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SEPARATION OF IRON IMPURITY FROM COBALT-BEARING SOLUTIONS

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This invention relates to processes for the separation of iron impurities from cobalt-bearing solutions and more particularly to the purification of acidic aqueous cobalt-bearing solutions containing small amounts of iron at least a part of which is in the divalent state.

A number of processes have been suggested and described in the prior art for the recovery of cobalt, nickel and other valuable metals from various ores containing iron in addition to said valuable metals involving selective leaching of the valuable metal by the action of acids in aqueous solution. Although these processes accomplish very substantial selective dissolution or concentration of the valuable metal content, the product liquors containing the dissolved salts of the valuable metals (e.g. the sulfates and chlorides of cobalt and nickel) invariably also contain a small amount of iron as an impurity.

It has also been suggested that these product liquors containing this iron impurity be treated for the separation of the iron by lowering the hydrogen ion concentration through the addition of an alkali to a level which causes selective precipitation of iron, that is to a level of from 3.5 to 5 after which the treated liquor is filtered or otherwise treated for the removal of the iron precipitate. This process, however, removes only a portion of the iron impurity.

Analytical examinations of the metal compounds contained in the product liquors hereinbefore described reveal that the iron impurity is present in both the divalent state and in the trivalent state. An increased proportion of the iron can be removed from acidic cobalt and nickel product liquors by raising the pH of the solution to a value of 5, or more, next introducing air and then filtering, but this oxidation procedure causes a considerable amount of the cobalt and nickel to coprecipitate with the iron, which mixed precipitate is not economically amenable to treatment accomplishing separation of iron from the cobalt and nickel.

The ultimate object of the present invention is to provide a process for treating the acidic aqueous solutions of cobalt salts generally in admixture with salts of nickel and other valuable metals, having iron impurities by which all of the iron, practically considered, is removed without coprecipitation of cobalt or nickel.

An immediate object of the invention is to provide an efficient and relatively simple process for converting the divalent iron impurity in cobalt- and nickel-bearing leach liquors into the trivalent state such that all of the iron can be selectively precipitated from the total valuable metal content simply by decreasing the hydrogen ion concentration to the level of 3.5 to 5 pH value.

Broadly considered, the invention may be described as a process for the separation of iron impurity from acidic aqueous solutions of cobalt compounds, or of cobalt and nickel compounds, containing iron at least in part in divalent form which involves adding cobaltic pentammine to such solution in a quantity sufficient to oxidize the divalent iron, or more precisely a quantity at least stoichiometrically equivalent to the amount of divalent iron present in the solution, reacting said pentammine with said divalent iron and selectively precipitating the iron impurity from the cobalt by adjusting to or maintaining the hydrogen ion concentration of such solution at a pH value of 3.5–5.

In accordance with a preferred procedure, the acidic solution containing the cobalt and the iron impurity is first heated to a temperature adapted to speed up the pentammine-iron reaction, then the cobaltic pentammine is added and oxidation of the divalent iron commences, next the hydrogen ion concentration of the solution is adjusted to the above-mentioned level of pH value whereupon precipitation of all of the iron from the solution soon takes place and finally, the precipitated iron is separated from the solution as by filtration, thereby obtaining (1) a substantially iron-free, cobalt-bearing solution from which a substantially pure cobalt product may be readily recovered, and (2) an iron precipitate virtually free of nickel and cobalt.

For efficiently accomplishing the oxidation reaction of the invention, the impure cobalt-containing solution should be heated to a temperature of at least about 170° F. and preferably to about 185° F. Heating to this temperature provides a rapid rate of reaction and causes the iron impurity (oxides and hydroxides) to coagulate effectively thus facilitating filtration. Heating to temperatures above about 200° F. leads to little additional benefit, if any. Theoretically the amount of cobaltic pentammine to be added to the cobalt solution should be stoichiometrically equivalent to the amount of ferrous iron present therein. However, in actual practice it is preferable to add a slight excess of the pentammine to insure the oxidation of all of the ferrous iron. Through this addition the recovery of a substantially pure cobalt product is assured.

When the cobaltic pentammine reacts with the ferrous iron, ammonia is released, and if the cobalt solution containing the ferrous iron is not sufficiently acidic at the outset, the release of the ammonia will raise the pH value of the solution to a level above the operable range for effecting selective precipitation of the iron in accordance with the practice of the present invention. Therefore, if the cobalt-bearing solution is not sufficiently acid initially, sulfuric or other acid may be added thereto in order to insure that the action of the cobaltic pentammine will not cause the pH value to rise to a level as high as 5, and preferably to about pH 4.

If the hydrogen ion concentration of the impure cobalt containing solution is below a pH of about 4, anhydrous or concentrated aqueous ammonia is preferably added to the solution during continuous agitation thereof, this agitation serving to eliminate any localized adjustment to a pH value above 5 at which level precipitation of cobalt and any nickel present will occur. Though ammonia is the most convenient alkali to employ, alkali metal and alkaline earth metal hydroxides may be alternatively used. The alkali may be added in small amounts from time to time during the oxidation-precipitation reaction in such manner as to maintain the pH value between 3.5 and 5. At lower pH values, little if any oxidation and precipitation of the iron will take place whereas at pH values greater than 5 the cobalt or cobalt and nickel will be precipitated along with the iron and defeat the selective precipitation feature of the invention.

The reaction of the pentammine with the ferrous iron and the precipitation of all of t he iron impurity will ordinarily be accomplished in about 15 minutes. After this period the reaction mass is filtered, decanted or otherwise treated for the separation of the iron precipitate. The iron-free liquor obtained in this manner may be processed by any of the several known recovery processes to separate the cobalt and nickel values.

Although the invention is particularly applicable to acid product liquors obtained by the leaching of cobalt-nickel limonitic ores and their sulfide concentrates, it is generally applicable to acidic solutions of cobalt com-