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(602) 968-1275 (602) 277-2483

CHARLES R. WARD CORPORATION

Mining Development & Mineral Recovery

4728 N. 21ST AVENUE PHOENIX, ARIZONA 85015

THE PRIME PROCESS FOR TOTAL RECOVERY OF PURE GOLD AND SILVER FROM ORES

by

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Introduction

While this process may seem complicated, in reality it is very simple when compared to the limitations imposed by other processes. This is a four phase system comprising a liquid state, a selective solid metallic state, selective solid hydroxyl and selective liquid hydroxyl states. These four states are controlled by only four chemicals. The chemicals in addition to these are for control and testing.

Ore Requirements

The ore should be pulverized to at least 300 mesh or finer if possible.

Volume

The following components can be expanded to any volume if necessary. All components can be added dry to the tap water.

IN LEACHER

2 liters or quarts of water
200 grams of C5_____
5 to 20 grams of C14_____, or eliminated if silver is not a factor and slower leach can be permitted.
Up to 1 lb. of ore can be leached in above if metal present is only moderate.

NOTE: 291.66 grams (10 assay tons) is used for assay. 1 milligram is to 29.16 grams what 1 troy ounce is to 2000 lb. ore. For assay draw off 1 liter of pregnant liquor, arrive at the concentrate (following) weigh, double the weight and move the decimal point one place to left. This gives exact weight as troy ounce per ton. The reason for using only 1 liter is to avoid having to filter out the mud. Letting it settle for ½ hour or so will usually give clear liquor when siphoned off. If liquor from the negative electrode cylinder is to be used, be sure and include this in the total volume present in the leacher, otherwise the assay will show slightly less metal than is actually present.

IN NEGATIVE ELECTRODE CYLINDER

Fill with a saturated solution of C5_____ just above the water line in the leacher. For mining operation apply optimum D.C. of 1 to 3 watts per six square inches of electrode area. More can be tolerated for assay. The limit is heating and/or bombardment of colloidal particles off the

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electrodes. This can be detected from the oily film appearing on the appearing on the surface of the leach liquor which refuses to be stirred into the liquor.

With C15_____ in squeeze bottle, periodically puff a jet of vapor over the surface of the leach liquor. When a white cloud forms, this means one of several conditions: a) C21_____ is higher than can be absorbed by the combination of metals within the ore, or b) current is too high for the metals present. Reduce current to ½ and after 15 minutes only a faint trace of vapor should show. If moderately high current produces no vapor after a long period suspect exhaustion of C5_____. Add a little and hold steady. If gassing begins again, you ran out of C5. If it doesn't, you have a very rich ore indeed. Continue to gas point when current is decreased almost to zero. This technique is identical to charging a lead/acid battery and also with reference to the battery, it is vitally important that the current/voltage taper is complete, otherwise unreacted metals will be left in the ore, the same as acid is left behind in the battery if the charge is not complete.

When leach period is complete, romove M-3 and cylinder with contents. Remove M-1. Using pH indicator paper, add cylinder liquor to leach until pH therein is at least 7 - 8, but not below 7 or above 10. If contents of cylinder is not enough, add C8_____ slowly. Stir and allow leacher to rotate for at least 15 minutes until complete reaction has time to conclude and all metals except gold and silver have become solids and thoroughly mixed with the mud.

Allow to settle which should produce a clear liquor in 15 minutes or so, or filter if desired. You will have a metal value in solution in the mud also and these can be rinsed out completely if so desired. For assay only ½ the liquor is used.

NOTE: All haze must be eliminated or impurities will be present in the recovered metals. Proper pH of at least 8 will usually do this automatically.

Transfer liquor to a clean beaker or vat and begin stirring, adjust pH with C9_____ only, to between 5 and 7. This has been devised in that manner so that in large applications it takes only minute amounts of titrating chemicals to effect selective changes and drop out unwanted metals, especially with respect to gold and silver.

The most important item is to keep a surplus always of C5 since the chart shown and all other separations and suspensions are dependent upon presence of this chemical in surplus. Without a surplus this entire process is void.

With the liquor being stirred continuously in the beaker or vat, begin slowly adding C1_____. At first you may or may not develop a slight yellow tint or a richer tint with more gold present. Then suddenly a black cloud will begin to develop. Allow the solution to reach equilibirium and add just enough more of C1 to give a slight milky appearance. This will take several minutes to develop to maximum milky density so go very slow on the last stage of adding C1. If too much C1 is added it is only wasted but does no harm otherwise since it is removed with ma

electrodes. This can be detected from the oily film appearing on the appearing on the surface of the leach liquor which refuses to be stirred into the liquor.

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CHARLES R. WARD CORPORATION

Mining Development & Mineral Recovery

4706 EAST ALTA VISTA

PHOENIX, ARIZONA 85040

Dear Sirs:

The Ward Corporation has recently acquired several listings in regards to gold, silver, and copper, both in placer and lode deposits.

In order to better serve the needs of companies such as yours, we are asking that you inform us as to the general requirements on mining properties you seek.

Very truly yours,

Douglas K. Martin
Vice President

DKM/ld

THE PRIME PROCESS FOR TOTAL RECOVERY OF PURE GOLD AND SILVER

ORE: 300 mesh (1 pound or less)

IN LEACHER:
2 liters of water
200 grams of NaCl
5 to 20 grams of Potassium Bromide

IN NEGATIVE ELECTRODE CYLINDER
Fill with saturated NaCl solution just above water line
Apply optimum D.C. of 1 to 3 watts/6 square inches of electrode area (limit is when oily film appears on surface of the leach liquor which refuses to be stirred into liquor)
TEST: Puff jet of Ammonium hydroxide vapor over surface of leach liquor. White cloud means: a) Chlorine gass is higher than can be absorbed by the combination of metals within the ore
b) Current is too high for the metals present.
CORRECTION: Reduce current to ½ and after 15 minutes only a faint trace of vapor should show.
If moderately high current produces no vapor after long period, suspect exhaustion of NaCl. Add a little and hold steady.
If gassing begins again, you ran out of NaCl.
If no gassing, you have a very rich ore indeed.
Continue to gas point when current is decreased almost to zero.
When leach period is complete, remove Nickel Strip and cylinder with contents.
Remove Graphite or carbon rod.
TEST: Using pH indicator paper, add cylinder liquor to leach until pH therein is at least 7-8, but not below 7 nor above 10.
If contents of cylinder is not enough, add Sodium Hydroxide solution slowly.
Stir and allow leacher to rotate for at least 15 minutes until complete reaction has time to conclude and all metals except gold and silver have become solids and thoroughly mixed with the mud.
Allow to settle which should produce a clear liquor in 15 minutes or filter if desired.
(You will have a metals values in solution in the mud also and these can be rinsed out completely if desired.
NOTE: All haze must be eliminated or impurities will be present in the recovered metals. Proper pH of at least 8 will usually do this automatically.
Transfer liquor to a clean beaker or vat and begin sttrring,
Adjust pH with HCl only, to between 5 & 7.
Stirring continuously, slowly add Sodium Hydro-Sulfite ($Na_2S_2O_4$)
A slight gold tint should develop indicating ore.
Suddenly a black cloud will begin to develop.
Allow solution to reach equilibrium
Add just enough more ofSodium Hydro-Sulfite to give a slight milky appearance. (This will take several minutes to develop to maximum milky density so go very slow.
NOTE: A slight overage of Sodium Hydro-Sulfite is indicated where Nitric Acid is to be used as the flocculent. Nitric Acid is the quickest and cheapest. Otherwise Oxalic or

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Aluminum Sulfate in saturated solution may be used for flocculation which is much slower.

Do not add more than 10 to 15 drops of Nitric Acid per liter, unless the suspension becomes "stubborn", then add Oxalic or Aluminum Sulfate in saturated solution, about 10cc per liter of liquor.

Continue stirring and in a few minutes to ½ hour (sooner with Nitric Acid) the black floc should be seen in the white or dark background.

