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"IMPROVED PROCESS FOR THE ELECTROCHEMICAL RECOVERY OF COPPER FROM INDUSTRIAL BY PRODUCT COPPER COMPOUNDS. "

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The following specification particularly describes and ascertains the nature of this invention and the manner in which it is to be performed :-

PRICE : TWO RUPEES

148329

This is an invention by HANDADY VENKATAKRISHNA UDUPA, PENNAGARAM VYASARAO VASUDEVA RAO, HENGASWAMY VIJAYAVALLI, all Scientist, KURNISERI VENKATACHALAM VENKATESWARAN, Junior Scientific Assistant, all of the Central Electrochemical Research Institute, Karaikudi, Tamil Nadu, India, all Indian citizens.

This invention relates to an improved process for the electrochemical recovery of copper from industrial byproduct copper compounds such as copper oxide waste from copper rolling mills as well as byproduct copper compounds obtained from the chemical industry.

Hitherto it has been proposed in the art to utilise the copper waste either in the preparation of copper salts by dissolving the copper waste in appropriate acid and crystallisation or recovering copper by the electrolysis of homogeneous solution of copper sulphate obtained by dissolving the above mentioned waste in sulphuric acid, using soluble anodes. It has also known to use the copper oxide obtained as a byproduct from alloy making process after conversion of the oxide into the metal. Gaseous reduction of copper oxide has also been reported for making copper powder from pure copper oxide obtained either as byproduct or as copper scrap. A direct electrochemical process for the reduction of copper oxide to copper powder has been described in our prior Indian Patent No. 99656. According to the prior patent the process for electrochemical production of copper powder from byproduct copper oxide obtained from the copper wire and tube drawing and sheet rolling industry or the chemical industry comprises the electrochemical reduction of solid copper oxide kept as a sediment on the cathode substrate of an electrolytic cell containing an aqueous alkaline electrolyte (preferably NaOH solution) keeping an alkali resistant anode immersed in the electrolyte above the sediment.

Prior Indian Patent No. 83655 also relates to a process of electrolytic deposition of copper from an electrolyte containing dissolved copper the improvement comprising the use of nickel catalysts.

Recovering copper from the copper compounds as mentioned above as per known process stated herein, has not been adopted for industrial use in a large way. Though the gaseous reduction has been found to be satisfactory for small scale productions, the utilisation of byproduct waste copper compounds could not be done by ~~the~~ this process. While known process for converting the copper waste to copper powder, in the oxidation of scrap the efficiency has been found to be low it also results in loss of considerable quantity of energy and thus the entire process becomes uneconomical in operation. The electrolytic copper powder has always been considered to be superior to that obtained by thermal methods. Besides the considerations as mentioned above in the conventional electrolytic process the maintenance of the process variables such as concentration and current density are to be strictly maintained in order to make the product more uniform and satisfactory in quality. The direct electrochemical reduction process is meant only for making copper powder from industrial byproduct copper oxide waste which are not contaminated and are fairly in pure form.

The main object of this invention is to obviate these disadvantages and to work out a new and improved method for the recovery of copper from copper waste compounds which are obtained as industrial byproducts in considerable quantities.

The other important objects of the invention are that:-

(1) Copper can be recovered in the form of uniform sheet or powder and the waste need not be got into uniform solution for electrolysis, thus avoiding the handling operations such as dissolution and filtration.

(2) The process can be made continuous by feeding the copper compounds at predetermined intervals.

(3) The deposit obtained is free from any other impurity and the only impurity may be that of oxide of copper.

(4) The deposit (in the case of sheet) is metallic in character and is of high purity. Due to the metallic character of the deposit higher efficiencies could be obtained for melting.

(5) The electrolyte can be used over and over again for considerable length of electrolysis with occasional making up for the loss of water due to evaporation and acid by spray without only detrimental effect either on the efficiency of recovery or purity of the metal obtained. The solid inclusions which might have accumulated are removed by passing the suspension at one stage through a filter and the electrolyte can again be used for after electrolysis.

The main find of this invention is the fact that the economic recovery of copper either in the form of sheet or powder is possible by the electrolysis of a suspension of finely powdered waste copper compounds in a dilute sulphuric acid solution.

Accordingly this invention provides an improved process for the electrochemical recovery of copper from industrial byproduct copper compounds which is characterised in that the byproduct compounds are used as a suspension of finely powdered copper oxide waste in dilute sulphuric acid solution as the electrolyte using lead alloy anodes and stainless steel or copper cathode to obtain copper deposited on the cathode as a sheet or powder.

The particle size of the powdered copper compound added to the electrolyte may vary from - 100 to -200 mesh.

