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SELECTIVE RECOVERY OF COBALT FROM AN AMMONIACAL CARBONATE SOLUTION CONTAINING COBALT AND NICKEL

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ABSTRACT OF THE DISCLOSURE

When cobalt is precipitated from ammoniacal carbonate solutions containing both cobalt and nickel by addition of a sulfiding agent to the solution, the amount of of nickel co-precipitated with the cobalt is substantially reduced if, after addition of the sulfiding agent, the solution is treated with an oxygen-containing gas. This produces a two-fold desirable result: a precipitate enriched in cobalt and a mother liquor enriched in nickel.

The precipitate is further enriched in cobalt by first thickening the slurry containing the precipitate and then treating the thickened slurry with an oxygen-containing gas. This treatment solubilizes some of the nickel sulfide in the liquid phase of the slurry serving to simultaneously increase the cobalt content of the precipitate and the nickel content of the mother liquor.

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a continuation-in-part of copending application Ser. No. 143,267, filed May 13, 1971.

BACKGROUND OF THE INVENTION

In commercial mineral processing, aqueous ammoniacal carbonate solutions containing dissolved cobalt and nickel are produced by heating an ore containing oxides of cobalt and nickel in a furnace with a reductant and then leaching the reduced ore, in the presence of air, with an aqueous solution of ammonium hydroxide and ammonium carbonate. Since it is commercially desirable to separate the cobalt from the nickel, separation processes have been developed. In one known process, the ammoniacal solutions containing cobalt and nickel are treated with a sulfiding agent, the objective being to precipitate the cobalt as cobalt sulfide while leaving the nickel dissolved in the mother liquor. Unfortunately, however, substantial amounts of nickel sulfide ordinarily co-precipitate with the cobalt sulfide. This is undesirable because the proportion of cobalt in the precipitate is diminished thus making recovery of the cobalt more difficult; moreover, the mother liquor, which is the source of recovered nickel values, has had its nickel content substantially diminished by the co-precipitation of nickel sulfide with the cobalt sulfide. It is apparent, therefore, that a method for retaining as much nickel as possible dissolved in the ammoniacal carbonate solution during the sulfiding operation would be most desirable. It is also apparent that a method for enriching the cobalt content of the precipitate, after it is formed in the sulfiding operation, by selectively redissolving the nickel sulfide in the mother liquor would be most desirable. Insofar as is known to applicants, no such methods have yet been provided by the prior art.

It is, therefore, an object of this invention to provide a method for separating cobalt from the nickel dissolved in an aqueous ammoniacal carbonate solution, using a sulfiding treatment, by which co-precipitation of nickel sulfide with the cobalt sulfide is minimized, thereby retaining more nickel in the mother liquor and producing a precipitate of enriched cobalt content.

It is another object of this invention to provide a method for selectively redissolving nickel sulfide present in the precipitate from the sulfiding treatment, in the ammoniacal carbonate mother liquor, to produce a precipitate further enriched in cobalt and a mother liquor further enriched in nickel.

It is another object of this invention to reduce the volume of the treated material in the case where the nickel values are selectively redissolved from the precipitate.

These and other objects of this invention will be apparent to one skilled in the art from a consideration of this entire disclosure.

SUMMARY OF THE INVENTION

In accordance with this invention, the above objectives are accomplished by treating the ammoniacal carbonate solution with an oxygen-containing gas after addition of the sulfiding agent to the solution. It has been found that such gas treatment has the surprising effect of significantly arresting the degree of nickel sulfide which co-precipitates with the cobalt sulfide. The result is that the precipitate is substantially enriched in cobalt values and substantially depleted in nickel values since more nickel has been retained in the mother liquor where it is desired. The gas treatment of this invention has produced precipitates containing up to about 30% more cobalt and about 30% less nickel than those produced by conventional processing, i.e. without the gas treatment of this invention.

The sulfiding treatment produces a slurry of low solids content in which the solid phase is the mixed nickel sulfide-cobalt sulfide precipitate. This slurry is thickened to increase its solids content and reduce the volume of material for subsequent processing. The thickened slurry is then treated with an oxygen-containing gas which causes nickel sulfide in the precipitate to selectively redissolve in the mother liquor. The result is a precipitate enriched in cobalt and a mother liquor enriched in nickel. This post-precipitation gas treatment has produced precipitates containing up to about 63% more cobalt and 17% less nickel than untreated precipitates. It has increased the nickel content of the mother liquor by as much as about 66% as compared to untreated mother liquors.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Selective precipitation of cobalt sulfide

The ammoniacal carbonate solution containing dissolved nickel and cobalt is treated with the oxygen-containing gas at any time after addition of sulfiding agent to the solution. Generally, such treatment should occur within about 60 minutes after addition of the sulfiding agent is completed and preferably within about 2 to 30 minutes after said addition is completed.

The amount of oxygen-containing gas used can vary considerably and need only be an amount effective to enhance the selective precipitation of cobalt sulfide. Generally, however, the amount of gas used should be sufficient to provide between about 0.2 and 30, and preferably between about 0.5 to 5, moles of oxygen per mole of sulfide ion used in the process. This treatment should provide between about 0.05 and 0.9, and preferably between about 0.1 and 0.8, mole of dissolved oxygen per mole of sulfide ion used in the process.

Dissolved oxygen represents that portion of the oxygen contained in the gas used to treat the reaction mixture which dissolves in the reaction mixture. The quantity of dissolved oxygen can be determined by measuring the difference between the quantity of oxygen fed to the re-