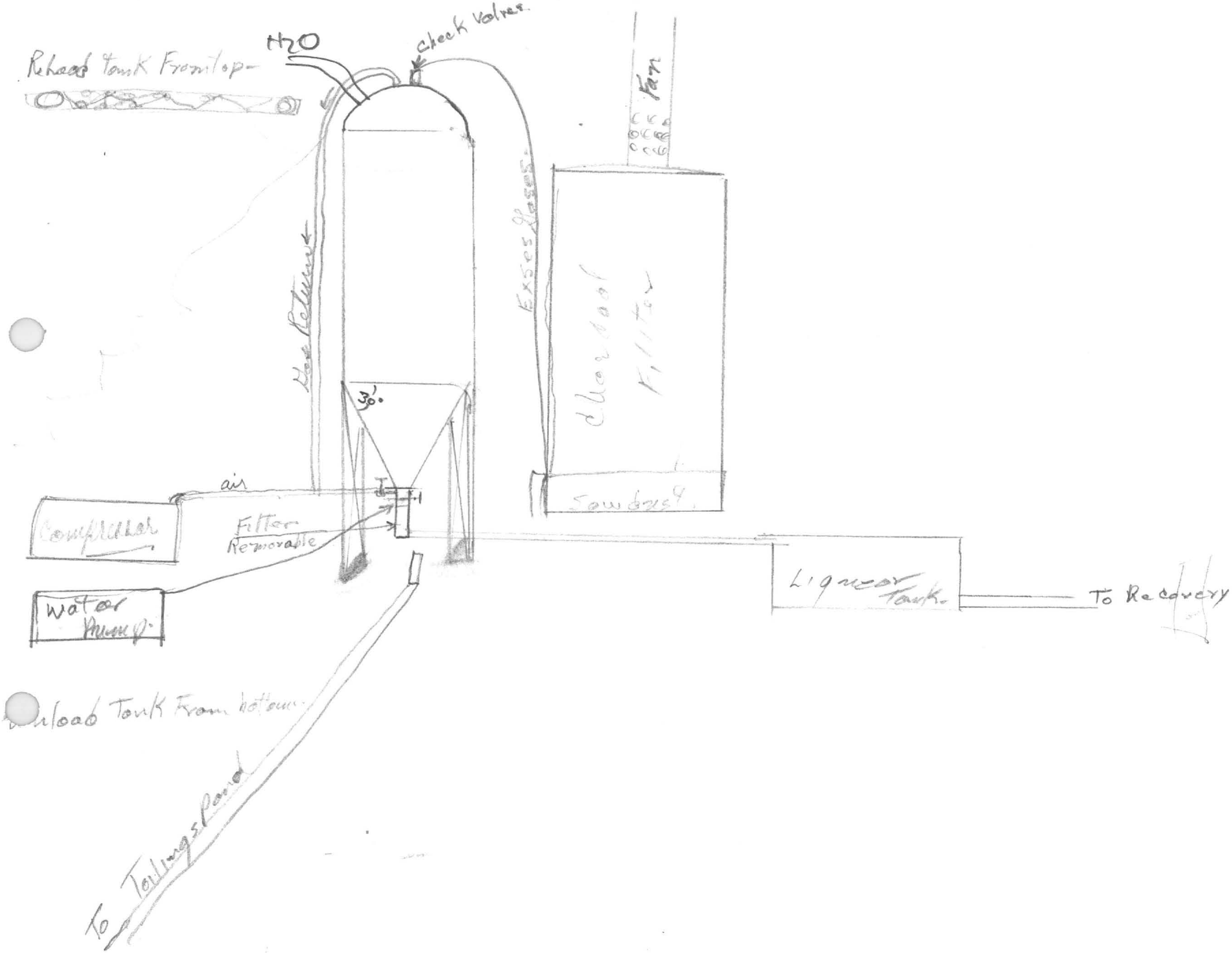
Continue stirring until the liquid clears and black snow is evident throughout.

Cease stirring and allow to settle in a large separatory funnel or beaker.

Extract concentrate at bottom of funnel only after ALL floc has settled

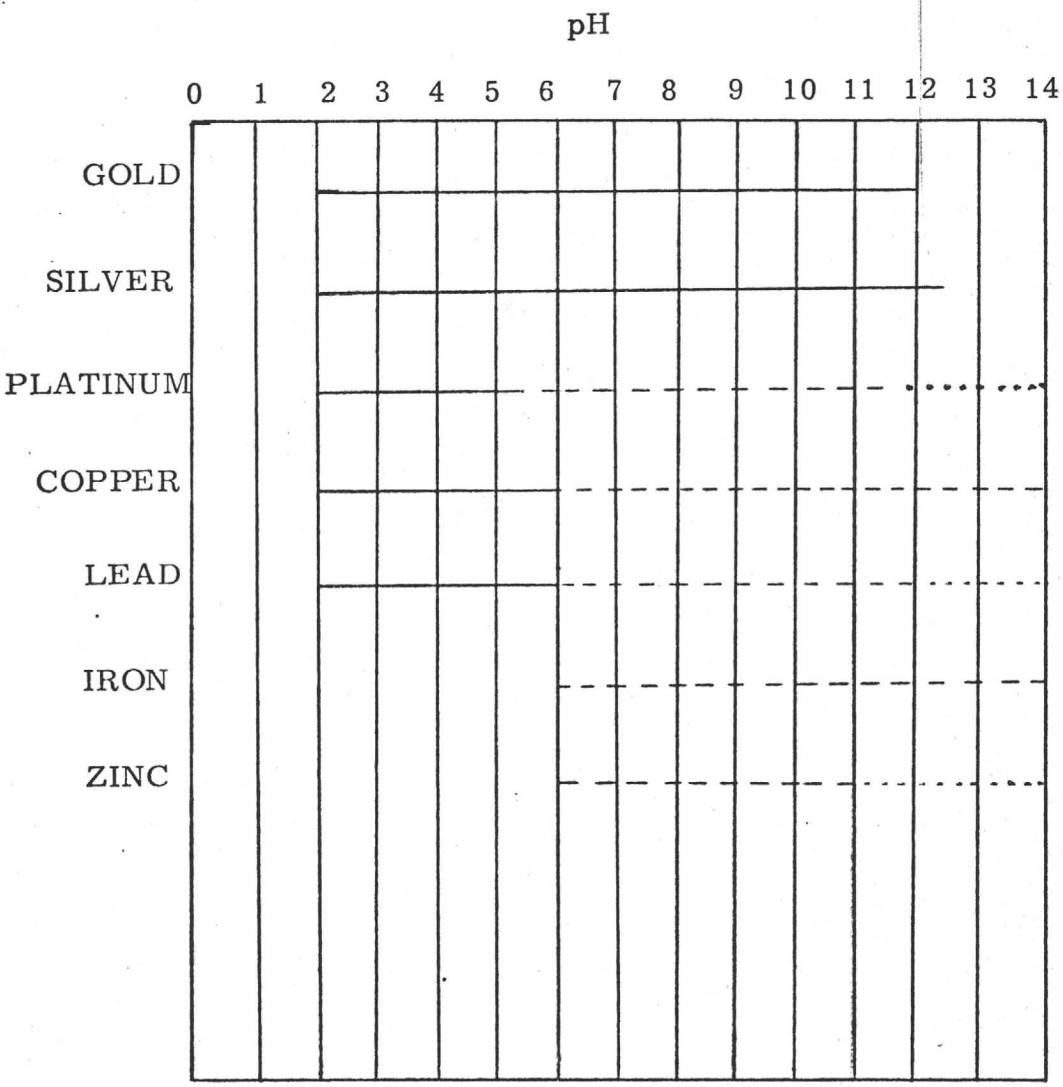
NOTE: For maximum effectiveness of the floc technique do not allow stirring device to drag over the container surface since this breaks up the floc continuously. The smaller the floc the slower it is to settle out.

Silver floc is always small as compared to gold.


Reload tank From top
H2O
check Valves
Fan
Gas Return
Exses Gases
Charcoal Filter
Sawdust
30'
air
Compressor
Filter Removable
Water Pump
Liquor Tank
To Recovery
Unload Tank From bottom
To Tailings pond

SILICONE/URETHANE FOAM ROOFING SYSTEM NOTES

PROCESS FOR RECOVERY OF PRECIOUS METALS



KEY: Solid lines indicate metals released from solution by _____

Dashes indicate pH change alone precipitate these metals instantly as hydroxide solids. - in presence of C5

Dots indicate metal hydroxides that go back into solution again at high pH shown. These metals are know as amphoteric for their ability of being soluble at both extremes of the pH scale.

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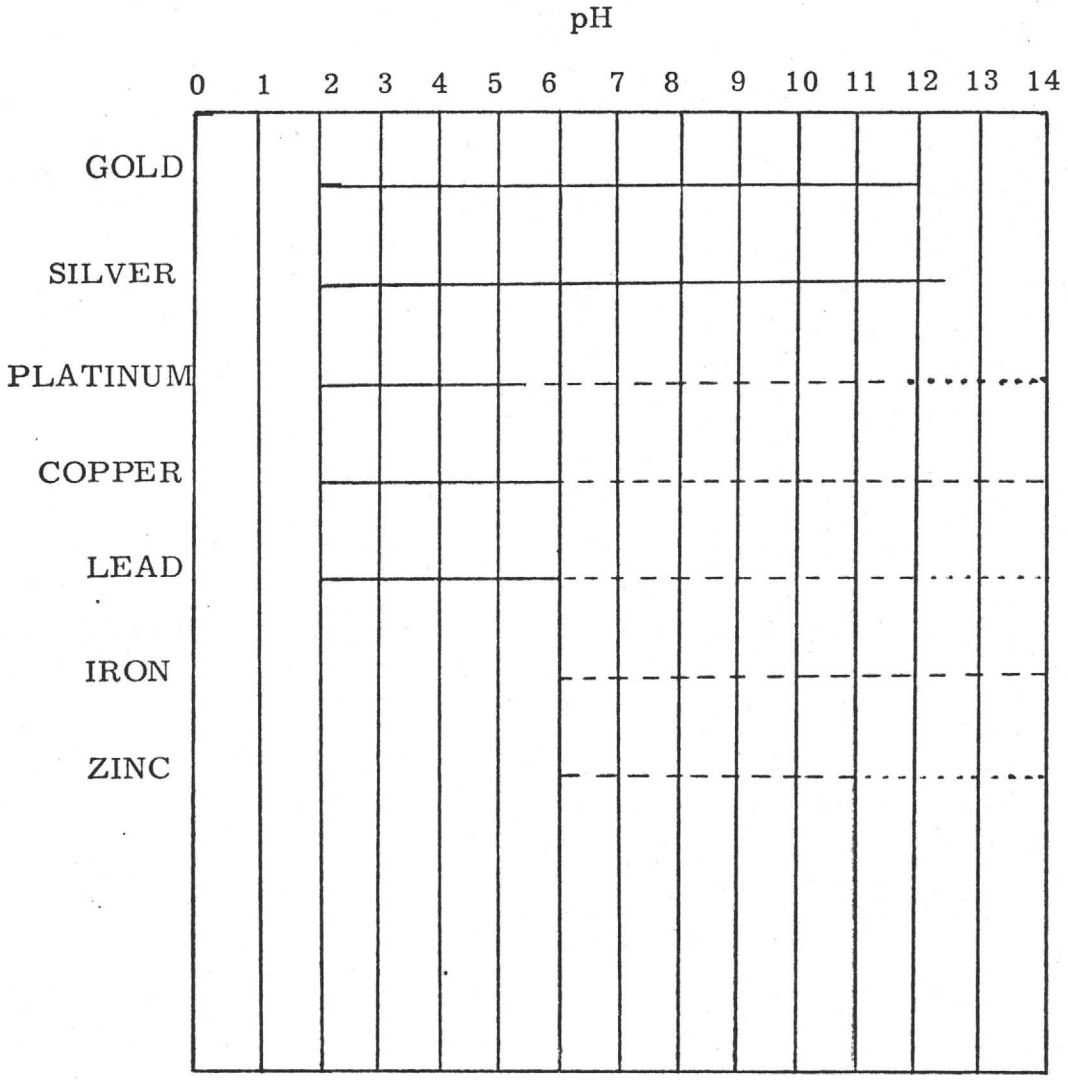
THE PRIME PROCESS FOR TOTAL RECOVERY OF PURE GOLD AND SILVER FROM ORES