The process consists in the electrolysis of a suspension of finely powdered copper oxide waste in a solution of dilute sulphuric acid using electrodes wherein mettallic copper gets deposited on cathode in

the form of sheet or powder depending on the conditions adopted for the electrolysis and can be melted and cast in the form of ingots. The by-product copper waste compound is ground to uniform powder and suspended in dilute sulphuric acid and electrolysed. Conditions of electrolysis of this suspension are adjusted in such a manner as to obtain copper deposited in the form of sheet or powder on the cathodes. The suspension of the powdered material is electrolysed between lead or lead alloy anodes, and stainless steel or copper cathodes. During electrolysis the powdered material is kept in uniform suspension by effective stirring. Copper compounds go into solution in the form of copper sulphate and get deposited on to the cathode there from.

Cells made of glass have been used for the laboratory scale experiments. The cell was run continuously removing the deposit at intervals and periodic replenishment of the bath was done by adding calculated quantity of copper compound to the bath at predetermined intervals one SS cathode/Cu cathode and two lead anodes on either side of the cathode were used. The electrodes were tightly held in their position by proper arrangement. The total number of hours of electrolysis was 114 hours stretched over a period of 30 days. The inter electrode distance was maintained at 2.5 cm. Effective agitation of the solution was done by means of stirring arrangement. The deposit obtained was analysing 99.85% copper. Raw materials from different sources were tried in the laboratory scale and found to be satisfactory.

The following examples further illustrate the invention :

Example-1 Raw Material

Copper oxide byproduct from a Chemical Industry Copper content 57.5% and Iron 0.5 to 1%

Slurry ratio	..	1:10
Current density	..	5 Amp/dm^2
Duration of Electrolysis	..	3 hours
Nature of deposit	..	Sheet
Current efficiency	..	99.0%
Purity	..	99.82% (as deposited)

Example-2 Raw material - same as in (1)

Current density	..	20 Amp/dm^2
Slurry ratio	..	1:20
Nature of deposit	..	Powder
Current efficiency	..	94.1
Purity	..	99.6
Particle size	..	-200 mesh - 25%

Example-3 Pure copper oxide

Slurry ratio	..	1:10
Current density	..	5 Amp/dm^2
Duration of the electrolysis	..	5.Hours
Nature of deposit	..	Sheet
Current efficiency	..	92.2
Purity	..	99.85%

To summarise, copper may be recovered from byproduct cooper compounds, copper oxide waste from copper rolling mills as well as byproduct copper compounds obtained from the chemical industry by the process known as suspension electrolysis. As the name implies, a suspension of finely powdered material in sulphuric acid solution is electrolysed between lead or lead alloy anodes and stainless steel or copper cathodes. During

electrolysis copper goes into solution and gets deposited on the cathode whereas the impurities remain in solution.

The deposited metal may be in the form of sheet of powder depending on the conditions of electrolysis. The process can be made continuous by frequent addition of the powdered material at predetermined intervals. In this process of recovery, some of the unit processes, such as precipitation and filtration of the impurities, purification of the solution etc. are eliminated and the material is fed direct into the electrolysis tank for electrolysis. The type of the raw material does not influence to any great extent, either the purity of the metal or the efficiency of the process.

We Claim :

1. An improved process for the electrochemical recovery of copper from industrial byproduct copper compounds characterised in that the by-product copper compounds are used as a suspension of finely powdered copper oxide waste in dilute sulphuric acid solution as the electrolyte using lead alloy anodes and stainless steel or copper cathode to obtain copper deposited on the cathode as a sheet or powder.

2. Process as claimed in claim 1 wherein copper compound powder is continuously added to the electrolyte to replenish the metal concentration of the suspension.

3. Process as claimed in claims 1 or 2 wherein the copper compound suspension in the electrolyte is in the ratio of 1:2 to 1:50 or preferably at 1 : 10.

4. Process as claimed in claims 1 to 3 wherein the particle size of the powdered copper compound added to the electrolyte is from -100 to -200 mesh.

5. Process as claimed in any of the preceding claims wherein the electrolyte used is an aqueous sulphuric acid of 0.5N to 5N strength and the electrolysis is carried out using a current density of 2.0 to 50 Amp/dm^2 at a temperature of 25-35°C with a copper concentration of the electrolyte being maintained between 10 and 100 g/l.

6. Process as claimed in claim 5 wherein the electrolysis is carried out using a current density of 5.0 Amp/dm^2 and maintaining copper concentration at around 50 g/l in the electrolyte.

7. An improved process for the electrochemical recovery of copper from industrial by-product copper compounds substantially as herein described and illustrated.

Dated this 27th day of March, 1978,

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