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SUPLENTE DE INDUSTRIA Y COMERCIO



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Señora Jefe de la
DIVISION DE NUEVAS CREACIONES
Superintendencia de Industria y Comercio
E. S. D.

Trámite : 011
Evento : 379
Actuación : 538

Referencia : Expediente No. 07.063.508
Asunto : SOLICITUD DE PATENTE PARA UNA COMPOSICION
QUE CONTIENE CIANURO ACUOSO QUE
COMPRENDE UN TENSOACTIVO NO IONICO
Solicitante : BASF AKTIENGESSELLSCHAFT
Clase : C22B 011/008
Publicada en : La Gaceta No. 583 del 18 de diciembre de 2007
Fecha de solicitud : 22 de junio de 2007

1. Yo, Emilio FERRERO, identificado como aparece al pie de mi firma, actuando como apoderado en el asunto de la referencia, atentamente, solicito se efectúe el examen de patentabilidad de la solicitud en referencia presentada de acuerdo con el Capítulo II del PCT y según lo establecido en el artículo 44 de la Decisión 486 de la Comisión de la Comunidad Andina. Para tal efecto presento junto con este escrito el recibo por valor de \$ 210.000.00 correspondiente a la tasa fijada.

2. Ruego atentamente a la Señora Jefe se sirva ordenar que se anexe este recibo para que se efectúe dicho examen y se continúe con el trámite de la solicitud.

Señora Jefe,

EMILIO FERRERO
T.P.A. No. 31.929

COLO-00361-841-168-4
MVN\MGT\ID-119230\WPCL0361
No. M-2008-119230\MVN

DIVISIÓN DE NUEVAS CREACIONES

RADICACIÓN EXPEDIENTE No. 07-63508

EL EXTRACTO DE LA PRESENTE SOLICITUD DE PATENTE DE INVENCION
FUE PUBLICADO EN LA GACETA DE PROPIEDAD INDUSTRIAL No 583 DE
FECHA 18 DE DICIEMBRE DE 2007 EL TÉRMINO HÁBIL SEÑALADO POR LA
LEY EXPIRA EL 14 DE MARZO DE 2008

NOTA: Dentro del plazo de los seis (6) meses siguientes a partir de la fecha de publicación en la gaceta de Propiedad Industrial, deberá solicitar y cancelar el examen de patentabilidad so pena de que la solicitud caiga en abandono, de acuerdo con lo establecido en el Artículo 44 de la Decisión 486/2000.

SE PRESENTARON OPOSICIONES POR PARTE DE TERCEROS.

SI _____

NO X

United States Patent

Luttinger

[9]

[11] Patent Number: 4,929,274
[45] Date of Patent: May 29, 1990

RECOVERY OF METAL VALUES FROM ORES

[54] Invention: Leland R. Luttinger, Erieview, Pa.
[71] Assignee: Drew Chemical Corporation, Broomfield, N.J.
[21] Appl. No.: 362,896
[22] Filed: Jan. 7, 1989

[31] Int. Cl. C22B 11/04
[32] U.S. Cl. 423/25; 75/722; 423/24; 423/29
[33] Field of Search: 75/101 R, 101 BE, 105, 75/118 R; 423/29, 24, 25

References Cited

[56] U.S. PATENT DOCUMENTS
1,519,396 12/1924 Darrow 423/29
1,599,256 8/1925 Darrow 423/29
2,234,140 3/1941 Fehner 75/105
4,171,226 1/1988 Elmore 75/118 R

OTHER PUBLICATIONS

McClelland, Gene E., et al., "Silver and Gold Recovery

from Low-Grade Resources" Mining Congress Journal, 1981, pp. 17-23.
"Gold and Silver Heap and Dump Leaching Practice", CA92(10):13251q.
Soc. Mining Eng., Proc. Fall 1983 SME Meeting, pp. 41-49 Pilot Scale Heap Leaching at the Finsen Mine, Humboldt County, Nev., Marc E. Smith and W. R. Craft.

Primary Examiner—Robert L. Stoll
Attorney, Agent, or Firm—Walter H. Schneider

ABSTRACT

Heap leaching of gold/silver ores with an aqueous alkali cyanide solution containing a surfactant hydrolyzable at the pH of the solution, the surfactant being present in an amount sufficient to increase the rate of metal value recovery without adversely affecting the carbon efficiency in the subsequent step of separating the metal cyanide value from the pregnant leach solution by absorption on carbon columns.

4 Claims, No Drawings

RECOVERY OF METAL VALUES FROM ORES

4,929,274

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fulfill this interest. It is a particular object of this invention to improve the leach rate of recovery of metal values from low grade gold/silver ores by the process of heap-leaching with a metal cyanide leach solution. It is a further object of this invention to obtain an improved leach rate without adversely affecting the carbon columns used in the subsequent separation of the metal cyanide complex from the pregnant leach solution.

DESCRIPTION OF THE PREFERRED EMBODIMENT

These objects have been met in accordance with this invention by incorporating in the aqueous metal cyanide solution used for leaching a low grade gold/silver ore an amount of a surfactant effective to improve the metal value recovery rate. While the use of a surfactant in a metal cyanide leach solution has been reported in the prior art referred to above, various adverse effects were observed without, moreover, any improvement being realized in the metal value recovery rate. It is essential, therefore, in order for a surfactant to be effective in heap-leaching, that it not only improve the rate of metal value recovery, but accomplish this without adversely affecting the carbon efficiency of the carbon columns used in the subsequent metal cyanide absorption step.

It has now been found, in accordance with this invention, that an improved metal value recovery rate can be obtained in heap-leaching of gold/silver ores without affecting carbon efficiency in the subsequent metal cyanide absorption step by incorporating in the cyanide leach solution an effective amount of a surfactant readily hydrolyzable under alkaline conditions. With an intent to limit this invention by any theory of operation, it may be that hydrolysis of the surfactant prior to or during the metal cyanide absorption step keeps the activated carbon surfaces more completely available for metal cyanide absorption.

An important class of surfactants that hydrolyzes readily at a pH of 10-11; i.e., the alkalinity of the cyanide leach solution, is ethoxylated fatty acid esters. Preferably, the surfactant comprises a fatty acid residue of 8-30 carbons and about 4-20 units of ethylene oxide. Condensates of ethylene oxide and oleic or stearic acids and mixtures of these, e.g., polyethylene glycol 200 distearate have been found to be particularly suitable.

Another class of surfactants effective in the practice of this invention is alkyl sulfosuccinates in which the alkyl is a fatty acid residue of 5-30 carbons. An example of this class of surfactants is sodium diethoxyethyl sulfosuccinate.

Still another class of surfactants that may be used according to the present invention is long chain fatty alcohol sulfates in which the fatty alcohol residue contains about 8-30 carbons. Representative of such surfactants is sodium heptadecylsulfate.

In the practice of the process of this invention, the surfactant or a mixture of surfactants is simply incorporated in the aqueous alkali cyanide leach solution and kept at a concentration effective to improve the rate of recovery of the metal value. It is difficult to define a concentration range of surfactant effective, in the sense of this invention, for use in the heap-leaching of ores of varying compositions since it will depend to a large extent on the nature of the ore, e.g., its clayiness, as well as the particular surfactant employed. The

BACKGROUND OF THE INVENTION

1. Field of the Invention
The present invention relates generally to the recovery of metal values from ores. More particularly, the present invention relates to the recovery of metal values by the leaching of ores. Still more particularly, the present invention relates to an improvement in the treatment of gold/silver ores by the method of heap-leaching in which the metal values are recovered as a cyanide complex.

2. Description of the Prior Art
The recovery of gold and silver by heap-leaching low grade ores and tailings from other recovery processes is well known. In general, the procedure comprises spraying, trickling or pouring on, or otherwise applying to, a pile of low grade ore or tailings an aqueous alkali cyanide solution, e.g., aqueous calcium, sodium or potassium cyanide, so as to cause the solution to permeate and percolate through the pile thereby extracting the metal values as a cyanide complex. The resultant metal cyanide complex-bearing liquor is recovered from the bottom of the pile, of which there is usually a series of extraction facilities, and routed to a recovery system for separating the metal cyanide complex by absorption on a column of activated carbon, usually coconut shell carbon. The metal cyanide complex-bearing carbon particles are then further treated, as by electrowinning, to separate and recover the elemental metal value.

