. Preferably, the cell equipment includes transport means for carrying the metal source in steel baskets through the electrolyte at such a rate as to reach the end of the cell for removal at about the time that extraction is complete.

The following examples will describe specific procedures employing the present method for different source metals. It is not intended that these will necessarily describe preferred or ideal embodiments, and by the following specific examples there is no intention to limit the scope of the present invention by any of the specific, non-essential details described.

Example 1: Tin

An electrolytic cell, identical in construction to that described in the examples and specifications of my co-pending application Ser. No. 77,536 filed Oct. 2, 1970 is used in the extraction step described below. The cell

is filled three-fourths full with an electrolyte solution comprising 50–75 percent sodium chloride and 25–50 percent sodium carbonate, at a concentration of about 15–20° Bé. Tin cans are punctured through both ends and the bodies are cut into two and flattened. These materials are cleaned to remove foreign matter and put into steel baskets which are connected to the anode of the cell and lowered into the aqueous electrolyte. The tin cans and steel basket pass from one end to the other of the electrolytic cell, hanging on a monorail, in about 15 to 20 minutes. The baskets then pass out of the top of the cell into a washing vat. After rinsing, the detinned steel or iron is dipped into a rust-preventing solution, dried, packed and shipped to steel smelters.

The tin is extracted from the plating into the aqueous electrolyte in the form of sodium stannate, Na_2SnO_2. The extraction procedure is continued until the aqueous electrolyte becomes saturated with sodium stannate, at a concentration of about 40–50 percent, when it is withdrawn from the electrolytic cell through an appropriate outlet connected also to a filter assembly. The sodium stannate solution is filtered and transferred to vats, where it is titrated with acid to form stannous dihydroxide. After titration, the stannous dihydroxide is transferred to a separatory tank made of acrylic plastic to withdraw the clear supernatant liquid, a solution of sodium chloride. The stannous dihydroxide precipitates to the bottom as a gelatinous material, and is withdrawn from the separatory tank through an appropriate outlet at the conical end of the bottom of the tank.

The electrolytic extraction cell operates at about 35–70° C., 40–80 amperes per sq. ft., 6–24 volts. During operation, in the event of hydrogen over-voltage, which rarely happens, the potentials may be exchanged, thus avoiding the deposition of metallic tin at the cathode during detinning. Hydrochloric acid may be used to convert the sodium stannate to stannous dihydroxide.

The gelatinous stannous hydroxide may be dried and calcined to form purified stannous oxide, which in turn may be employed to obtain pure tin, for example in accordance with the method of reducing stannous oxide to pure tin described in my co-pending application, Ser. No. 77,536, filed Oct. 2, 1970.

Example 2: Aluminum

This example is performed in the same extraction cell employed in Example 1. Here, aluminum is extracted from aluminum ore, containing aluminum oxide.

The electrolyte employed comprises 50 percent sodium chloride and 50 percent sodium carbonate in aqueous solution at 15–20° Bé. The voltage across the cell is 6 to 12 volts and the cell operates at about 40–80 amperes per sq. ft. and 35–70° C. The aluminum is extracted as a temporary compound of aluminum chloride, which is ultimately converted to sodium aluminate and aluminum hydroxide.

The solution of sodium aluminate is diluted with water until the hydrometer reading is about 15° Bé, and then filtered. This dilute solution of sodium aluminate and caustic soda is subjected to a series of thickeners in order to settle and precipitate the impurities, consisting primarily of silica, titanium, iron oxide, and double aluminates and silicates, and further filtered through rotary vacuum type filters. The purified filtrate is now seeded with a small amount of aluminum to accelerate the development of aluminum hydrate, $Al(OH)_3$, in the form of crystals. The procedure of crystallization is substantially the same as the method described in my copending application Ser. No. 77,536, filed Oct. 2, 1970.

The recovered aluminum hydrate crystals may be dried and calcined to form purified aluminum oxide, which may then be employed to recover aluminum metal by conven-

tional reduction procedures. The purification procedures described in the above co-pending application may also be employed.

Example 3: Chromium

This example is performed in the same extraction cell employed in Examples 1 and 2. Chromium is extracted from an ore containing chromium oxide, for example chromite. The electrolyte and cell operation are substantially the same as for Example 2. The chromium is extracted as a temporary compound, chromic chloride, which is ultimately converted to sodium chromate and then chromic hydroxide.

The chromic hydroxide precipitates from the aqueous electrolyte solution as a green gelatinous precipitate, which can be removed and heated to form substantially pure chromic oxide.

I claim:

1. A method of extracting metal from a metal source selected from the group consisting of metal plating scraps and ores of tin, aluminum, zinc, lead, vanadium, chromium, manganese, molybdenum, copper, nickel, and silver, which comprises charging said metal source into an electrolytic cell, containing an electrolyte of 25–75 percent sodium chloride and 25–75 percent sodium carbonate in water at a concentration of not less than about 15° Bé and not more than 40° Bé but in any event not more than saturation, providing an electrical connection between said metal source and an anode of said cell, extracting the metal from said metal source by electrolytic reaction at about 30–90° C., 6–24 volts, and 40–80 amperes/sq. ft. area, to form a metal salt, and removing and recovering said metal salt.

2. The method of claim **1**, wherein said metal source is passed through said electrolytic cell in moving baskets electrically connected to the anode thereof.

3. A method of extracting metal from a metal source selected from the group consisting of metal plating scraps and ores of tin, aluminum, zinc, lead, vanadium, chromium, manganese, molybdenum, copper, nickel and silver, which comprises charging said metal source into an electrolytic cell, containing an electrolyte of 25–75 percent sodium chloride and 25–75 percent sodium carbonate in water at a concentration of about 15–20° Bé, providing an electrical connection between said metal source and an anode of said cell, extracting the metal from said metal source by electrolytic reaction at about 30–90° C., 6–24 volts, and 40–80 amperes/sq. ft. area to form a metal salt, and removing and recovering said metal salt.

4. The method of claim **3**, wherein said metal source is passed through said electrolytic cell in moving baskets electrically connected to the anode thereof.

References Cited

UNITED STATES PATENTS

1,195,211	8/1916	Guiterman	204—96
1,352,208	9/1920	Lovelace	204—96 X
1,361,041	12/1920	Fry	204—96
179,658	7/1876	Keith	204—121
3,198,720	8/1965	Knippers et al.	204—121

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