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REFINING OF COPPER-NICKEL MATTE.

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To all whom it may concern:

Be it known that ROBERT LEE PEEK, a citizen of the United States, residing at Ottawa, Ontario, Canada, and TORGNY FREDERICK TORELL, a subject of the King of Sweden, residing at Aylmer, county of Wright, Quebec, Canada, have invented certain new and useful Improvements in the Refining of Copper-Nickel Matte; and we do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to improvements in the separation of metals from solution by cementation and in the electrolytic refining of metals, and more particularly to the separation of copper from copper-nickel sulfate solutions by cementation, and the electrolytic refining of nickel.

According to the present invention, the separation of copper from copper-nickel sulfate solutions is effected by cementation on Bessemerized copper-nickel matte, with the utilization of an excess of the matte, so that its theoretical cementation capacity is but partly exhausted, and so that the cementation can be effected rapidly and completely on large scale operations. The resulting partially exhausted Bessemerized matte and cement copper is then further treated for the removal of its excess copper, and the residue can then be used for the production of copper-nickel anodes for use in the electrolytic refining of nickel. The amount of copper contained in the anodes can be so regulated that it can be effectively removed from the electrolyte by cementation upon a corresponding amount of the Bessemerized matte. The electrolytic process accordingly can be advantageously carried out as a cyclic process and with effective utilization of the Bessemerized matte.

In the purification of copper-nickel sulfate solutions by cementation, for the removal of copper therefrom, it has been the practice heretofore to make use of reduced metal, produced by oxidation of Bessemerized copper-nickel matte, and subsequent reduction of the oxides so produced.

According to the present invention, the oxidation of the matte, and the subsequent reduction to produce the metals for use in the cementation, are eliminated, and an excess of the Bessemerized matte is employed directly for the cementation.

The Bessemerized copper-nickel matte has been rendered essentially free from iron by the Bessemerizing operation. Such matte will usually contain a considerable amount of sulfur, for example, around 18%, although the matte may be further desulfurized, to a greater or less extent, so that the sulfur content will be further reduced. The matte may vary in its copper and nickel content, as well as in its sulfur content, for example, it may contain about 50% nickel, 30% copper, 18% sulfur and the remainder iron and slag.

The copper-nickel solution to be purified by cementation, according to the present invention, may be produced in any suitable manner, for example, by first roasting the Bessemerized matte and treating the roasted matte with acid, thereby dissolving all or part of the copper and nickel as metallic salts; or by carrying out the electrolytic refining of nickel with copper-nickel anodes, with resulting production of a copper-nickel sulfate solution in the anode compartment of the electrolytic cell. The solutions produced in this way, as well as similar copper-nickel sulfate solutions, must be freed from copper in order to obtain a commercially pure solution of nickel sulfate, from which pure nickel or its compounds may be separated by chemical or electro-chemical treatment.

According to the present invention, the copper-nickel salt solutions, such as copper-nickel sulfate solutions, are brought into contact with an excess of Bessemerized matte containing nickel, and the matte is used in sufficient excess to insure a sufficiently rapid and complete removal of copper by cementation, so that the resulting purified solution is well adapted for use for the production of substantially pure nickel or nickel compounds. Thus, the separation of the copper from the solution containing salts of copper and nickel is effected by keeping the solution in contact with the matte for a sufficient length of time and preferably at a temperature of about 70 to 80° C. The whole of the copper contained in the solution is thereby cemented out on

the particles of matte and is replaced in the solution by an equivalent of nickel. A purified nickel sulfate solution is thus produced of sufficient purity for use in the electrolytic production of nickel, or for the production of substantially pure nickel compounds.

The copper-nickel sulfate solution can be brought into contact with the Bessemerized matte in any suitable apparatus, and the cementation can be promoted, for example, by agitation, or by the use of a series of bodies of the matte through which the solution is passed on the counter-current principle, or by fine grinding and by heating the solution. For practical purposes, however, it is advantageous to carry out the operation at temperatures such as those above indicated, and with the use of a large excess of matte, such that only a part of the total nickel is dissolved therefrom, for example, only about 20 to 30%. The nickel content of the matte is thus only partially utilized, while the matte is correspondingly increased in copper content.