Various factors can affect the economics of heap leaching, a principal one being the physical nature of the crushed ore being treated. For instance, the presence of a high content of slimes or fines in a highly clayey ore can, in the presence of the aqueous leach solution, result in the swelling of the fines and the filling of the interstices of the ore particles, or even a coating of the particle surfaces. As a consequence, the porosity of the ore particles is reduced thereby preventing effective percolation of the leach solution with corresponding decreased leach solution percolation rate and decreased metal recovery rate.

To minimize the effect of slimes or fines, various treatments, e.g., flotation, have been practiced on the ore prior to being heap leached in order to reduce the fines content. Various means have also been used during the heap-leaching procedure itself in an effort to increase the rate and quantity of metal recovery. CA92(10):13251q, for example, reports an increase in the percolation rate in the heap leaching of gold/silver ores by using a cyanide leach solution containing a flocculant such as polyethylene oxide. On the other hand, the use of a nonionic ethylene/propylene oxide-based surfactant in a gold/silver cyanide heap leaching solution, as reported in "Gold and Silver Heap and Dump Leaching Practice", pp. 41-49, Soc. Mining Eng., Proc. Fall 1983 SME Meeting, showed no effect on percolation rate, metal recovery rate or reagent consumption. The use of the surfactant, moreover, resulted in a drastic drop in the carbon efficiency of the subsequent metal recovery system.

SUMMARY OF THE INVENTION

As the prices of gold and silver increase, interest in developing improved procedures for treating low grade gold/silver ores for the recovery of these metal values increases. It is a principal object of this invention to

optimum concentration effective in each circumstance, therefore, must be determined through use. Accordingly, it can be stated that, depending on the surfactant to be used and the ore to be treated, the surfactant concentration may be low as 1 ppm of leach solution with an upper limitation of about 50 ppm governed principally by economies. Usually, an optimum concentration of surfactant will be found to be within the range of 10-30 ppm of leach solution. A further benefit derived from the process of this invention results in the continuous defoaming action that is obtained under conditions of certain surfactant use. Thus, the hydrolysis of esters used in accordance with this invention will yield intermediate length-chain fatty alcohols which are well known defoamers. For example, the hydrolysis of di-*tert*-butylsebacate releases ethyl hexanol, a particularly active defoamer. In this case, since the hydrolysis is relatively slow, there will be a constant presence of ethyl hexanol in the leach solution circuit. This presence will have a lowering effect on foam formed by the waste discharge water and can even effectively influence both the ore extraction and the subsequent metal cyanide recovery by minimizing foam and air froth during these processes.

The process of the invention is further illustrated by the following examples in which all parts are by weight unless otherwise indicated.

EXAMPLE I

Ore Leaching Tests

A Nevada gold and silver ore identified as McCoy Ore was reduced to 80% minus 1/4 inch and the head (or Au/ton ore) calculated for each of five samples. Each sample was then leached into a 6 in. I.D. x 6 ft. high column for leaching.

The surfactants and their concentrations in the aqueous sodium cyanide leach liquors applied to the five columns were as follows:

P1—11.25 ppm of polyethylene glycol 600 diolene available under the trademark Drewperse 739 from Drew Chemical Corporation.

P2—9.75 ppm of sodium diethylhexyl sulfosuccinate available under the trademark DrewFus 0007 from Drew Chemical Corporation.

P3—10 ppm of polyoxyethylene (20) sorbitan trioleate available under the trademark Tween 85 from ICI Americas Inc.

P4—30 ppm of polyethylene glycol 600 diolene available under the trademark Drewperse 739 from Drew Chemical Corporation.

P5—blank

Leaching was conducted by applying an aqueous sodium cyanide leaching solution (2 lbs. NaCN per ton of solution) over the ore charge in each column. The application rate, controlled by a calibrated chemical feed pump, was 0.005 gpm/ft² of column cross-sectional area. The pH was maintained during leaching by the addition of lime to the dry ore during column leaching.

The aqueous cyanide leach solution was percolated through the ore charge in each column and collected in a pregnant solution reservoir daily. The volume of effluent solution was measured and a sample taken for precious metal analysis by conventional atomic absorption methods. The pH and cyanide concentration of each effluent solution were determined. Fresh leach solution was prepared and applied to the ore charge daily. An equal amount of pregnant solution was saved daily from

pregnant solution saved from each column for this purpose from the extraction tests of Example I. The tests were conducted by agitating the carbon in the pregnant solution for 24 hours while the solutions were withdrawn at different time intervals and tested for gold and silver. The results from the 24 hr. testing appear in Table III.

TABLE III

Col.	Vol. (l)	Preg. Sol. (gpm Au)	Burton Sol. (gpm Au)	Carbon Loading (oz Au/ton C)
P1	53	0.84	0.02	23.70(4)
P2	53	0.84	0.04	21.62(2)
P3	53	0.84	0.01	24.06(5)
P4	53	0.84	0.04	21.62(2)
P5	53	0.84	0.01	23.04(6)

Solvent Assay Checks (oz Au/ton C): (1) 2.09; (2) 2.13; (3) 2.51; (4) 2.51; (5) 2.38; (6) 2.47

The above data show that the presence of the surfactants does not have a diminishing effect on the absorption capacity of the coconut shell carbon.

I claim:

1. In a process for recovering gold and silver values in which an aqueous alkali-cyanide leach solution of about pH 10-11 is percolated through a heap of particulate gold/silver-bearing ore to form a pregnant leach solution containing extracted gold and silver as metal cyanide complexes; separating said extracted metal cy-

nide complexes from said pregnant leach solution by absorption on a column of activated carbon; and subjecting said activated carbon column to a stripping circuit in which the metal cyanide complexes are desorbed, the improvement which comprises extracting said gold and silver values using an aqueous alkali cyanide leach solution containing at least about 1 ppm of a surfactant which is hydrolyzable at the alkalinity of said leach solution and which does not interfere with the effectiveness of the subsequent carbon absorption of the metal cyanide complexes from said pregnant leach solution.

2. The improvement according to claim 1 in which the hydrolyzable surfactant is selected from ethoxylated fatty acid esters, alkyl sulfosuccinates and fatty alcohols.

3. The improvement according to claim 2 in which the surfactant is selected from (a) polyethylene glycol diolene in which the polyethylene glycol portion has a molecular weight of 600; sodium diethylhexyl sulfosuccinate; and (c) polyoxyethylene sorbitan trioleate having 20 ethylene oxide groups per molecule.

4. The improvement according to claim 3 in which the aqueous alkali cyanide leach solution contains about 10-30 ppm of surfactant.

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each column for the purpose of measuring carbon activity kinetic tests.

Results of the leaching tests appear in the following Table I.

TABLE I

Results	P1	P2	P3	P4	P5	P6
Au Extraction (%)	84.5	61.2	59.0	66.2	58.7	58.7
Ag Extraction (%)	72.5	51.6	54.1	64.4	56.4	56.4
20 days	78.6	56.9	56.2	68.5	62.1	62.1
30 days	80.7	57.3	56.5	69.4	62.5	62.5
35 days	80.7	57.3	56.5	69.4	62.5	62.5
Au Extraction (%)	84.5	61.2	59.0	66.2	58.7	58.7
Ag Extraction (%)	72.5	51.6	54.1	64.4	56.4	56.4
20 days	78.6	56.9	56.2	68.5	62.1	62.1
30 days	80.7	57.3	56.5	69.4	62.5	62.5
35 days	80.7	57.3	56.5	69.4	62.5	62.5

Following 35 days of leaching, the above data show that gold extractions varied from 50.4% for P5 to 84.5% for P1 as compared to 52.5% for P6 (blank). The failure to show comparable improved extraction for P1 appears to be the result of the low concentration of surfactant employed as compared, for instance, to P5 in which a greater amount of the same surfactant was employed with significantly improved results. The cyanide requirements ranged from 0.49 to 0.83 pounds NaCN per ton of ore compared with 0.46 pounds/ton for the blank. Cyanide consumption, therefore, was not significantly affected by the use of a surfactant. The lime requirements were low for all of the columns at 3.1-3.5 pounds CaO per ton of ore.