by

WILLIAM DUSENBERRY

PROCESS FOR RECOVERY OF PRECIOUS METALS



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COPY

17 March 1975

Mr. William Dusenberry
7046 E. Paradise Dr.
Scottsdale, Arizona
85254

Dear Mr. Dusenberry:

Enclosed you will find a copy of your process for recovering gold and silver.

We sincerely regret the delay plus the fact that you did not receive the original copy, which was sent to you some time ago.

Again I would like to thank you for the use of your documents.

Very truly yours,

Douglas K. Martin
Vice President

DKM/ld

encl

WILLIAM L. DUSENBERRY Ph.D.

CONSULTANT FOR THE PHYSICAL SCIENCES OF
ELECTRONICS - MINERALOGY - CHEMISTRY

7046 E. PARADISE DRIVE 602-948-2546 SCOTTSDALE, ARIZONA 85254

MARCH 22, 1977.

A PRACTICALABILITY STUDY OF AN ORE MILLING FACILITY, MILL EQUIPMENT, FLOW SHEET PROCESS, ORE AVAILABILITY AND MARKETING CONCEPTS.

FACILITY:

DUE TO THE EXTREMELY HIGH CHARGES BY THE LARGER SMELTERS IN THE STATE AND ALSO THEIR CONDITIONAL ACCEPTANCE OF THE ORE, THERE HAS BEEN A LONG NEEDED FACILITY TO PROCESS ALL OF THE ORE THAT IS AVAILABLE IN THIS STATE. THERE IS NO PROPER FACILITY IN THIS STATE THAT CAN PROPERLY PROCESS THE ORES THAT ARE QUITE AVAILABLE. SILVER ORES HAVE TO BE SHIPPED EITHER TO EL PASO, TEXAS OR TOOLE, UTAH TO BE PROCESSED, BOTH OF WHICH ARE NOT ACCEPTING FUTURE DELIVERIES, TUNGSTEN HAS TO BE SHIPPED EITHER TO BISHOP, CALIFORNIA OR FALLON, NEVADA. ALTHOUGH PLACER GOLD NEEDS TO HAVE LITTLE PROCESSING, THERE IS NOWHERE THAT THE ORE CAN BE SHIPPED EXCEPT ONLY AS A BY-PRODUCT OF COPPER AND PLACER GOLD HAS SO LITTLE COPPER IN IT THAT IT DOES NOT QUALIFY FOR ACCEPTANCE.

AS OF THIS DATE, GOLD IS BEING MARKETED AT $152.00 PER TROY OUNCE AND THEREFORE THE PRICE SURELY SUBSTANTIATES A RECOVERY FACILITY IN THIS STATE. SILVER, HOWEVER, DOES PRESENT A PROBLEM DUE TO ITS NATURAL EMBODYMENT AND THE COMBINATION WITH OTHER ELEMENTS, HOWEVER, ON THE FOLLOWING FLOW-SHEET, ALL OF THE PROBLEMS WITH SILVER ARE EASILY OVERCOME.

A STUDY HAS TO BE MADE ON THE MARKETING OF THE FINAL METAL PRODUCT IN ORDER TO ACHIEVE THE BEST POSSIBLE PRICES AND SUCH LESSOR METALS AS ZINC, LEAD AND COPPER COULD BE RETAINED IN THE "TAILING" PILES TO BE RECOVERED AT A LATER DATE SHOULD FURTHER PRICE INCREASES ARE ACHIEVED.

AT THIS TIME, GOLD, SILVER, PLATINUM AND TUNGSTEN ARE OF PRIMARY INTEREST FROM AN ECONOMIC STANDPOINT, THEREFORE ORE PAYMENT SHOULD BE BASED ON THE CONTENT OF THESE METALS ONLY. ANY OTHER VALUES SHOULD BE RECOVERED LATER FROM THE "TAILINGS" SHOULD THE CURRENT PRICES AT THAT TIME WARRANT IT.

TAKING ALL OF THE ABOVE INTO CONSIDERATION, THE ORE MILLING FACILITY SHOULD HAVE THE FACILITIES TO BENEFIT OR TO REJECT ALL ORES THAT ARE DELIVERED TO THE MILL. IN ORDER TO ACHIEVE THIS, THE MILL WOULD CONTAIN THE MOST MODERN EQUIPMENT WITH TOP PERSONNEL AND WOULD BE SECOND TO NONE AND ALSO A CREDIT TO THE ENTIRE STATE. CERTAIN ENVIRONMENTAL PROTECTION AGENCY REGULATIONS HAVE TO BE CAREFULLY OBSERVED WHICH ARE EXTREMELY LARGE IN SCOPE, HOWEVER COMPLIANCE IS WELL WITHIN THE REALM OF POSSIBILITY WITH AN INTELLIGENT APPROACH.

[CONT'D]

MILL EQUIPMENT:

AN EFFORT IS HEREIN EFFECT TO ACCOMODATE ANY AND ALL ORES THAT ARE MINED IN THE STATE AND EVEN THE SURROUNDING STATES. WHILE CERTAIN METALLIC VALUES AT THIS TIME ARE SOMEWHAT DEPRESSED DUE TO VARIOUS REASONS, OTHER ORES ARE AT THEIR NEARTIME PEAK AND IT IS COMMONLY ACCEPTED THAT MINERAL PRICES HAVE NOWHERE TO GO BUT UP IN VALUES.

VALUES HERETOFORE HAVE BEEN LOST IN THE "TAILINGS" DUE TO THE STATE OF THE ART OF RECOVERY AT THAT TIME, HOWEVER, THE MOST MODERN METHODS ARE AT OUR DISPOSAL IN ORDER TO TAKE ADVANTAGE OF ALL THE METALLIC VALUES THAT CAN BE ACCOMPLISHED AT THIS TIME.

THE MILL EQUIPMENT WOULD HAVE TO BE THE MOST MODERN, FLEXIBLE, UNIVERSAL EQUIPMENT PROPERLY INSTALLED THAT HAS EVER BEEN ACCOMPLISHED TO DATE, AND THIS IS NOT A PROBLEM TO ACHIEVE. THE EQUIPMENT AND TECHNOLOGY IS AVAILABLE PROVIDING THE KNOWLEDGE TO COMBINE THE TWO IS AVAILABLE, AND THIS CANNOT BE A PROBLEM.

AS NO TWO ORES ARE EXACTLY ALIKE IN MANY RESPECTS, A WELL EQUIPPED LABORATORY IS NEEDED AND AS SOME ORES REQUIRE A THREE DAY DETERMINATION OF VALUES, SAMPLES OF THE ORE SHOULD THEREFORE BE SHIPPED PRIOR TO DELIVERY OF BULK AND A DETERMINATION OF THE VALUES SHOULD BE OBTAINED. THEN A REPRESENTATIVE PORTION OF THE MILL SHIPMENT IS THEN TAKEN TO CORROBORATE THE SAMPLE EVALUATIONS.

AS THE FOLLOWING FLOW-SHEET IS IN DETAIL, I AM ONLY HEREBY EXPLAINING THE FUNDAMENTAL PROCEDURES THAT APPLY TO ALL OF THE TYPES OF ORES THAT WILL BE DELIVERED TO THE MILL. FIRST, THE ORE HAS TO BE SAMPLED FOR A DETERMINATION OF VALUES PRIOR TO DELIVERY, IF THE ORE IS ACCEPTED, VALUES DETERMINED AND A PROPOSAL TO PURCHASE IS ACCEPTED, THE ORE IS THEN DELIVERED WHEN ANOTHER SAMPLE IS TAKEN TO PROVE TO US THE AUTHENTICITY OF THE ORE. IT IS THEN DEPOSITED INTO AN ORE BIN ORE STOCK-PILED AFTER WEIGHING. THE PROCEDURE FOR THE BEST RECOVERY HAS BEEN ALREADY DETERMINED AND THEN THE ORE IS PROCESSED THROUGH THE BEST METHOD OF THE MANY WAYS THAT WE COULD PROCESS THE ORE.