The copper deposits on the matte particles as metallic copper, and this may be ascribed, in part at least, to the influence of metallic nickel which is a component of converter mattes containing copper and nickel. A part of the nickel in such mattes is commonly combined with sulfur; but there is never a sufficiently large proportion of sulfur in such mattes to combine with all of the copper and nickel contained therein. It is also probable that a reaction takes place between the nickel sulfide on the one hand, and the copper salt on the other.

While it is possible by prolonged treatment of the matte with successive amounts of the copper bearing solution to remove the greater part of the nickel from the matte, leaving a residue consisting essentially of copper sulfide and metallic copper, it is more advantageous to continue using the matte only so long as the cementation proceeds with reasonable speed. The speed of cementation on matte can be increased by finer grinding of the matte, and by carrying out the cementation at a higher temperature and with agitation. The matte will commonly be discarded as cementation material while there still remains therein substantial amounts of nickel.

The discarded cementation residue, impoverished in nickel and correspondingly increased in copper content, as compared with the original Bessemerized matte, can be subsequently treated for the recovery of copper. Thus it may be roasted, the roasted product leached, and the copper plated out electrolytically from the resulting solution with the employment of insoluble anodes. Any residue from the leaching operations may be dried, reduced with carbon or other reducing material, melted down and cast into anodes for electrolytic refining.

The solution to be purified by the cementation may be either neutral or acid. The cementation process is effective in either case, but is strongest when the solution contains a slight amount of free acid.

The improved process of the present invention is of particular advantage when carried out in conjunction with the electrolytic refining of the purified nickel sulfate solution with the use of the copper-nickel anodes. The partially exhausted matte can thus be utilized for producing the copper-nickel anodes, by subjecting the material to roasting, to convert the metals into oxides, leaching the greater portion of the copper from the roasted material, smelting the undissolved oxides to produce metal containing only a small percentage of sulfur, and casting such metal into anodes. These anodes are then used in the electrolytic cell, and the copper-nickel sulfate solution produced in the anode compartment can be purified from copper by cementation upon further amounts of the Bessemerized matte. In this way, the partial exhaustion of the matte by cementation, and the utilization of the partially exhausted matte for the production of the copper-nickel anodes make possible the balancing of the process so that the anodes will contain only so much copper as can readily be cemented upon the Bessemerized matte. That is, the Bessemerized matte is used to particular advantage in this way, for the reason that it is used for cementation only in part and in such a way that it exerts a rapid and effective cementing action, while the remaining partially exhausted material, after being freed from the excess copper, can be utilized in the form of copper-nickel anodes, and only so much copper will be contained therein as can be rapidly and effectively removed by cementation by an equivalent amount of the Bessemerized matte.

The electrolytic operation may, with advantage, be such an electrolytic operation as is described in the U. S. Patent No. 805,969 to Hybinette, or in the process of the U. S. application of Hybinette Serial No. 328,968 filed February 16, 1920, in which the nickel sulfate solution is supplied to the cathode compartment and passed through a filtering diaphragm, and a copper-nickel sulfate solution produced in the anode compartment. The copper-nickel sulfate solution can be freed from copper by cementation upon the Bessemerized matte, and the partially exhausted matte after extraction of the greater part of the copper can be utilized for making

the copper-nickel anodes for the electrolytic operation. The process can thus be made a cyclic process, with advantageous and effective use of the matte for cementation, and of the partially exhausted matte for anode production.

The process can thus advantageously be made a cyclic process for the separation of copper from nickel consisting in several steps that may be somewhat varied, but including the steps of, (1) cementation of copper from solution on the matte (2) roasting of the partially exhausted matte and leaching of the roasted product with acid for the removal of the bulk of copper and (3) recovering the remainder of the copper from a solution of the copper-nickel residue by the first step of cementation.

While I have described the invention in connection with the treatment of Bessemerized copper-nickel matte, produced in a Bessemer converter, yet other copper-nickel mattes from which substantially all the iron has been removed, and which have been produced by other processes, can be similarly used, and are to be considered as equivalents of Bessemerized copper-nickel matte for purposes of the present invention, and their treatment within the scope of the appended claims.