Statistical testing was conducted in order to compare the means of each column with the blank column. The testing allows for the elimination of standard errors introduced in each column and also takes into consideration the effects of rate of recovery of gold in each column. Both the F-Test and the T-Test treatments measure the 95% confidence as to whether the means of two populations are significantly different. Statistical results appear in the following Table II.

TABLE II

Statistical Results	P1	P2	P3	P4	P5
Variance	41.8	34.5	52.5	33.9	33.9
Mean	75.4	51.7	50.1	64.3	56.4
Mean Variance (Compared to Blank)	37.5	33.7	42.8	33.6	33.6
Variance of Means (Compared to Blank)	1.4	10.9	4.5	26.2	26.2
F	1.289	10.310	1.504	26.374	26.374
T	1.135	3.548	1.423	3.155	3.155
95% Significantly Different	No	Yes	No	Yes	Yes

The above data show that at the 95% confidence level, a one way analysis of variance shows that P2 and P3 are significantly better than the blank for both the rate and absolute extraction.

EXAMPLE II

Carbon Kinetics Tests

Tests were conducted using 1 gram (Calgon GRC-22, 6x16 mesh) of coconut shell carbon in 1 liter of preg-



US 2003/0192403 A1

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(54) DRAINAGE AID FOR METAL HEAP LEACHING

Publication Classification

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(51) Int. Cl.⁷ C21B 15/00
(52) U.S. Cl. 757/43; 757/11

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(57) ABSTRACT

Methods for increasing drainage or percolation of a lixiviant solution through mineral ore in a heap mining operation. A drainage and compressing ethoxylated aliphatic primary alcohols and mixtures thereof is dripped, sprayed or otherwise brought into contact with the heaped metal ore aggregate and thereby improves percolation or drainage of the lixiviant through the heaped metal ore.

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US 2003/0192403 A1

FIG-1

Effect of 50 ppm of best capillary rise surfactants (50 ppm) on gold uptake on activated carbon

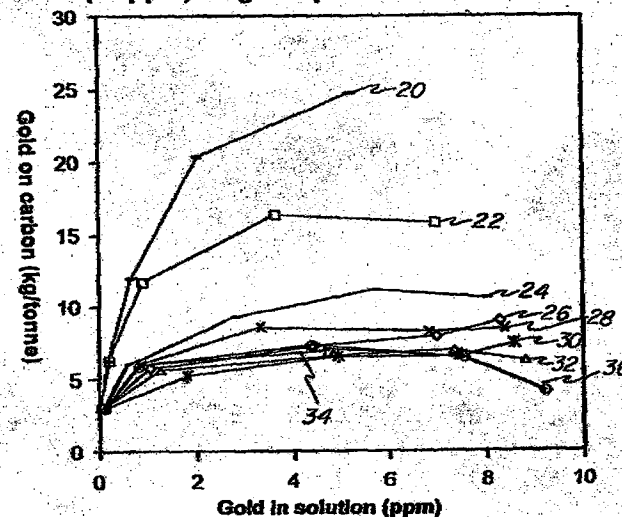
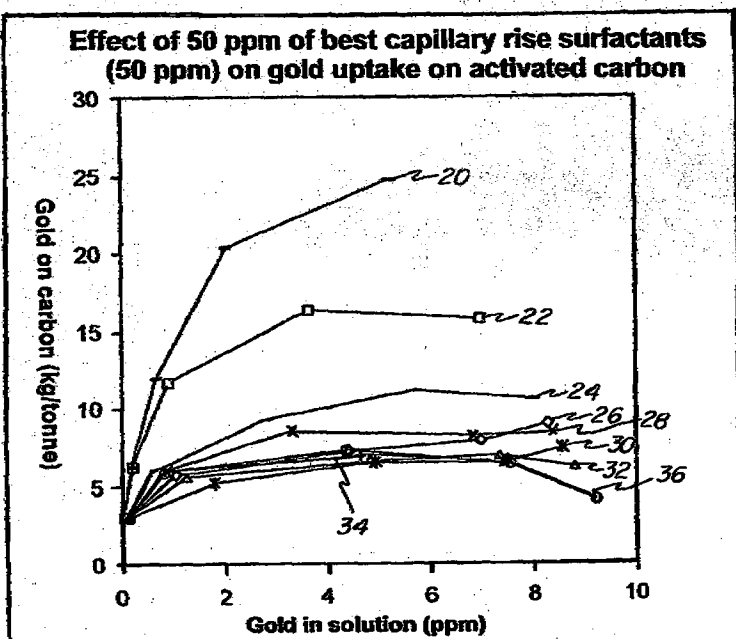
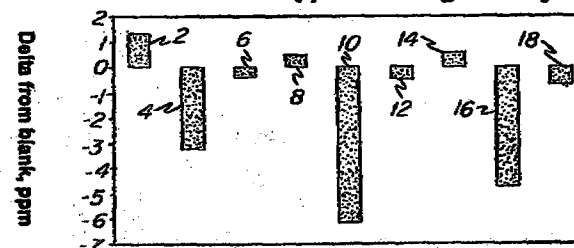


FIG-2

Removal of 10 ppm drainage aid by ore



DRAINAGE AID FOR METAL HEAP LEACHING

FIELD OF THE INVENTION

[0001] The present application relates to an improved process for leaching of metal from ore heaps in which a fixviant solution is brought into contact with the ore to form a "pregnant" solution, from which the metal is ultimately separated. The improvement lies in contacting the metal ore with an ethoxylated aliphatic alcohol to improve percolation of the fixviant through the heap.

BACKGROUND OF THE INVENTION

[0002] In recent years, heap leaching has become a cost effective method for recovering precious metals such as gold or silver from low grade ores. In the process, a fixviant system, comprising a ligand and an oxidant is used to dissolve out the desired precious metal from the ore. As used herein, the phrases "fixviant system" and "fixviant solution" will be used interchangeably and do not imply a true chemical solution—only a chemical combination adapted to extract the mineral value in the ore.

[0003] In heap leaching, the metal bearing ore may be obtained from an open pit mine or the like and is crushed to produce an aggregate that is coarse enough to expose the desired mineral values but fine enough to allow intimate contact of the fixviant system or solution therewith. The fixviant solution may be distributed over the top of the metal ore heap via sprinklers, woblbers, or other similar equipment. The barren fixviant "percolates" through the heap to perform its desired function with the metal and the resulting pregnant solution is then collected by an impervious leach pad or the like located at the bottom of the heap. The pregnant solution is then subjected to conventional mineral recovery techniques to obtain the desired precious metal.

[0004] In gold heap mining operations, a fixviant system comprising cyanide, air and lime is commonly used under highly alkaline conditions (pH 9-11.5) to form the pregnant solution, (i.e., a complex or ligand coordinated with a gold cation). The gold cation complex or ligand leaches from the ore heap and is recovered. The gold is then separated from the fixviant complex via conventional separation techniques such as the conventional method of adsorption on an activated carbon column or bed.

[0005] A variety of factors can contribute to poor percolation of the fixviant through the heap. For example, high clay ores, the formation of large rock fragments and the formation of surface muds or slimes on the heap can be detrimental to the desired percolation through and contact of the ore with the fixviant solution.

[0006] It is therefore desirable to provide a treatment that can enhance the percolation or contact of the ore with fixviant solution so as to increase the amount of precious metal recovered per unit area of the metal ore heap.

[0007] It is especially desirable to provide such a percolation or drainage aid that does not severely impede the functioning of desired process parameters such as the ability of the fixviant solution to react or complex with the ore, or the ability of the pregnant fixviant solution to drain through the heap for recovery.