MANY VALUES WILL REMAIN IN THE REMAINING ORE CALLED THE "TAILINGS" WHICH ARE NOT TAKEN INTO ACCOUNT IN THE PURCHASING OF THE ORE AND WILL BE RETAINED FOR FUTURE PROCESSING SHOULD ECONOMIC CONDITIONS DICTATE SO.

ALTHOUGH A 50 TON PER DAY MILL COULD POSSIBLY SEEM RATHER SMALL, IT REALLY IS NOT AND THE VALUES RECOVERED ON THIS SIZE OF MILL COULD BE EXTREMELY PROFITABLE. AS INCREASED DEMANDS FOR THIS MILL SERVICE INCREASES, IT COULD BE VERY EASILY INCREASED TO TAKE CARE OF ALL OF OUR NEEDS. WE ARE ONLY CONCERNED IN THIS OPERATION TO GIVE EVERY MINER HIS FAIR SHARE OF PROCEEDS AND TO MAKE A FAIR AND LEGITIMATE PROFIT ON EACH AND EVERY SHIPMENT THAT WE PROCESS.

ORE AVAILABILITY

IN THE GENERAL AREA OF THE PROPOSED MILL THERE ARE MANY SMALL MINES WHO HAVE QUITE RICH INDEED ORE VEINS, HOWEVER, WITH THEIR SMALL PRODUCTION, CANNOT PROFITABLY HAUL THEIR ORE TO A DISTANT SMELTER AT A PROFIT, THEREFORE THEY ARE ALL BUT CLOSED DOWN DUE TO THE MARKETABILITY OF THEIR PRODUCT. THEIR PROBLEM IS OUR MAIN ENDEAVOR TO ACHIEVE A CONTINOUS FLOW OF ORE TO OUR MILL.

[CONT'D]

WE SHOULD NOT BE JUST CONCERNED WITH THE NEARBY IMMEDIATE AREA, AS WITHIN THE NEARBY STATES, NO SUCH FACILITY IS AVAILABLE. FOR EXAMPLE THE FAMOUS CARLETON TAILING DEPOSITS IN PIOCHE, NEVADA HAS OVER 11,000,000 TONS AVAILABLE AVERAGING OVER 10,000.00 PER TON AND DUE TO LACK OF PROCESSING FACILITIES, HAS LAIN IDLE FOR MANY YEARS AS NO SMELTER CAN ACCEPT THE ORE. THE TOOLE, UTAH DEPOSIT, ALREADY MILLED AND READY FOR PROCESSING, IS EVEN MORE VALUABLE BUT CANNOT BE RECLAIMED DUE TO ENVIRONMENTAL AGENCY RESTRICTIONS BUT WOULD BE VERY AMENABLE TO OUR FOLLOWING FLOWSHEET, SAMPLES OF BOTH OF THESE ORES HAVE ALREADY BEEN EXAMINED AND PROVEN AMENABLE TO THE FOLLOWING PROCESSES.

EVEN THE PRESENT INFLATION FACTOR HAS NOT PERMITTED THE SMALL "PLACER" MINER TO EXTRACT THE GOLD WITH HIS TIME PROVEN METHODS OF JIGGING, SLUICING AND ETC. THIS PARTICULAR TYPE OF VALUES CAN BE EASILY CONCENTRATED BY THE MINER AND THAT IS WHERE HIS ABILITY STOPS. THE CONCENTRATES COULD BE BROUGHT TO THIS MILL FOR FINAL RECOVERY. THERE IS NO MILL IN THIS STATE OR IN THE SURROUNDING STATES THAT ARE CAPABLE OF CATERING TO THIS TYPE OF CLIENTLE AND IT IS VERY SORELY NEEDED. WHY HAS THIS NOT BEEN DONE BEFORE? MERELY BECAUSE THE STATE OF THE ART HAS NOT PROGRESSED TO THIS POINT ~~HERE~~ DUE TO THE FACT THAT THE PRICE LEVEL WAS NOT AS PROFITABLE TO FINACIALLY MOTIVATE ANYBODY AND NO FACILITY WAS AVAILABLE TO PROCESS THEIR ORES.

THE SUBSEQUENT FLOW SHEET SHOWS NOTHING THAT IS NOT WITHIN THE REALM OF ~~EMINATE~~ PUBLIC DOMAIN, THAT IS, NOTHING PROPRIETARY OR PATENTABLE ON THE FOLLOWING PROCESSES, HOWEVER, TO MY KNOWLEDGE, ALL OF THESE PROCESSES HAVE NEVER HERETOFORE HAVE BEEN INCLUDED IN ONE UNIT.

MARKETING OF PRODUCT :

EVERYONE MAKES LIGHT OF THIS PARTICULAR SUBJECT, HOWEVER THE WRITER'S EXPERIENCE MAKES THIS AN EXTREMELY POINT TO CONTEND WITH. FOR EXAMPLE, WHEN YOU HAVE A LARGE AMOUNT OF VALUES ON HAND AND NEED SOME TO OBTAIN OPERATING CAPITAL, THE BUYERS ARE SO ADAMANT OR ARE WITHOUT CASH, THAT THE MARKETING PRESENTS A PROBLEM. VERY FEW PEOPLE HAVE BEEN CONFRONTED WITH THIS PROBLEM, BUT I HAVE AND IT IS A VERY DIFFICULT ONE TO SOLVE. THE EXTREMELY LARGE MOGULS OF THE INDUSTRY ARE DEFINITELY NOT THE ONES TO BE DEPENDED UPON BY THE SELLERS. A FUTURES CONTRACT VIA BONDED WAREHOUSES SHOULD BE CONSIDERED AS CASH IS IMMEDIATELY FORTHCOMING. SMALL INDIVIDUAL PURCHASES SHOULD BE DISCOURAGED FOR THE TIME INVOLVED. IN COMPLETING THE PURCHASE.

THIS MARKETING PHASE IS THE VERY HEART OF ANY TYPE OF PRODUCTION AND SHOULD BE VERY CAREFULLY CONSIDERED. MANY YEARS OF EXPERIENCE ATTEST TO ABOVE.

THE PRIME PROCESS FOR TOTAL RECOVERY OF PURE GOLD & SILVER FROM ORES.

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IN LEACHER

2 liters or quarts of water.

200 grams of C5 _____

5 to 20 grams of C14 _____, or eliminated if silver not factor and slower leach can be permitted.

Up to 1 lb. of ore can be leached in above if metal present is only moderate.

NOTE: 291.66 grams (10 assay tons) is used for assay. 1 milligram is to 29.16 grams what 1 troy ounce is to 2000 lb. ore. For assay draw off 1 liter of pregnant liquor, arrive at the concentrate (following) weigh, double the weight and move the decimal point one place to left. This gives exact wt. as troy oz per ton. The reason for using only 1 liter is to avoid having to filter out the mud. Letting it settle for 1/2 hour or so will usually give clear liquor when siphoned off. If liquor from the negative electrode cylinder is to be used be sure and include this in the total volume present in the leacher, otherwise the assay will show slightly less metal than is actually present.

IN THE NEGATIVE ELECTRODE CYLINDER (3)

Fill with a saturated solution of C5 _____ just above the water line in the leacher. For mining operation apply optimum D.C. of 1 to 3 watts per six square inches of electrode area. More can be tolerated for assay. The limit is heating and/or bombardment of colloidal particles off the electrodes. This can be detected from the oily film appearing on the surface of the leach liquor which refuses to be stirred into the liquor.

With C15 _____ in squeeze bottle, periodically puff a jet of vapor over the surface of the leach liquor. When a white cloud forms this means one of several conditions. a) C21 _____ is higher than can be absorbed by the combination of metals within the ore, or b) current is too high for the metals present. Reduce current to 1/2 and after 15 minutes only a faint trace of vapor should show. If moderately high current produces no vapr after a long period suspect exhaustion of C5 _____. Add a little & hold

steady. If gassing begins again you ran out of C5, if it doesn't you have a very rich ore indeed. Continue to gas point when current is decreased almost to zero. This technique is identical to charging a lead/acid battery and also with reference to the battery it is vitally important that the current/voltage taper is complete otherwise unreacted metals will be left in the ore, the same as acid is left behind in the battery if the charge is not complete.

When leach period is complete, remove M-3 and cylinder with contents. Remove M-1. Using pH indicator paper add cylinder liquor to leach until pH therein is at least 7 - 8, but not below 7 or not above 10. If contents of cylinder is not enough add C8_____slowly. Stir and allow leacher to rotate for at least 15 minutes until complete reaction has time to conclude and all metals except gold and silver have become solids and thoroughly mixed with the mud.

Allow to settle which should produce a clear liquor in 15 minutes or so, or filter if desired. You will have a metal values in solution in the mud also and these can be rinsed out completely if so desired. For assay only 1/2 the liquor is used.

NOTE: All haze must be eliminated or impurities will be present in the recovered metals. Proper pH of at least 8 will usually do this automatically.

Transfer liquor to a clean beaker or vat and begin stirring, adjust pH with C9_____ only, to between 5 & 7. I have devised this in that manner so that in large applications it takes only minute amounts of titrating chemicals to effect selective changes and drop out unwanted metals, especially with respect to gold and silver.

I will mention this several times before I am through: The most important item is to keep a surplus always of C5 since the chart shown and all other separations ans suspensions are dependent upon presence of this chemical in surplus. Without a surplus this entire process is void.