We claim—

1. The method of utilizing Bessemerized copper-nickel matte which comprises separating copper from copper-nickel sulfate solutions by cementation upon an excess of such matte, removing the greater part of the copper from the partially exhausted matte and producing from the residue the copper-nickel sulfate solution for use in the treatment of a corresponding quantity of Bessemerized matte.

2. The process of separating copper from nickel-copper solutions which comprises treating the same with an excess of Bessemerized nickel-copper matte, whereby the copper is cemented out and an equivalent of nickel taken into solution without exhausting the cementing capacity of the matte, roasting the partially exhausted matte and cement copper, leaching out part of the copper, and recovering the last of the copper by cementation from a solution of the residue.

3. The process of separating copper from a nickel-copper solution, which comprises treating the solution with an excess of Bessemerized copper-nickel matte, whereby the copper is cemented out and an equivalent of nickel taken into solution without exhausting the cementing capacity of the matte, roasting the partially exhausted matte and cement copper, leaching the roasted product to remove the greater part of the copper, converting the residue into copper-nickel anodes, subjecting the purified nickel sulfate solution to electrolysis using the copper-nickel anodes, and purifying the copper-nickel electrolyte produced at the anode by cementation upon further amounts of the Bessemerized matte..

4. The process of refining Bessemerized copper-nickel matte which comprises treating the same with a copper-nickel solution for the cementation of the copper therefrom with partial exhaustion of the matte, roasting the resulting matte and cement copper, leaching the roasted product to remove the greater part of the copper, smelting the residue into anodes, subjecting the purified nickel salt solution to electrolysis using the copper-nickel anodes and purifying the electrotlyte produced at the anode by cementation of the copper therefrom upon further amounts of the matte, the amount of copper remaining in the residue from which the anodes are produced being so regulated that it does not exceed the amount which can be cemented out on the Bessemerized matte.

5. The process of refining Bessemerized copper-nickel matte which comprises cementing copper from a copper salt solution upon the matte with resulting partial exhaustion thereof, roasting the resulting matte and cement copper, leaching the roasted product to remove the greater part of the copper, then dissolving the residue to produce the solution first referred to, recovering the nickel from such solution after the cementation of copper, and removing sufficient copper by such roasting and leaching that the remaining copper does not exceed the amount which the Bessemerized matte is capable of cementing

6. A cyclic process of separating copper from nickel which includes the steps of cementing copper from solution on Bessemerized copper-nickel matte, roasting the partially exhausted matte and leaching the roasted material for the removal of the greater part of the copper, and recovering the copper from the copper-nickel residue by subjecting a solution thereof to the step of cementation.

7. The method of utilizing Bessemerized copper-nickel matte which comprises cementing copper thereon from a copper-nickel sulfate solution, roasting the remaining matte and cement copper, leaching the roasted material with sulfuric acid to form a copper sulfate solution, reducing the leached residue, dissolving the reduced material to form a copper-nickel solution and cementing copper from such solution upon a further amount of Bessemerized matte.

8. The method of producing a nickel-sulfate solution, which comprises dissolving a copper-nickel material in dilute surfuric acid with introduction of air, stopping the

operation before the acidity is completely neutralized and removing copper from the resulting copper nickel sulfate solution by cementation.

9. The process of treating Bessemerized copper-nickel matte which comprises subjecting the same to the action of an acid nickel sulfate solution, with introduction of air, to effect partial neutralization of the free acid, and subjecting the resulting still somewhat acid solution to the action of material containing nickel, without introduction of air, for the separation of copper by cementation, thereby producing a purified acid nickel sulfate solution.

10. The method of refining Bessemerized copper-nickel matte which comprises electrolyzing an acid nickel sulfate solution with insoluble anodes and regenerating the nickel sulfate electrolyte by treating the solution with Bessemerized copper-nickel matte, with introduction of air, and then cementing out copper from the solution by contact with further amounts of matte wihout introduction of air.

In testimony whereof we affix our signatures.

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