SUMMARY OF THE INVENTION

[0008] The present invention is directed to a drainage aid useful in heap mining operations. More preferably, the invention is directed toward precious metal heap leaching operations such as gold heap leaching. The drainage aid can be applied by itself to the heap or it can be mixed with the fixviant solution and then sprayed or dripped onto the ore to thereby contact the ore.

[0009] The drainage aid is preferably applied in an aqueous solution via drip or spray application and is present in the aqueous solution in an amount of between about 1-1,000 ppm. The drainage aid is an ethoxylated aliphatic primary alcohol having a carbon chain length of from about C_4 - C_{20} and about 2-20 moles of ethoxylation per molecule.

[0010] The invention will be further described in the following detailed description and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] FIG. 1 is a graph showing the results of activated carbon gold uptake tests reported in Example 4; and

[0012] FIG. 2 is a bar graph illustrating the tests reported in Example 5 showing the uptake of the drainage aids by gold ore.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0013] The drainage aids in accordance with the invention are ethoxylated aliphatic alcohols having the formula



[0014] wherein R is C_4 - C_{20} alkyl or C_4 - C_{20} alkenyl with n being about 2 to 20. More preferably, R is C_4 - C_{14} alkyl or C_4 - C_{14} alkenyl and n is about 3 to 8.

[0015] Preferably, the drainage aid is applied to the metal ore in the form of an aqueous solution with the drainage aid present in an amount of about 1-1,000 ppm, preferably about 1-500 ppm active move, preferably, and 1-100 ppm, most preferred.

[0016] The ethoxylated aliphatic alcohols are commercially available from a plurality of suppliers. Based upon presently available data, the following four commercially available products appear to be especially effective.

Description	McCutcheon description	Analysis results
Ethoxylated aliphatic alcohol	Alcohol-ethoxylate	A heavily branched ethoxylated aliphatic alcohol. The average carbon chain length is 7.3 C's/molecule. The average ethoxylation is 4.5 moles/molecule.
Ethoxylated aliphatic alcohol	2-decylethoxy poly(ethyleneoxy) ethanol	A heavily branched ethoxylated aliphatic alcohol. The average carbon chain length is 6.7 C's/molecule. The average ethoxylation is 5.3 moles/molecule.
Ethoxylated aliphatic alcohol	Ethoxylated 2-decanol	A heavily branched alcohol 1 ethoxylated aliphatic alcohol. The average carbon chain length is 10.3 C's/molecule. The ethoxylation is 3.5 moles/molecule.
Ethoxylated aliphatic alcohol	Ethoxylated alcohol	A straight chain ethoxylated aliphatic alcohol. The average carbon chain

-continued-

Description	McCutcheon description	Analysis results
alcohol		length is 12.2 C's/molecule. The average ethoxylation is 4.0 moles/molecule.

[0017] At present, the most preferred treatment is the 2-decylethoxy poly(ethyleneoxy) ethanol.

EXAMPLES

[0018] The invention will be further explained in conjunction with the following illustrative examples which should not be construed as a limitation on the inventive concepts set forth herein.

[0019] A drainage aid for heap leaching must have certain desirable characteristics and not have some undesirable characteristics. Five tests proving these characteristics have been developed to determine the suitability of potential drainage aids for gold heap leach applications. The importance of the ability of a potential drainage aid to pass each test is described below.

[0020] capillary rise in gold ore—the basic desired outcome for application of a drainage aid is that it reduce the extent of capillary rise in a gold ore. Reduction of capillary rise especially in smaller ore particles is important to promote uniform movement of fixviant through the heap. Excessive capillary rise will lead to so-called "blinding" so that movement of cyanide and oxygen into and gold cyanide complex out of that portion of the heap is greatly reduced. A successful drainage aid will have the maximum possible reduction in capillary rise at a given concentration.

[0021] goldfill dissolution inhibition—While it is important that a drainage aid reduce heap blinding, it is equally important that the drainage aid not impede gold dissolution from the ore. Gold is generally present in ore as particles of metallic gold in the rock matrix. Any coating of the gold metal by the drainage aid could slow the dissolution process leading to slower recovery of the gold value, an undesirable outcome. The use of a surface-active agent to modify capillary rise could reasonably be expected to have an impact on gold dissolution as any surface film formed by the surfactant could interfere with the gold dissolution reaction. Given equal drainage properties, the drainage aid with the least effect on gold dissolution would be the most successful.

[0022] clear solution cyanide reactivity—Another important property that a potential drainage aid must possess is an inertness to cyanide under leaching conditions (pH 9-11.5, 7-9 ppm oxygen). Cyanide concentration is one of the two important parameters (the other is oxygen concentration) which affect gold dissolution rates. A drainage aid that reacts with cyanide to reduce cyanide concentration in the heap will also lead to a slower recovery of the gold value. Given equal drainage properties, the drainage aid with the least effect on cyanide concentrations would be the most successful.

[0023] activated carbon gold uptake—After gold is leached from a heap, it is passed through a column of activated carbon to strip the gold cyanide from the fixviant (so-called carbon-in-column (CIC) gold recovery). Any drainage aid which prevents the uptake of gold by the activated carbon would not be desired unless it could be shown that in actual practice the drainage aid does not reach the activated carbon column. Again as surface-active agents are being used, it is a reasonable expectation that gold uptake would be affected by the film-forming properties of the agent on the activated carbon.

[0024] uptake of the drainage aid by gold ore—if the drainage aid had a detrimental effect on activated carbon gold uptake, it is still possible that a drainage aid could be successfully applied if it were adsorbed onto the ore in the process of improving drainage. As is stated in U.S. Pat. No. 5,827,348, proper wetting of the ore is an important factor in optimizing precious metal recovery.

[0025] A large number of potential drainage aids were initially tested using a capillary rise experiment to determine if they had any effect on drainage. Potential drainage aids were selected on the basis of their stability in high pH (pH 10.5) solutions and a stated ability (in McCutcheon's Emulsifiers and Detergents 1999: North American Edition, Vol. 1) to impact wetting. Those tested included fatty acid derivatives (such as those described in AU application 07/011,659), ethylene oxide/propylene oxide block copolymers (such as those described by Smith and Craft in Chapter 5 of Heap and Dump Leaching Practice), sulfosuccinate derivatives (such as those described in U.S. Pat. No. 5,827,348), ethoxylated alkylphenols, betaine derivatives, various phosphate esters, caprylic and imidazoline amphoterics, sulfonated aromatics, silicones, 2-ethyl hexyl sulfate, various ethoxylated aromatic alcohols, branched- and straight-chain aliphatic alcohols, and some proprietary mixtures of surfactants provided by manufacturers.

Example 1

[0026] Benchtop Capillary Rise Experiments.

[0027] Capillary rise screening tests were performed using an 18x30 mesh sieved ore from a mine in Northern Nevada (Marigold Mine). The ore was prepared by first sieving to this size fraction. The 18x30 fraction was washed extensively with tap water to remove embedded clays. Material was dried overnight at 105° C. and then stored in an environmental chamber at 50% humidity and 25 C.

[0028] A 1 cmx30 cm plastic tube was prepared with a fine stainless steel mesh pushed to the bottom of the tube to hold the ore in place. The tube was filled about ¾ full with the sieved, washed, and dried ore and suspended from the bottom weighing hook of a Mettler analytical balance. A petri dish was filled with a solution of the surfactant at the desired concentration prepared in buffer solution. The buffer solution was prepared by dissolving 0.1 gram of calcium oxide per liter of solution along with 400 ppm of sodium sulfate (expressed as sulfate) adjusted to a pH of 10.5 with sulfuric acid. The sulfate was added to more closely approximate the high ionic strength of a typical fixviant solution. Some surfactants show reduced activity at his ionic strength, therefore it was important that test solutions match a typical fixviant.

[0029] The petri dish was placed under the suspended plastic tube and raised with a lab jack until the solution just touched the bottom of the tube and solution began to rise in the tube due to capillary action. Capillary rise was monitored by the rise in the liquid level in the tube (easily seen as a darkening of the tube interior) and by the weight gain of the tube.