With the liquor being stirred continuously in the beaker or vat begin slowly adding C1_____. At first you may or may not develop a slight yellow tint or a richer tint with more gold present. Then suddenly a black cloud will begin to develop. Allow the solution to reach equlibrium and add just enough more of C1 to give a slight milky appearance. This will take several minutes to develop to maximum milky density so go very slow on the last stage of adding C1. If too much C1 is added it is only wasted but does no harm otherwise since it is removed with mild heat in the final stages. A slight overage of C1 is indicated where C3 is to be used as the flocculent. C3 is the quickest and cheapest. Otherwise C2_____ _____may be used for flocculation which is much slower. 10-15 drops C3 liter is sufficient. Do not add more than this unless the suspension becomes "stubborn", then add C2, saturated solution, about 10cc per liter of liquor.

Continue stirring and in a few minutes to 1/2 hour (sooner with C3) the black floc can be seen in the white or dark background. Continue stirring until the liquid clears and black snow is evident throughout. Cease stirring and allow to settle in a large separtaory funnel or beaker. Extract concentrate at bottom of funnel only after ALL floc has settled. As a high speed substitute use a Millipore filter system (I will provide info on request) This has problems in assay but should work swiftly for mine runs. To continue---

For maximum effectiveness of the floc technique do not allow stirring device to drag over the container surface since this breaks up the floc continuously. The smaller the floc the slower it is to settle out. With Millipore it doesn't matter.

Silver floc is always small as compared to gold.

****

Now for the final stage of recovery and purification of the metals gold and silver --- and watch this carefully, there is no substitute.

Alternately flood with C16 and allow to settle several times. Then switch to C17_____several times and allow to settle. Decant and test decanted C17 for C5_____by using C10_____. Repeat until there is no indication of C5 after 60 seconds with C10 solution.

This previous paragraph may be avoided when Millipore is used but here again--for assay purposes--we might have problems, it is too early for me to tell for sure here.

SILVER

Now apply C18_____to the concentrate in sufficient volume to extract all silver. Stir several times and allow to settle. After at least 30 minutes pour C19_____off into 10 percent C20, if silver is to be saved for assay or mine run, Repeat washing until there is no indication of C18 when C20 is used as an indicator. The repeat washing to be done with C17_____.

To recover pure silver from C20, rinse out electrolyte several times with C16 _____only. Pack wet sponge in graphite crucible. Slowly heat to dryness or there will be an explosion which will scatter the contents. Reduce to metallic ingot by raising temperature to melting point of silver. This should yield spectrally pure silver if you followed the procedure.

NOTE: Where large masses of silver are leached and gold showsonly a trace not worthy of recovery or separation, colloidal silver can be treated the same as gold & silver except that it is safer to precipitate with C11. Again 10-15 drops per liter is sufficient. -----Also the silver floc recovered may be treated identical to the final gold conversion following except do not expect silver to present the bright look at the temperature gold assumes its yellow. Colloidal silver temperature will have to be about doubled in order to realize the granular silver stage.

GOLD

The clean black gold sponge remaining will probably have traces of C12_____ remaining. Place this mass in a graphite crucible. Carbon is too coarse and will hold gold granules. Raise heat VERY SLOWLY or an explosion will occur and C22 can be formed. After dryness, increase temperature until colloids begin to weld together. The gold will then turn brown, red and finally yellow as temperature is slowly increased. The cause of this penomenon is clumping of particles.

Increase heat to a dull red or black red -- very slowly -- so that the yellow stage is obtained without loss of colloidal particles to atmosphere. From here you may go on to melt and ingot. If colloidal gold is heated too quickly or before the particles have had time to adhere to one another, colloidal gold and silver will simply vanish into atmosphere. Many researchers have been fighting this for years and wondering where the money went.

This gradual increase of heat will vaporize all traces of C12_____ and it will be necessary to heat the sides of the crucible to the same temperature in order to prevent condensation of C12 and subsequent re-contamination of the gold. Your gold remaining will be from 999 plus fineness to spectrally pure if you have followed this carefully.

This concludes the prime purpose of this process. After the notes that follow you will find briefs on the remaining metals shown on the chart. Those metals and the methods for recovering them are a by-product of the above process and at this time have not been completed for mine runs except that their compounds may be recovered and converted to metals easily since in the forms they present they are easy to convert with heat and proper fluxes. I use them primarily for assay purposes at this stage.

NOTES:

WARNING: Do not allow any liquid C15 to get into the liquor at any stage since gold and silver since azides and fulminates will form which not only interfers with final recovery but presents a dangerous hazard. They are all violently explosive even in minute amounts.

For full delivery of colloidal products reduce pH to just below 7. Call it 6. Below pH 3, C1 will be wasted in mine runs.

If at least a trace of C14 is not present, silver will be lost in the leach.

Pregnant liquors of pH4.5 or under will appear yellow. at pH 5 and above even heavily pregnant liquors are clear. Follow this procedure and IGNORE COLOR OF COLLOIDAL CLOUD. It has no meaning.

If after many hours (24 or so) with a lot of metals present, no gassing occurs, suspect exhaustion of C5. Add 50 grams, wait a while & test with C15. Cloud should appear unless metals are be reacted upon. Use same current after adding C5 as you had before.

Liquor cannot be re-cycled to leacher if C2 has been used as flocculent. It can be reused if C3 or C11 is used. Never us C9 for flocculent.

For instant tests involving gold and/or silver colloids use foils such as gold leas (Elquest store) Place in C7_____. Foils go into solution instantly. Always use sequence--1st part of C7, foil, then 2nd part of C7. EXTREME DANGER HERE, DO THIS OUTSIDE, DO NOT INHALE, MOVE pH BACK TO 7-8 BEFORE RETURNING IT INSIDE BUILDING.

Direct current power supply can be half wave or pure D.C. to 14 volts. 5 to 10 volts for leach is optimum. Current should not go above .5 amps maximum, on leacher or electrodes will suffer.

BASIC CHEMICALS REQUIRED FOR MINE AND ASSAY APPLICATION FOR TOTAL RECOVERY OF PURE GOLD AND SILVER FROM ALL ORES.

General--- C1, C5, C9, C3, C14, C2 and/or C11. C8 is obtained from leach liquor.

Leach chemicals are: C5, C14, and C8.
Extraction and refinement chemicals are C1, C2 and/or C11, C3 and a small amount of C4 or C17.

Minor chemicals are: C1, C10, C14, C11 & C15. Other C numbers listed are chemicals which are either the same as above or are compounds generated during the process.

EQUIPMENT NEEDED (see drawing of leacher attached)

Leacher

1 glass or rubber lined tank rotating at the angle shown 2 to 6 rpm.
2, M-1 partly submersed in leach tank
3, Pyrex cylinder closed at bottom end with M-2.
4, An M-3 extending almost to M-2 and equal in area to submersed portion of M-1.

One tank capable of receiving clear pregnant liquor.

One slow speed stirring device for same.

One steep sided funnel for settling out gold and silver precipitate with a valve or other means at the bottom for drawing off precipitate. For tunning assay you may decant carefully.

One beaker for receiving decanted concentrates.

One plastic squeeze bottle with internal tube cut off above liquid line to be partly filled with C15 and used as an indication to determine leach end point.

One reel of pH paper, range 3 to 11 or more.

THE FOLLOWING IS FOR ATTAINMENT OF PURE METALS AND THEIR COMPOUN
FOR FIRE ASSAY AND MINE RUNS, OTHER THAN GOLD AND SILVER.

OBSERVE THE CHART ATTACHED: After conventional leach cycle.

PLATINUM:

In the presence of C5
Set pH at 3--4.5
Add C1 and C2
Precipitate floc and rinse with C4 to stand C10 test.
Discard liquor with Fe, Ni, Zn etc.
Add C3 to colloidal concentrate, soak for 30 min.
Precipitate with C2, discard liquor containing Ag, Pb, Cu.
Wash to stand C10 test with C4.
Dissolve precipitate in C7, 1st component, colloids, 2nd component.
In presence again of C5 again, Adjust pH to 8-9 with C8, precipitate of platinum will appear as white cloud.
Pre-weigh filter paper (finest grain available of Millipore.)
Filter out white platinum residue, discard solution which might contain gold.
Dry, not over 212°F, weigh, subtract paper and 34 from molecular wt. 229.2
of platinum hydroxide.
The remaining weight is metallic platinum

COPPER:

In the presence of C5.
Set pH at 3--4.5. If pH 6 or above is reached, test is ruined.
Add C1 to precipitate Au, Ag, Pt, Cu, Pb as colloids. Use in slight surplus.
Floc with C11
Discard liquor containing Fe, Ni, Zn etc.
In presence again of C5 re-dissolve colloids in C7 as with platinum above.
Adjust pH to 13 with C8.
Pre-weigh filter paper.
Filter out copper hydroxide, discard liquor or save for lead determination.
Dry and weigh as with Pt. above. Subtract 34 from molecular weight 97.56 of copper hydroxide. This gives remaining weight as metallic copper.

LEAD:

In the presence of C5
Using the liquor from previous copper test,
Adjust pH to 7-9.
Pre-weigh filter paper, filter out white precipitate and weigh as with copper removing 34 from a molecular weight of 241.43 for lead hydroxide.
Remaining weight is metallic lead.

ZINC:

After precipitation of gold, silver, copper and lead from previous tests if zinc is present it will always be left behind in solution along with iron and nickel. This liquor may be set aside or the first five top metals extracted a s colloids from the liquor with C1.
To determine zinc---in the presence of C5, adjust pH to 11.5 or above.
Filter and treat exactly as with copper and lead previous paragraphs i. e.
Adjust pH to 7-9, zinc will appear. Subtract again 34 from molecular weight of zinc hydroxide (99.40) to arrive at metal as with lead of Cu.

