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CYANIDATION OF PRECIOUS METALS

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This invention relates to the cyanidation of precious metals.

In the past, the cyanidation of precious metal ores has frequently been combined with flotation because of the great cheapness of the flotation process and the fact that flotation frequently reduces the amount of cyanide required. With many precious metal ores, therefore, it is standard procedure to float the ore and treat the flotation concentrate by cyanidation. The most common flotation promotors for precious metals are the xanthates but unfortunately xanthates exert an inhibiting action on the solution of precious metals in cyanide so that losses of precious metal occur in cyaniding, cyanide consumption is frequently increased and the time cycle of cyanidation is also increased. It is of course commercially impractical to remove the small amounts of xanthate in the concentrate and therefore an investigation was made to determine whether the inhibiting action of the xanthate could be counteracted. During this investigation, numerous compounds were tried but only two proved really effective.

The present invention is therefore based on the use of compounds which will counteract to a greater or less extent the solution inhibiting properties of xanthates. These compounds are thiourea and the aldehyde-ammonia condensation products thereof.

By means of the present invention, it is possible to increase the solution rate of precious metals in cyanide from three to five times. The invention is not limited to any particular percentage of added compound. As little as 0.1 lb/ton exerts a marked effect and very good results are obtained with quantities of about 0.5–2 lbs/ton. Some improvement is to be noted when the amount used is in excess of 2 lbs/ton but the improvement is usually not sufficiently great to warrant the added reagent cost. It should be understood, therefore, that while the best practical range is usually from 0.5 to 2 lbs/ton, the invention is not limited to this particular range and in every case the metallurgist will adopt the best compromise for any particular concentrate, balancing reagent cost against added solution.

Both thiourea and an aldehyde-ammonia condensation product of thiourea are very effective. The extent of their action, however, appears to vary slightly. Thiourea has a somewhat lower threshold value, that is to say, its effect in very low concentrations tends to be somewhat greater; however, improvement with increased concentration is greater with the aldehyde-ammonia condensation product. Both are, however, very effective and either may be used alone or mixtures of the two can be employed.

The following examples are given to illustrate the invention specifically. The first example is a quantitative determination of the effect of the reagents on solution of gold and the second example shows the results when applied to a typical gold-silver ore. It should be understood that the invention is not limited to the details of the examples which are given only as representative illustrations of the operation of the invention.

Example 1

Solution tests were made with a 0.1% sodium cyanide solution on gold discs having a surface area of 10 cm.², the solution rate being determined by weighing the gold disc after 1½ hours and it can be expressed as the amount of gold dissolved during that period. A blank test was made with no xanthate present and then the series of tests with 0.05 lb/ton of potassium ethyl xanthate and also in the presence of the same amount of xanthate with various amounts of thiourea or acetaldehyde-ammonia condensation product of thiourea added to the solution. Temperature, agitation and all other factors were kept entirely constant. The results are shown in the following table:

Potassium ethyl xanthate	Thiourea	Aldehyde-ammonia thiourea	Gold dissolved in 1½ hours
---	---	---	43.90
0.05	---	---	4.40
0.05	0.10	---	7.42
0.05	0.50	---	12.00
0.05	2.00	---	14.80
0.05	---	0.10	5.25
0.05	---	0.50	9.60
0.05	---	2.00	21.00

It will be noted that the presence of the xanthate reduces the rate of solution to approximately one tenth. The rate of solution is almost doubled with 0.1 lb. thiourea per ton whereas 0.1 lb. aldehyde-ammonia thiourea per ton exerted only a small improvement. 0.5 lb/ton of thiourea gives greatly increased results and 2 lbs/ton of thiourea increases the solution rate about three times. It will be noted that the higher amounts of aldehyde-ammonia thiourea give still higher increases in solution rate.

Example 2

The effect of thiourea was tested on a gold-silver ore. The ore was a quartz carrying pyrite

and free gold and having the following analysis:

Au	oz/ton	0.708
Ag	ozs/ton	3.35
Fe	per cent	1.98
Pb	do	0.05
Zn	do	0.10
Cu	do	0.10
S	do	2.07
Insol.	do	88.01

Tests were made, in each case, on 600 gms. of ore ground to 60% and 200 mesh, the cyanidation being for 24 hours with a 0.05% sodium cyanide solution having 0.02–0.03% CaO. Pulp density was 25% solids. In the first test, no xanthate was added, in the second test potassium ethyl xanthate was added, in the third test potassium ethyl xanthate and thiourea were added, in the fourth test potassium secondary butyl xanthate was added and in the fifth test, potassium secondary butyl xanthate and thiourea. The results appear in the following table:

	Xanthate added	Thiourea added	Assay of residue after cyanidation		Extraction	
			Au	Ag	Au	Ag
	Lbs/ton	*Lbs/ton*	*Ozs/ton*	*Ozs/ton*	*Per cent*	*Per cent*
			0.022	0.33	96.9	90.2
Pot. ethyl	0.50		0.110	0.41	84.5	87.7
Pot. ethyl	0.50	0.50	0.074	0.37	89.6	89.9
Pot. sec. butyl	0.50		0.214	0.72	69.8	78.6
Pot. sec. butyl	0.50	0.50	0.133	0.42	81.3	87.5

It will be noted that in each case the extraction of gold and silver is markedly increased by the addition of thiourea, the increase being particularly striking in the case of the potassium secondary butyl xanthate which appears to exert a greater inhibiting action. This is of special importance as this flotation reagent is very largely used in precious metal ores because of its increased promoting power over the ethyl xanthate.

The mechanism by which thiourea and aldehyde-ammonia condensation products act in the present invention is not definitely known. I believe, however, that the effect is primarily one on the surface of the metal. However, the invention is not intended to be limited to any theory of action.

What I claim is:

1. A method of recovering precious metals by cyanidation of precious metal pulps containing xanthates, which comprises carrying out the cyanidation in the presence of a small amount of a compound included in the group consisting of thiourea and aldehyde-ammonia condensation products of thiourea.

2. A method of recovering precious metals by cyanidation of precious metal pulps containing xanthates, which comprises carrying out the cyanidation in the presence of a small amount of thiourea.

3. A method of recovering precious metals by cyanidation of precious metal pulps containing xanthates, which comprises carrying out the cyanidation in the presence of a small amount of an aldehyde-ammonia condensation product of thiourea.

4. A method according to claim 1 in which the amount of the compound is between 0.5 and 2 lbs/ton, based on the solids of the pulp.

5. A method according to claim 2 in which the amount of thiourea is between 0.5 and 2 lbs/ton, based on the solids of the pulp.

6. A method according to claim 3 in which the amount of the aldehyde-ammonia condensation product of thiourea is between 0.5 and 2 lbs/ton, based on the solids of the pulp.

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