[0030] The liquid was allowed to enter the tube for seven minutes after which the petri dish was lowered, the gain in weight of the tube was measured and then the tube was removed from the hook to measure the height. In general, weight gain and the rise of liquid were highly correlated for a given one so that the two measurements were used as checks on each other. Height of the wetted column after seven minutes is reported below.

[0031] Surfactants were run at 5, 20 and 100 ppm. Below the surfactants are described as one of three classes, those that no effect or does response (>95% of blank, approximate noise level of experiment), those that slightly decreased capillary rise with increasing dose (75% to 95%), and those that had a significant impact (<75% of blank).

Type	chemical name	height cm	height % of blank	Classification
Ethoxylated aliphatic alcohol	Lauryl alcohol	9.0	88%	Some effect
Sulfonate aliphatic	di-ethyl sodium sulfosuccinate	9.2	90%	Some effect
Sulfonate aromatic	sodium di-isooctyl naphthalene sulfonate	9.2	90%	Some effect
Proprietary	C-12 to C-14 secondary alcohol	9.4	91%	Some effect
Ethoxylated aliphatic alcohol	C-12 to C-14 secondary alcohol	9.5	93%	Some effect
Ethoxylated aromatic alcohol	ethoxylated naphthalene	9.5	93%	Some effect
Ethoxylated aliphatic alcohol	C-12 to C-14 secondary alcohol	9.6	94%	Some effect
phosphate ester	aromatic based organic phosphate ester	9.7	95%	No effect
sulfonate aliphatic	diethyl sodium sulfosuccinate	9.7	95%	No effect
Silicone	silicone glycol copolymer	9.7	95%	No effect
Ethoxylated aromatic alcohol	ethoxylated naphthalene	9.8	96%	No effect
Proprietary	block copolymer	9.9	97%	No effect
Proprietary	block copolymer	9.9	97%	No effect
block copolymer	block copolymer	10.0	98%	No effect
amphoteric betaine	alkylbetaine	10.0	98%	No effect
Ethoxylated aliphatic alcohol	C-12 to C-14 secondary alcohol	10.0	98%	No effect
amphoteric caprylic	caprylic	10.1	99%	No effect
amphoteric imidazolin	imidazolin	10.1	99%	No effect
sulfonate aliphatic	sodium salt	10.1	99%	No effect
amphoteric imidazolin	sodium salt of 2-caprylic 1 (ethyl beta oxypropionic acid)	10.2	100%	No effect
amphoteric block copolymer	block copolymer	10.4	101%	No effect
amphoteric betaine	betaine	10.4	101%	No effect
sulfate	2-ethyl hexyl sulfate	10.6	103%	No effect
Proprietary	ethoxylated aromatic alcohol	10.7	104%	No effect
Proprietary	ethoxylated aromatic alcohol	10.9	109%	No effect
Ethoxylated aliphatic alcohol	Lauryl alcohol	8.0	80%	Some effect
Alkylated soap	alkylated soap	8.7	85%	Some effect
Proprietary	Modified ethoxylate	8.7	85%	Some effect
sulfonate aliphatic	tetrasodium N-(1,2 dicarboxyethyl) octadecyl sulfosuccinate	8.7	85%	Some effect
fatty acid + amphoteric	sodium lauryl sulfate	8.8	88%	Some effect
fatty acid	nonanion lauryl sulfate	8.8	88%	Some effect

-continued-

Type	chemical name	height cm	height % of blank	Classification
Ethoxylated aliphatic alcohol	Lauryl alcohol	9.0	88%	Some effect
Sulfonate aliphatic	di-ethyl sodium sulfosuccinate	9.2	90%	Some effect
Sulfonate aromatic	sodium di-isooctyl naphthalene sulfonate	9.2	90%	Some effect
Proprietary	C-12 to C-14 secondary alcohol	9.4	91%	Some effect
Ethoxylated aliphatic alcohol	C-12 to C-14 secondary alcohol	9.5	93%	Some effect
Ethoxylated aromatic alcohol	ethoxylated naphthalene	9.5	93%	Some effect
Ethoxylated aliphatic alcohol	C-12 to C-14 secondary alcohol	9.6	94%	Some effect
phosphate ester	aromatic based organic phosphate ester	9.7	95%	No effect
sulfonate aliphatic	diethyl sodium sulfosuccinate	9.7	95%	No effect
Silicone	silicone glycol copolymer	9.7	95%	No effect
Ethoxylated aromatic alcohol	ethoxylated naphthalene	9.8	96%	No effect
Proprietary	block copolymer	9.9	97%	No effect
Proprietary	block copolymer	9.9	97%	No effect
block copolymer	block copolymer	10.0	98%	No effect
amphoteric betaine	alkylbetaine	10.0	98%	No effect
Ethoxylated aliphatic alcohol	C-12 to C-14 secondary alcohol	10.0	98%	No effect
amphoteric caprylic	caprylic	10.1	99%	No effect
amphoteric imidazolin	imidazolin	10.1	99%	No effect
sulfonate aliphatic	sodium salt	10.1	99%	No effect
amphoteric imidazolin	sodium salt of 2-caprylic 1 (ethyl beta oxypropionic acid)	10.2	100%	No effect
amphoteric block copolymer	block copolymer	10.4	101%	No effect
amphoteric betaine	betaine	10.4	101%	No effect
sulfate	2-ethyl hexyl sulfate	10.6	103%	No effect
Proprietary	ethoxylated aromatic alcohol	10.7	104%	No effect
Proprietary	ethoxylated aromatic alcohol	10.9	109%	No effect

[0032] Of the surfactants showing a maximum reduction in capillary rise ("good effect"), it was found that these were of four types, a sulfosuccinate, ethoxylated aliphatic alcohols, mixtures of fatty acids and amphoteric, and a sulfo salt of a fatty acid. A fifth material is described by its manufacturer as a mixture of anionic and nonionic surfactants. The fatty acid/1 mixtures were found to be too expensive and were not tested further.

[0033] It is interesting to note that the longer chain ethoxylated aliphatic secondary alcohols did not show any effect; neither did the ethoxylated aromatic alcohols. With regard to

the sulfosuccinates, only sodium dioctyl-sulfosuccinate and possibly diethyl sodium sulfosuccinate showed an appreciable impact on capillary rise.

Example 2

[0034] Goldfilm Dissolution Inhibition

[0035] Gold dissolution rates were monitored in the presence and absence of the candidate drainage aids. The technique used was similar to that described in U.S. Pat. No. 5,484,470. Gold metal films sputtered onto 1/2" x 2" plastic film backings were prepared. The gold film was stripped from the film in the presence of cyanide at pH 10.5 in a magnetically stirred UV-Vis cuvette. Gold dissolution was monitored during the stripping using a Au(CN)₂ absorption peak at 240 nm. The absorbance at this wavelength is linearly related to Au(CN)₂ for concentrations up to 20 ppm.

[0036] The experiment was run for 15 minutes. Initially, no surfactant was added to the cuvette. After 1 minute, monitoring of the rise in the Au(CN)₂ absorbance peak began at one minute intervals until 6 minutes. At 7 minutes, 100 ppm of surfactant was added to the solution using a microliter pipette. Monitoring the Au(CN)₂ continued until 15 minutes. The slope of the increase in absorbance taken from 7 to 10 minutes was expressed as a percentage of the slope for 1 to 6 minutes. Typically, the slope for a blank (no surfactant solution) was slightly (10%) lower than that at the start of the experiment. A suppression of the gold dissolution by a surfactant was seen as a further decrease in the ratio (or percentage) of the slopes after and before surfactant addition.