NOTE: Hydroxyl molecule is OH, molecular wt 17, times two is 34 or OH_2.

EXTRACTION AND EVALUATION OF PLATINUM (among others.)

Set liquor at PH3 but not more than 4 if iron is present.

Colloid with hydrosulfite

PPT with separan

Filter through Polyvic, discard liquor containing iron, zinc nickel etc.,

Rinse ppt on filter with distilled to withstand silver nitrate test.

With no vacuum on filter, steep ppt for 1 hour in nitric acid.

Pour resulting liquor into beaker if Ag, Cu or Pb is to be evaluated.

NOTE: In case Ag is wanted, shift PH to 8 to ppt Cu and Pb.

Wash original ppt on filter with distilled to again stand silver nitrate test.

Dissolve colloids remaining in Purex 5 cc, Hcl 1 cc and add potassium bromide.

Adjust pH to 8-9 with NaOH.

Ppt of platinum hydroxide will appear as a white cloud.

Pre-weigh filter, ppt is filtered out and will be light gray to tan in color.

Subtract paper weight and 34 from molecular wt of 229.25 (Pt hydroxide) to give answer.

Remaining liquor contains gold, react, filter and weigh as metal.

If liquor contains gold, reset pH at 7. Use hydrosulfite with usual procedure.

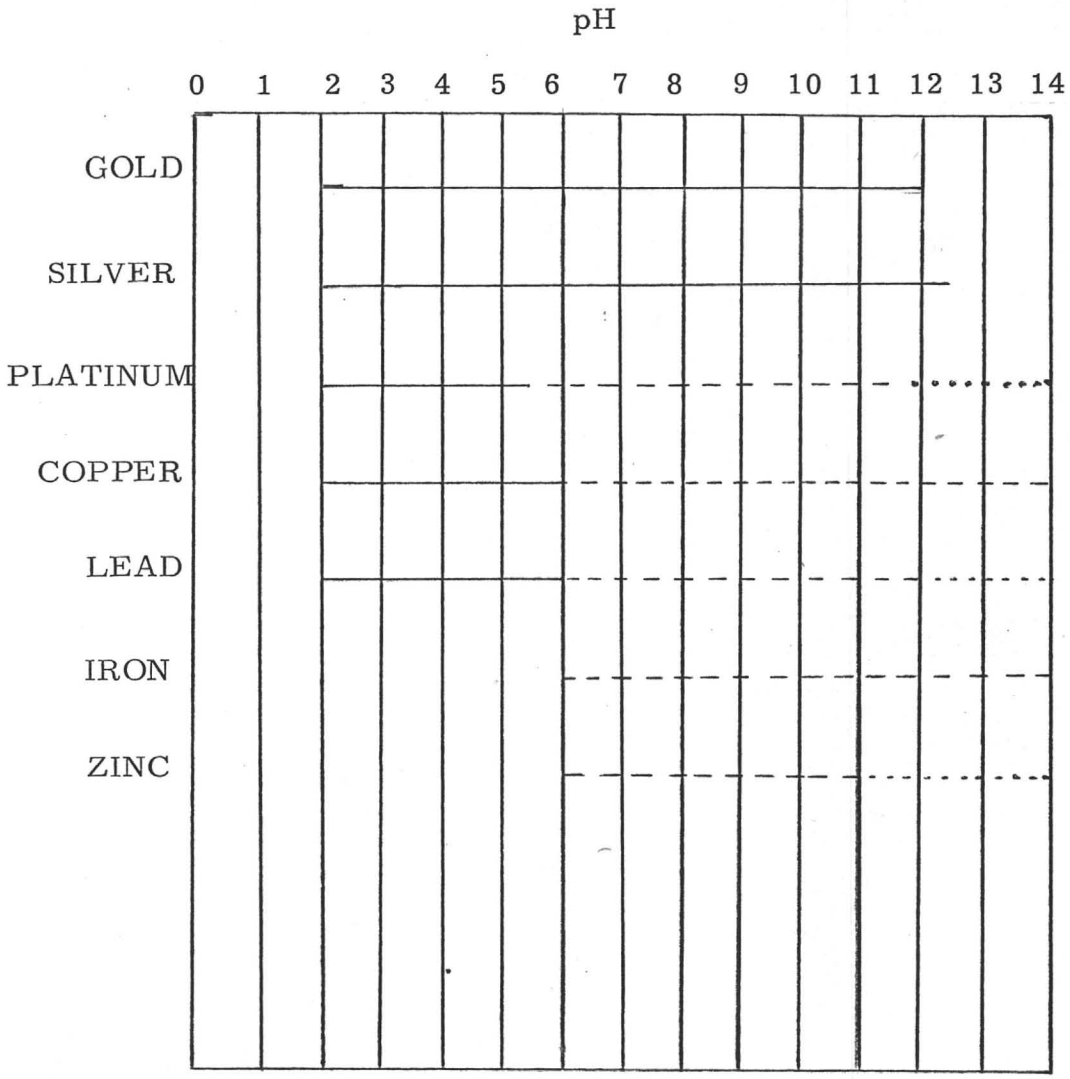
Sept. 29, 1967

CODE

	C1	Sodium Hydro-Sulfite ($Na_2S_2O_4$)
	C2	Oxalic or aluminum sulfate in saturated solution. 10cc min per liter
	C3	Nitric acid (drops) when used as flocculent. 10-15 drops per liter
	C4	Distilled water
	C5	Sodium chloride (NaC1). For cathode or negative cylinder use saturated solution/ 35 grams per 100 cc tap water.
	C6	Silver Chloride
Test	C7	5 parts chlorox or Purex to 1 part Hc1. Add chlorox first, then Hc1. Caution violent release of chlorine and hypochlorous acid. Do not inhale.
	C8	Sodium Hydroxide (NaOH), 2 normal made by mixing 80 grams to 1 liter distilled. For mine run use liquor from negative/cathode cylinder.
	C9	Hydrochloric acid (Hc1)
Test	C10	Silver nitrate, about 1/4 gram to 1 oz distilled in dropper bottle. This is used as indicator in drops to tell when all traces of C5 and other salts are out. Otherwise when C3 is used to solubilize silver from gold, C6 will form and permanently contaminate gold. This is insoluble.
	C11	Sulfuric acid H_2SO_4.
	C12	Sulfur.
	C13	Hydroxide Solids of the metals.
	C14	Potassium bromide. This holds silver in solution in presence of C5 and also increases speed of leach of other metals.
Test	C15	Ammonium hydroxide. (kitchen ammonia will do)
	C16	Tap water.
	C17	Distilled water.
	C18	Nitric acid when used to dissolve silver from gold.
	C19	Silver nitrate as formed from C18 and silver.
	C20	Sodium chloride when used as an indicator for C19
	C21	Chlorine gas.
	C22	Gold sulfide.
	M1	Graphite or carbon rod, large arc lamp type ok.
	M-2	Fine pore pyrex glass frit disc fused to pyrex tubing end.
	M-3	Nickel strip.

Note both M-1 and 3 are permanent unless M-3 is consumed by too high current which produces oily black film on top of leach that refuses to mix.

PROCESS FOR RECOVERY OF PRECIOUS METALS



KEY: Solid lines indicate metals released from solution by _____

Dashes indicate pH change alone precipitate these metals instantly as hydroxide solids. - in presence of C5

Dots indicate metal hydroxides that go back into solution again at high pH shown. These metals are know as amphoteric for their ability of being soluble at both extremes of the pH scale.

THE PRIME PROCESS FOR TOTAL RECOVERY OF PURE GOLD & SILVER FROM ORES.

While this process may seem complicated, in reality it is very simple when compared to the limitations imposed by other processes. This is a four phase system comprising a liquid state, a selective solid metallic state, selective solid hydroxyl and selective liquid hydroxyl states. These four states are controlled by only four chemicals. The chemicals in addition to these are for control and testing.

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The ore should be pulverized to at least 300 mesh, or finer if possible. The following components can be expanded to any volume if necessary. All components can be added dry to the tap water.

IN LEACHER

2 liters or quarts of water.

200 grams of C5_____

5 to 20 grams of C14_____, or eliminated if silver not factor and slower leach can be permitted.

Up to 1 lb. of ore can be leached in above if metal present is only moderate.

NOTE: 291.66 grams (10 assay tons) is used for assay. 1 milligram is to 29.16 grams what 1 troy ounce is to 2000 lb. ore. For assay draw off 1 liter of pregnant liquor, arrive at the concentrate (following) weigh, double the weight and move the decimal point one place to left. This gives exact wt. as troy oz per ton. The reason for using only 1 liter is to avoid having to filter out the mud. Letting it settle for 1/2 hour or so will usually give clear liquor when siphoned off. If liquor from the negative electrode cylinder is to be used be sure and include this in the total volume present in the leacher, otherwise the assay will show slightly less metal than is actually present.

IN THE NEGATIVE ELECTRODE CYLINDER (3)

Fill with a saturated solution of C5_____just above the water line in the leacher. For mining operation apply optimum D.C. of 1 to 3 watts per six square inches of electrode area. More can be tolerated for assay. The limit is heating and/or bombardment of colloidal particles off the electrodes. This can be detected from the oily film appearing on the surface of the leach liquor which refuses to be stirred into the liquor.