[0037] Examples of the four top classes of surfactants from the capillary rise experiments were compared to blank (no surfactant) solution. The materials included ethoxylated 2-decanol, fatty acid sulfo salt, I.D-450 (Stephan-Proprietary), and sodium dioctyl sulfosuccinate. Because of claims made in U.S. Pat. No. 4,929,274 about the hydrolyzability of the sodium dioctyl sulfosuccinate, tests were done using both hydrolyzed (prepared by allowing an alkaline solution to sit overnight) and unhydrolyzed (freshly prepared) solutions. The results are shown in the table below:

	Blank	X-1	C-1	C-2	C-3 (fresh)	C-4 (aged)
Average % of slopes (9 to 15 minutes) (1 to 6 minutes)	89%	81%	9%	9%	45%	44%
Standard deviation of ave %	11%	5%			39%	21%
% decrease in dissolution rate from blank (Ave % sample - Ave % blank) / Ave % blank	0%	9%	90%	90%	50%	51%

[0038] Of the tested materials only X-1 showed acceptable performance. Both C-1 and C-2 had a dramatic inhibitory effect on dissolution, reducing the dissolution rate by 90% compared to the blanks. C-3 reduced the gold dissolution by about 50%. Aged (hydrolyzed) C-4 had the same effect as fresh C-3. X-1 had no statistically significant impact on the gold dissolution rate.

[0039] X-1=ethoxylated 2-decanol

[0040] C-1=I.D450—Stephan-proprietary

[0041] C-2=fatty acid sulfo salt

[0042] C-3=sodium dioctyl sulfosuccinate

[0043] C-4=hydrolyzed sodium dioctyl sulfosuccinate

Example 3

[0044] Clear Solution Cyanide Reactivity

[0045] Experiments were completed evaluating the effect of the same four surfactants on cyanide consumption after 1 and 24 hours. Testing was done with 100 ppm of the surfactants (C-1, C-2, C-3, and C-4) in the presence of 200 ppm cyanide. Cyanide consumption was measured as the amount of cyanide consumed in the reaction with the surfactant. The results are shown in the table below:

[0046] Analysis of free CN was done using a LACHAT Flow Injection Analyzer and an analysis method which converts CN in an alkaline media to cyanogen chloride, CNCl, by reaction with chloramine-T at pH-8. The CNCl then forms a red-blue dye by reacting with a pyridine-barbituric acid reagent. The resulting color is read at 570 nm. The results are shown below:

	Exposure time, hrs			
	1		24	
	surfactant concentration, ppm			
	50	100	50	100
C-3	96%	96%	95%	96%
C-1	100%	96%	95%	98%
C-2	96%	96%	95%	96%
X-1	98%	94%	96%	91%

[0047] Within the error of the cyanide analysis methodology ($\pm 10\%$), none of the surfactants had a negative effect on cyanide consumption.

Example 4

[0048] Activated Carbon Gold Uptake

[0049] Similar types of experiments have been reported in U.S. Pat. No. 5,827,348.

[0050] Stock solutions of gold cyanide were prepared by dissolving 0.900 g of KAu(CN)₂ and 12.6 g of NaCN (95%) in DI water to 55 liters. The solution pH was adjusted to pH 10.5. After gold analysis, the stock solutions were diluted further with DI water to adjust the gold concentration to 10.25 mL. This gives a test solution concentration of 10 ppm and approximately 200 ppm NaCN. Stock solutions of the reagents were prepared to contain 2000 ppm of active surfactant in a 500 mL solution. The pH was adjusted to pH 10.5 with time before final dilution. Surfactants prepared using this procedure included C-3, X-2, C-5, C-1, X-3, X-1, C-6, C-2, X-4, C-7, C-8.

[0051] For a test, the specified volume of 10.25 ppm gold stock solution is placed in a 2.5 liter bottle along with the required amount of surfactant stock solution to obtain the desired surfactant concentration (0 ppm, 10 ppm, 50 ppm). Additional DI water was added to adjust the gold concentration to 10 ppm. The required amount of preatrited (+20 mesh) Calgon GRC-22 carbon was added. For each surfactant concentration, five solution to carbon ratios were tested as shown in the table below. The ratio of gold solution volume to weight of carbon ("carbon loading") is an important factor in representing what might happen in a carbon stripping column. As gold is progressively loaded onto a carbon column, a profile of loading values is created across the column. It is important to know if an inhibitor of the gold adsorption process affects the process at both low and high solution to carbon ratios.

Test	Gold Stock Sol., mL	Carbon g	Reagent Test Conc. mg/L	Total Solution Volume mL	Solution to Carbon Ratio
1	1500	0.8	10	1538	5125
2	1000	0.4	10	1025	2563
3	500	0.4	10	514	1281
4	500	0.8	10	514	641
5	450	1.5	10	481	308

[0052] Each bottle was rolled for 48 hours then a sample of the solution was filtered and analyzed for gold expressed as ppm of gold in solution. The carbon with loaded gold was fire-assayed for its gold content expressed as kilograms of gold per metric ton of carbon. A plot of results (carbon loading vs. solution gold concentration) is shown in FIG. 1.

[0053] Reference numerals used in FIG. 1 are as follows:

[0054] 20—control

[0055] 22—C-8; di-tridecyl sodium sulfosuccinate

[0056] 24—C-6; dihexyl sodium sulfosuccinate

[0057] 26—C-2; fatty acid sulfo salt

[0058] 28—C-3; sodium dioctyl sulfosuccinate

[0059] 30—C-1; I.D. 450 Stepan proprietary

[0060] 32—C-5; ammonium lauryl sulfate/ammonium laureth sulfate/cocamidopropyl betaine/ocamide dea

[0061] 34—X-1; ethoxylated 2-decanol

[0062] 36—X-3; isodecyl alcohol ethoxylate

[0063] The results clearly show that all surfactants (with the possible exception of C-8, di-tridecyl sodium sulfosuccinate) have a detrimental effect on carbon loading at 50 ppm. Running the same experiments at 10 ppm show a decreased but still significant impact of surfactant on recovery.

Example 5

[0064] Uptake of the Drainage Pail by Gold Ore

[0065] As mentioned above, if the drainage aid had a detrimental effect on activated carbon gold uptake, it is still possible that a drainage aid could be successfully applied if

it were adsorbed onto the ore in the process of improving drainage. Tests were conducted with the four most cost-effective drainage aids to determine their retention on a representative oxide gold ore from Northern Nevada.

[0066] As with the capillary rise experiments, the uptake experiments were done using an 18x30 mesh sieved ore. The ore was prepared by first sieving to this size fraction. The 18x30 fraction was washed extensively with tap water to remove any embedded clays. Material was dried overnight at 105° C. and then stored in environmental chamber at 50% humidity and 25 C.

[0067] A 1 cmx30 cm plastic tube was prepared with a fine stainless steel mesh pushed to the bottom of the tube to hold the ore in place. Ore was filled to a height of 10 cm in the tube and 10 ppm surfactant solutions were dripped onto the ore at a pumping rate (3.24 ml/min) corresponding to a typical heap leach application rate of 0.005 gpm/ft². Buffer solution was the same as the capillary rise experiments, 0.1 g/L Ca with 400 ppm sulfate added, adjusted to pH 10.5 with sulfuric acid.

[0068] The experiments were run over 66 hours during which a composite sample of the effluent solution was collected.

[0069] Uptake of surfactant by the ore was measured using total carbon after acidification with a Shimadzu Model TOC-5000 Carbon Analyzer calibrated using potassium hydrogen phthalate standards. Recovery was calculated by the following equation:

$$\left(\frac{\text{Effluent Total Carbon}_{\text{effluent}} - \text{Influent Total Carbon}_{\text{influent}}}{\text{Carbon}_{\text{heap}}} \right)$$

[0070] Results are shown in the graph shown in FIG. 2.

[0071] Reference numerals used in FIG. 2 are as follows:

2	C-3	2-decylethoxy Poly (ethyleneoxy) ethanol
4	X-2	
6	C-5	
8	C-1	
10	X-1	
12	C-6	ethoxylated alcohol sodium dodecyl diphenyl oxide disulfonate
14	C-2	
16	X-4	
18	C-7	

[0072] Combining the results of all five of the above examples, one class of compounds successfully meets the desired criteria for a gold heap leach application. Specific commercial products of this class (CAS # 61827-42-7) which demonstrated efficacy include the following:

Description	McCutcheon description	Analysis results
Ethoxylated aliphatic alcohol	Isodecyl alcohol ethoxylate	A heavily branched ethoxylated aliphatic alcohol. The average carbon chain length is 7.3 C's/molecule. The average ethoxylation is 4.5 moles/molecule (X-3).

—continued—

Description	McCutcheon description	Analysis results
Ethoxylated aliphatic alcohol	2-decylethoxy poly(ethyleneoxy) ethanol	a heavily branched ethoxylated aliphatic alcohol. The average carbon chain length is 6.7 C's/molecule. The average ethoxylation is 5.3 moles/molecule (X-4)
Ethoxylated aliphatic alcohol	Ethoxylated 2-decanol	a heavily branched alcohol ethoxylated aliphatic alcohol. The average carbon chain length is 10.5 C's/molecule. The ethoxylation is 3.5 moles/molecule (X-2)
Ethoxylated aliphatic alcohol	Ethoxylated alcohol	a straight chain ethoxylated alcohol aliphatic alcohol. The average carbon chain length is 12.2 C's/molecule. The average ethoxylation is 4.0 moles/molecule (X-4)

[0073] The invention is therefore applicable to enhance drainage or percolation of lixiviant solutions such as the cyanide based lixiviant solutions through a heap of mineral ore. The invention performs particularly well in the leaching of gold from gold ore with a cyanide/oxygen/line lixiviant system operated at a pH of from about 9-11.5 but is also applicable to other heap mining environments such as precious metal heap mining in general and copper heap mining.

[0074] While the present invention has been described with respect to particular embodiments thereof, it is apparent that other forms and modifications of the invention will be obvious to those skilled in the art. The appended claims and this invention generally should be construed to cover all such obvious forms and modifications which are within the true spirit and scope of the present invention.

What is claimed is:

1. In a method of leaching metals from metal ore in which a lixiviant solution is placed in contact with said metal ore to extract said metal therefrom, the improvement comprising contacting said metal ore with an effective amount of a drainage aid comprising an ethoxylated aliphatic alcohol.

2. Method as recited in claim 1 wherein said ethoxylated aliphatic alcohol has the formula



wherein R is C₂-C₂₀ alkyl or C₄-C₂₀ alkenyl and n is from about 2 to about 20.

3. Method as recited in claim 2 wherein R is C₄-C₁₄ alkyl or C₄-C₁₁ alkenyl and n is about 3 to about 8.

4. Method of recited in claim 2 wherein said step of contacting said metal ore comprises contacting said metal ore with an aqueous solution containing said drainage aid, said drainage aid being present in said aqueous solution in an amount of about 1-1,000 ppm.

5. Method as recited in claim 4 wherein said drainage aid is present in an amount of about 1-500 ppm.

6. Method as recited in claim 4 wherein said drainage aid is present in an amount of about 1-100 ppm.

7. Method as recited in claim 3 wherein said drainage aid comprises a mixture of ethoxylated aliphatic alcohols and wherein, in said mixture, R is about 7.3 alkyl and n is about 4.5.

8. Method as recited in claim 3 wherein said drainage aid comprises a mixture of ethoxylated aliphatic alcohols and wherein, in said mixture, R is about 6.7 alkyl and n is about 5.3.

9. Method as recited in claim 3 wherein said drainage aid comprises a mixture of ethoxylated aliphatic alcohols and wherein, in said mixture, R is about 10.5 alkyl and n is about 3.5.

10. Method as recited in claim 3 wherein said drainage aid comprises a mixture of ethoxylated aliphatic alcohols and wherein, in said mixture, R is about 12.2 alkyl or alkenyl and n is about 4.

11. In a method of leaching gold from a heap of gold metal ore in a heap leaching operation wherein a cyanide based lixiviant system is used to contact and remove gold from said gold metal ore, the improvement comprising contacting said gold metal ore with a drainage aid comprising an ethoxylated aliphatic alcohol or mixtures of said ethoxylated aliphatic alcohol.

12. Method as recited in claim 11 wherein said lixiviant system has a pH of about 9 to about 11.5 and wherein said ethoxylated aliphatic alcohol is a primary alcohol having a carbon chain length of about 4 to about 20 carbon atoms and average ethoxylation of about 2-20 moles of EtO (ethylene oxide) per molecule.

13. Method as recited in claim 12 wherein said ethoxylated aliphatic primary alcohol is present in an aqueous solution in an amount of about 1—about 1,000 ppm.

14. Method as recited in claim 13 wherein said ethoxylated aliphatic primary alcohol is present in an amount of about 1-500 ppm.

15. Method as recited in claim 13 wherein said ethoxylated aliphatic primary alcohol is present in an amount of about 1-100 ppm.

16. Method as recited in claim 12 wherein said carbon chain length is from about 4-14 and said average ethoxylation is about 3 to about 8 moles of EtO per molecule.

17. Method as recited in claim 13 wherein said drainage aid comprises a mixture of ethoxylated aliphatic primary alcohols.

18. Method as recited in claim 17 wherein said mixture has an average carbon chain length of about 7.3 and an average of about 4.5 moles of EtO per molecule.

19. Method as recited in claim 17 wherein said mixture has an average carbon chain length of about 6.7 and an average of about 5.3 moles of EtO per molecule.

20. Method as recited in claim 17 wherein said mixture has an average carbon chain length of about 10.5 and an average of about 3.5 moles of EtO per molecule.

21. Method as recited in claim 17 wherein said mixture has an average carbon chain length of about 12.2 and an average of about 4 moles of EtO per molecule.

22. Method as recited in claim 11 wherein said drainage aid comprises isodecyl alcohol ethoxylate.

23. Method as recited in claim 17 wherein said drainage aid comprises 2-decylethoxy poly(ethyleneoxy) ethanol.

24. Method as recited in claim 11 wherein said drainage aid comprises ethoxylated 2-decanol.

25. Method as recited in claim 11 wherein said drainage aid comprises ethoxylated aliphatic alcohol having a chain length of about 12.2.

* * * * *

**SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO
DIRECCION DE NUEVAS CREACIONES**

2020
Bogotá, D.C.,

Doctor
EMILIO FERRERO
Abogado

ASUNTO

Radicación 07-63508
Trámite 311
Evento 379
Actuación 430
Oficio
Folios 0

000492

Patente de Invención

☒

Patente de Modelo de Utilidad

☐

Vía PCT (fase nacional)

☒

Cap. I

☐

Cap. II

☒

No. Sol. Internacional:

PCT/EP2005/013909

Fecha de Presentación Internacional: 22 de Diciembre de 2005

Como resultado del examen de fondo, realizado con fundamento en el artículo 45 de la Decisión 486 de la Comisión de la Comunidad Andina, se le comunica:

1. Documentos estudiados

Descripción:

Folios: 53 a 108

como se radicó inicialmente
modificada

Folios: 164 a 221

Reivindicaciones:

Folios: 120 a 127

como se radicó inicialmente
modificadas

Folios: 222 a 229

Prioridad:

DE102004063501.3, 24 de diciembre de 2004,
DE102005009574.7, 28 de febrero de 2004.

2. Objeto de la invención

Titulo de la invención:

Una composición que contiene cianuro acuoso que comprende un tensoactivo no iónico (folio 163).

El problema planteado en esta solicitud es como disminuir el tiempo y la cantidad de cianuro requerido para la lixiviación de oro y/o plata.

Para solucionar este problema técnico se desarrolla una composición que contiene cianuro que comprende al menos un tensoactivo, y un procedimiento para extraer metales nobles.

Clasificación internacional de Patentes (IPC) en C22B11/08.