With C15_____in squeeze bottle, periodically puff a jet of vapor over the surface of the leach liquor. When a white cloud forms this means one of several conditions. a) C21_____is higher than can be absorbed by the combination of metals within the ore, or b) current is too high for the metals present. Reduce current to 1/2 and after 15 minutes only a faint trace of vapor should show. If moderately high current produces no vapr after a long period suspect exhaustion of C5_____. Add a little & hold

steady. If gassing begins again you ran out of C5, if it doesn't you have a very rich ore indeed. Continue to gas point when current is decreased almost to zero. This technique is identical to charging a lead/acid battery and also with reference to the battery it is vitally important that the current/voltage taper is complete otherwise unreacted metals will be left in the ore, the same as acid is left behind in the battery if the charge is not complete.

When leach period is complete, remove M-3 and cylinder with contents. Remove M-1. Using pH indicator paper add cylinder liquor to leach until pH therein is at least 7 - 8, but not below 7 or not above 10. If contents of cylinder is not enough add C8_____slowly. Stir and allow leacher to rotate for at least 15 minutes until complete reaction has time to conclude and all metals except gold and silver have become solids and thoroughly mixed with the mud.

Allow to settle which should produce a clear liquor in 15 minutes or so, or filter if desired. You will have a metal values in solution in the mud also and these can be rinsed out completely if so desired. For assay only 1/2 the liquor is used.

NOTE: All haze must be eliminated or impurities will be present in the recovered metals. Proper pH of at least 8 will usually do this automatically.

Transfer liquor to a clean beaker or vat and begin stirring, adjust pH with C9_____ only, to between 5 & 7. I have devised this in that manner so that in large applications it takes only minute amounts of titrating chemicals to effect selective changes and drop out unwanted metals, especially with respect to gold and silver.

I will mention this several times before I am through: The most important item is to keep a surplus always of C5 since the chart shown and all other separations ans suspensions are dependent upon presence of this chemical in surplus. Without a surplus this entire process is void.

With the liquor being stirred continuously in the beaker or vat begin slowly adding C1_____. At first you may or may not develop a slight yellow tint or a richer tint with more gold present. Then suddenly a black cloud will begin to develop. Allow the solution to reach equlibrium and add just enough more of C1 to give a slight milky appearance. This will take several minutes to develop to maximum milky density so go very slow on the last stage of adding C1. If too much C1 is added it is only wasted but does no harm otherwise since it is removed with mild heat in the final stages. A slight overage of C1 is indicated where C3 is to be used as the flocculent. C3 is the quickest and cheapest. Otherwise C2_____ may be used for flocculation which is much slower. 10-15 drops C3 liter is sufficient. Do not add more than this unless the suspension becomes "stubborn", then add C2, saturated solution, about 10cc per liter of liquor.

Continue stirring and in a few minutes to 1/2 hour (sooner with C3) the black floc can be seen in the white or dark background. Continue stirring until the liquid clears and black snow is evident throughout. Cease stirring and allow to settle in a large separtaory funnel or beaker. Extract concentrate at bottom of funnel only after ALL floc has settled. As a high speed substitute use a Millipore filter system (I will provide info on request) This has problems in assay but should work swiftly for mine runs. To continue---

For maximum effectiveness of the floc technique do not allow stirring device to drag over the container surface since this breaks up the floc continuously. The smaller the floc the slower it is to settle out. With Millipore it doesn't matter.

Silver floc is always small as compared to gold.

****

Now for the final stage of recovery and purification of the metals gold and silver --- and watch this carefully, there is no substitute.

Alternately flood with C16 and allow to settle several times. Then switch to C17_____several times and allow to settle. Decant and test decanted C17 for C5_____by using C10_____. Repeat until there is no indication of C5 after 60 seconds with C10 solution.

This previous paragraph may be avoided when Millipore is used but here again--for assay purposes--we might have problems, it is too early for me to tell for sure here.

SILVER

Now apply C18_____to the concentrate in sufficient volume to extract all silver. Stir several times and allow to settle. After at least 30 minutes pour C19_____off into 10 percent C20, if silver is to be saved for assay or mine run, Repeat washing until there is no indication of C18 when C20 is used as an indicator. The repeat washing to be done with C17_____.

To recover pure silver from C20, rinse out electrolyte several times with C16 _____only. Pack wet sponge in graphite crucible. Slowly heat to dryness or there will be an explosion which will scatter the contents. Reduce to metallic ingot by raising temperature to melting point of silver. This should yield spectrally pure silver if you followed the procedure.

NOTE: Where large masses of silver are leached and gold showsonly a trace not worthy of recovery or separation, colloidal silver can be treated the same as gold & silver except that it is safer to precipitate with C11. Again 10-15 drops per liter is sufficient. -----Also the silver floc recovered may be treated identical to the final gold conversion following except do not expect silver to present the bright look at the temperature gold assumes its yellow. Colloidal silver temperature will have to be about doubled in order to realize the granular silver stage.

GOLD

The clean black gold sponge remaining will probably have traces of C12_____ remaining. Place this mass in a graphite crucible. Carbon is too coarse and will hold gold granules. Raise heat VERY SLOWLY or an explosion will occur and C22 can be formed. After dryness, increase temperature until colloids begin to weld together. The gold will then turn brown, red and finally yellow as temperature is slowly increased. The cause of this penomenon is clumping of particles.

Increase heat to a dull red or black red -- very slowly -- so that the yellow stage is obtained without loss of colloidal particles to atmosphere. From here you may go on to melt and ingot. If colloidal gold is heated too quickly or before the particles have had time to adhere to one another, colloidal gold and silver will simply vanish into atmosphere. Many researchers have been fighting this for years and wondering where the money went.

This gradual increase of heat will vaporize all traces of C12_____ and it will be necessary to heat the sides of the crucible to the same temperature in order to prevent condensation of C12 and subsequent re-contamination of the gold. Your gold remaining will be from 999 plus fineness to spectrally pure if you have followed this carefully.

This concludes the prime purpose of this process. After the notes that follow you will find briefs on the remaining metals shown on the chart. Those metals and the methods for recovering them are a by-product of the above process and at this time have not been completed for mine runs except that their compounds may be recovered and converted to metals easily since in the forms they present they are easy to convert with heat and proper fluxes. I use them primarily for assay purposses at this stage.

NOTES:

WARNING: Do not allow any liquid C15 to get into the liquor at any stage since gold and silver since azides and fulminates will form which not only interfers with final recovery but presents a dangerous hazard. They are all violently explosive even in minute amounts.

For full delivery of colloidal products reduce pH to just below 7. Call it 6. Below pH 3, C1 will be wasted in mine runs.

If at least a trace of C14 is not present, silver will be lost in the leach.

Pregnant liquors of pH4.5 or under will appear yellow. at pH 5 and above even heavily pregnant liquors are clear. Follow this procedure and IGNORE COLOR OF COLLOIDAL CLOUD. It has no meaning.

If after many hours (24 or so) with a lot of metals present, no gassing occurs, suspect exhaustion of C5. Add 50 grams, wait a while & test with C15. Cloud should appear unless metals are be reacted upon. Use same current after adding C5 as you had before.

Liquor cannot be re-cycled to leacher if C2 has been used as flocculent. It can be reused if C3 or C11 is used. Never us C9 for flocculent.

For instant tests involving gold and/or silver colloids use foils such as gold leas (Elquest store) Place in C7_____. Foils go into solution instantly. Always use sequence--1st part of C7, foil, then 2nd part of C7. EXTREME DANGER HERE, DO THIS OUTSIDE, DO NOT INHALE, MOVE pH BACK TO 7-8 BEFORE RETURNING IT INSIDE BUILDING.

Direct current power supply can be half wave or pure D.C. to 14 volts. 5 to 10 volts for leach is optimum. Current should not go above .5 amps maximum, on leacher or electrodes will suffer.

BASIC CHEMICALS REQUIRED FOR MINE AND ASSAY APPLICATION FOR TOTAL RECOVERY OF PURE GOLD AND SILVER FROM ALL ORES.

General--- C1, C5, C9, C3, C14, C2 and/or C11. C8 is obtained from leach liquor.

Leach chemicals are: C5, C14, and C8.
Extraction and refinement chemicals are C1, C2 and/or C11, C3 and a small amount of C4 or C17.

Minor chemicals are: C1, C10, C14, C11 & C15. Other C numbers listed are chemicals which are either the same as above or are compounds generated during the process.

EQUIPMENT NEEDED (see drawing of leacher attached)

Leacher
1 glass or rubber lined tank rotating at the angle shown 2 to 6 rpm.
2, M-1 partly submersed in leach tank
3, Pyrex cylinder closed at bottom end with M-2.
4, An M-3 extending almost to M-2 and equal in area to submersed portion of M-1.

One tank capable of receiving clear pregnant liquor.

One slow speed stirring device for same.

One steep sided funnel for settling out gold and silver precipitate with a valve or other means at the bottom for drawing off precipitate. For tunning assay you may decant carefully.

One beaker for receiving decanted concentrates.

One plastic squeeze bottle with internal tube cut off above liquid line to be partly filled with C15 and used as an indication to determine leach end point.

One reel of pH paper, range 3 to 11 or more.

THE FOLLOWING IS FOR ATTAINMENT OF PURE METALS AND THEIR COMPOUNI
FOR FIRE ASSAY AND MINE RUNS, OTHER THAN GOLD AND SILVER.

OBSERVE THE CHART ATTACHED: After conventional leach cycle.