3. De la solicitud de Patente (según el caso)

Reivindicaciones (artículo 30 D 486)

- La reivindicación 1 hace referencia a una composición que contiene cianuro, sin embargo reivindican el resultado a obtener como es una reducción del ángulo de contacto sobre vidrio después de un segundo por al menos 10°, lo cual no es permitido.
Se enfatiza al solicitante que las reivindicaciones de composiciones deben ser caracterizadas por sus componentes, y el rango ó proporciones de estos dentro de la misma. Las reivindicaciones deben caracterizar un producto por la forma o constitución del mismo, las partes que lo componen. No se aceptan reivindicaciones que caractericen resultados, usos, contenidos, ventajas o efectos. Por lo anterior, la reivindicación 1 debe eliminarse del capítulo en cuestión.
- Los términos "al menos" y "menor" utilizadas en las reivindicaciones 1, 2, 3, 5 y 6 para referirse al número de tensoactivos en la composición, ángulo de contacto, etc., deben eliminarse, dado que no proporcionan precisión ni concisión a las características esenciales de la invención.
- Observa este Despacho que en las reivindicaciones 6, 7 y 8 se pretende reclamar un elevado número de compuestos, dado que reivindica un tensoactivo no iónico con la fórmula



donde R^1 es al menos un alquilo C4-C22 ramificado o sencillo,

n tiene un valor medio de entre 1 a 50,

m tienen un valor medio de entre 0 a 20,

r tiene un valor medio de entre 0 a 50,

s tienen un valor medio de entre 0 a 50

en la que cada una de las letras representa un amplio grupo de radicales lo cual hace que el número de permutaciones posibles para cada radical sean numerosas y poco similares entre sí, lo que además de restarle concisión al capítulo, puede que no presenten el mismo efecto que se está reclamando, y además puede que carezca de soporte en la descripción.

Además, se presentan un alto rango de átomos de carbono para R^1 . Se observa una carencia de soporte en la descripción, ya que las moléculas probables – que son muchas – no se encuentran reveladas ni sugeridas en la descripción.

Se recuerda al solicitante que el alcance de las reivindicaciones debe ser una razonable generalización de los ejemplos, en el caso de la presente solicitud se observa que dicho alcance es muy elevado y se recomienda una modificación del alcance de las definiciones para estos radicales.

Por lo anterior, el capítulo reivindicatorio no cumple con el requisito de claridad, soporte en la descripción y concisión de acuerdo al art. 30 de la Decisión 486.

4. Determinación del Estado de la Técnica

Como fecha para determinar el estado de la técnica se tomará la fecha de radicación de la solicitud en esta oficina siendo el 24 de diciembre de 2004.

Tendiendo en cuenta la anterior fecha indicada, se realiza la búsqueda de las anterioridades de la presente solicitud, encontrándose los siguientes documentos relevantes:

Nº	Documento	Título	Fecha de publicación
D1	US4929274	RECOVERY OF METAL VALUES FROM ORES	1990-05-29
D2	US20030192403	DRAINAGE AID FOR METAL HEAP LEACHING	2003-10-16

D1 describe una solución acuosa alcalina de cianuro que contiene un surfactante hidrolizable al pH de la solución, el surfactante esta presente en una cantidad suficiente para incrementar el flujo de recuperación de metales noble sin afectar adversamente la eficiencia del carbón en el subsecuente paso de separar el metal noble del cianuro por absorción en una columna de carbón (Resumen).

D2 describe un proceso mejorado para lixiviar metales desde pilas de minerales en el cual la solución de lixiviación es puesta en contacto con el mineral para formar una lechada, en la cual el metal es separado. El mejoramiento se encuentra en contactar el la fuente del metal con un alcohol alifático etoxilado para mejorar la percolación del lixiviante a través de la pila (Resumen)

5. Análisis de patentabilidad (según requisito) (artículo 14 D486)

Es importante mencionar que el siguiente análisis de patentabilidad se realizó teniendo en cuenta la objeción del numerales 3 de la presente comunicación.

Novedad (artículo 16 D486)

Respecto a la reivindicación 1:

La reivindicación 1 hace referencia: "Una composición que contiene cianuro que comprende al menos un tensoactivo no iónico, en donde el tensoactivo no iónico, en una concentración de 0.01 a 0.02% en peso en una solución acuosa ajusta a un pH de 9.8 a 10.2 con NaOH, a 23°C, conduce a una reducción en el ángulo de contacto sobre vidrio después de un segundo por lo menos 10°.

Respecto a las reivindicaciones en estudio:

D1 afirma que la invención consiste en incorporar en una solución acuosa de cianuro metálico para ser usado en la lixiviación de minerales de bajo grado de oro/plata una cantidad efectiva de de un surfactante para mejorar el flujo de recuperación de metal noble (Col 2 líneas 13-17). La concentración del surfactante es baja de 1 a 50 ppm de solución de lixiviación (Col 3 líneas 2-9). La solución acuosa de lixiviación de cianuro alcalina tiene un pH 10-11, en la cual el tensoactivo es hidrolizado (Col 5 líneas 23-25).

D2 describe que la ayuda de drenaje puede ser mezclada con la solución de lixiviación y luego aplicada por goteo a través de la pila. La ayuda de drenaje es aplicada al Lafuente del metal en forma de una solución acuosa en una concentración de 1-1000 ppm. La invención es aplicada para mejorar el drenaje o percolación de las soluciones de lixiviación tales como las soluciones basada en cianuro a través de la pila. La invención es particularmente exitosa para lixiviar oro desde mineral de oreo con un sistema de lixiviación cianuro/oxígeno/ cal operado a un pH desde 9 a 11.5 (párrafos 0009, 0015, 0045 y 0073).

De acuerdo a lo descrito anteriormente tanto en D1 como en D2, donde se describen composiciones que contienen cianuro que comprende al menos un tensoactivo no iónico, se deja en evidencia que las características técnicas esenciales de esta reivindicación ya eran conocidas en el estado de la técnica.

Dado lo anterior, el objeto de la invención recogido en la reivindicación 1 ha sido divulgado idénticamente en las anterioridades D1 y D2, por lo tanto esta reivindicación y sus dependientes no pueden considerarse nuevas.

Respecto a la reivindicación 12:

La reivindicación 12 hace referencia: "Proceso para extraer metales de materiales que comprenden estos metales, comprende las siguientes etapas del proceso:

- (a) Suministro de un material que contiene metal opcionalmente molido,
- (b) Suministro de un composición de acuerdo a cualquiera de las reivindicaciones 1 a 11, y
- (c) Traer el material que contiene metal en contacto con la composición descrita anteriormente de acuerdo con cualquiera de las reivindicaciones 1 a 11 en la presencia de un agente de oxidación, se obtiene un licor madre enriquecido con metal.

Respecto a la solicitud en estudio:

Las anterioridades D1 y D2 describen un proceso para recuperar oro y plata, a partir de materiales fragmentados el cual comprende:

- (a) Suministro de un material que contiene metal opcionalmente molido (D1: Col 3 líneas 31-32, Col 5 líneas 25-26. D2: párrafo 0035,),
- (b) Suministro de un composición de acuerdo a cualquiera de las reivindicaciones 1 a 7, y (D1: Col 3 líneas 36-37, 52-58, ejemplo I. D2: párrafo 0045, 0050)
- (c) Traer el material que contiene metal en contacto con la composición descrita anteriormente de acuerdo con cualquiera de las reivindicaciones 1 a 11 en la presencia de un agente de oxidación, se obtiene un licor madre enriquecido con metal (D1: Col 3 líneas 60-62, Col 5 líneas 25-27. D2: Reiv. 11, 0073).

De acuerdo a lo descrito anteriormente en D1 y D2, donde se describe un proceso para extraer metal proveniente de materiales que contienen metal, dejando en evidencia que las características técnicas esenciales de esta reivindicación ya eran conocidas en el estado de la técnica.

Dado lo anterior, el objeto de la invención recogido en la reivindicación 12 ha sido divulgado idénticamente en la anterioridad D1 y D2, por lo tanto esta reivindicación y sus dependientes no pueden considerarse nuevas.

6. Conclusión

Los requisitos de patentabilidad de la presente solicitud se encuentran afectados así:

Nº	Documento N°	Reivindicaciones afectadas	Requisito que afecta
D1	US4929274	1-19	Novedad
D2	US20030192403	1-19	Novedad