PLATINUM:

In the presence of C5
Set pH at 3--4.5
Add C1 and C2
Precipitate floc and rinse with C4 to stand C10 test.
Discard liquor with Fe, Ni, Zn etc.
Add C3 to colloidal concentrate, soak for 30 min.
Precipitate with C2, discard liquor containing Ag, Pb, Cu.
Wash to stand C10 test with C4.
Dissolve precipitate in C7, 1st component, colloids, 2nd component.
In presence again of C5 again, Adjust pH to 8-9 with C8, precipitate of platinum will appear as white cloud.
Pre-weigh filter paper (finest grain available of Millipore.)
Filter out white platinum residue, discard solution which might contain gold.
Dry, not over 212°F, weigh, subtract paper and 34 from molecular wt. 229.25 of platinum hydroxide.
The remaining weight is metallic platinum

COPPER:

In the presence of C5.
Set pH at 3--4.5. If pH 6 or above is reached, test is ruined.
Add C1 to precipitate Au, Ag, Pt, Cu, Pb as colloids. Use in slight surplus.
Floc with C11
Discard liquor containing Fe, Ni, Zn etc.
In presence again of C5 re-dissolve colloids in C7 as with platinum above.
Adjust pH to 13 with C8.
Pre-weigh filter paper.
Filter out copper hydroxide, discard liquor or save for lead determination.
Dry and weigh as with Pt. above. Subtract 34 from molecular weight 97.56 of copper hydroxide. This gives remaining weight as metallic copper.

LEAD:

In the presence of C5
Using the liquor from previous copper test,
Adjust pH to 7-9.
Pre-weigh filter paper, filter out white precipitate and weigh as with copper removing 34 from a molecular weight of 241.43 for lead hydroxide.
Remaining weight is metallic lead.

ZINC:

After precipitation of gold, silver, copper and lead from previous tests if zinc is present it will always be left behind in solution along with iron and nickel. This liquor may be set aside or the first five top metals extracted a s colloids from the liquor with C1.
To determine zinc---in the presence of C5, adjust pH to 11.5 or above. Filter and treat exactly as with copper and lead previous paragraphs i.e. Adjust pH to 7-9, zinc will appear. Subtract again 34 from molecular weight of zinc hydroxide (99.40) to arrive at metal as with lead of Cu.

NOTE: Hydroxyl molecule is OH, molecular wt 17, times two is 34 or OH_2.

EXTRACTION AND EVALUATION OF PLATINUM (among others.)

Set liquor at PH3 but not more than 4 if iron is present.

Colloid with hydrosulfite

PPT with separan

Filter through Polyvic, discard liquor containing iron, zinc nickel etc.,

Rinse ppt on filter with distilled to withstand silver nitrate test.

With no vacuum on filter, steep ppt for 1 hour in nitric acid.

Pour resulting liquor into beaker if Ag, Cu or Pb is to be evaluated.

NOTE: In case Ag is wanted, shift PH to 8 to ppt Cu and Pb.

Wash original ppt on filter with distilled to again stand silver nitrate test.

Dissolve colloids remaining in Purex 5 cc, Hcl 1 cc and add potassium bromide.

Adjust pH to 8-9 with NaOH.

Ppt of platinum hydroxide will appear as a white cloud.

Pre-weigh filter, ppt is filtered out and will be light gray to tan in color.

Subtract paper weight and 34 from molecular wt of 229.25 (Pt hydroxide) to give answer.

Remaining liquor contains gold, react, filter and weigh as metal.

If liquor contains gold, reset pH at 7. Use hydrosulfite with usual procedure.

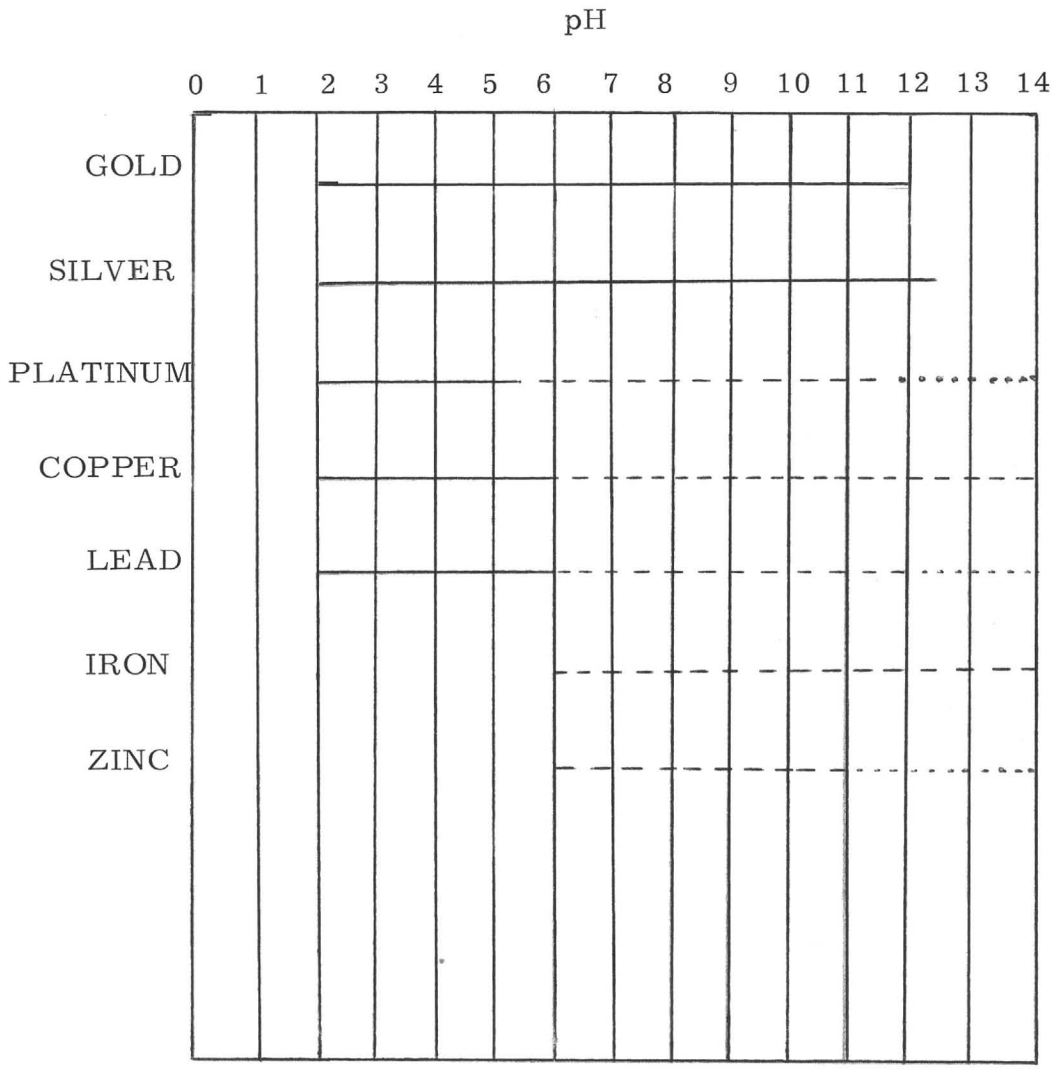
Sept. 29, 1967

CODE

	C1	Sodium Hydro-Sulfite ($Na_2S_2O_4$)
	C2	Oxalic or aluminum sulfate in saturated solution. 10cc min per liter
	C3	Nitric acid (drops) when used as flocculent. 10-15 drops per liter
	C4	Distilled water
	C5	Sodium chloride (NaC1). For cathode or negative cylinder use saturated solution/ 35 grams per 100 cc tap water.
	C6	Silver Chloride
Test	C7	5 parts chlorox or Purex to 1 part Hc1. Add chlorox first, then Hc1. Caution violent release of chlorine and hypochlorous acid. Do not inhale.
	C8	Sodium Hydroxide (NaOH), 2 normal made by mixing 80 grams to 1 liter distilled. For mine run use liquor from negative/cathode cylinder.
	C9	Hydrochloric acid (Hc1)
Test	C10	Silver nitrate, about 1/4 gram to 1 oz distilled in dropper bottle. This is used as indicator in drops to tell when all traces of C5 and other salts are out. Otherwise when C3 is used to solubilize silver from gold, C6 will form and permanently contaminate gold. This is insoluble.
	C11	Sulfuric acid H_2SO_4.
	C12	Sulfur.
	C13	Hydroxide Solids of the metals.
	C14	Potassium bromide. This holds silver in solution in presence of C5 and also increases speed of leach of other metals.
Test	C15	Ammonium hydroxide. (kitchen ammonia will do)
	C16	Tap water.
	C17	Distilled water.
	C18	Nitric acid when used to dissolve silver from gold.
	C19	Silver nitrate as formed from C18 and silver.
	C20	Sodium chloride when used as an indicator for C19
	C21	Chlorine gas.
	C22	Gold sulfide.
	M1	Graphite or carbon rod, large arc lamp type ok.
	M-2	Fine pore pyrex glass frit disc fused to pyrex tubing end.
	M-3	Nickel strip.

Note both M-1 and 3 are permanent unless M-3 is consumed by too high current which produces oily black film on top of leach that refuses to mix.

PROCESS FOR RECOVERY OF PRECIOUS METALS



KEY: Solid lines indicate metals released from solution by _____

Dashes indicate pH change alone precipitate these metals instantly as hydroxide solids. - in presence of C5

Dots indicate metal hydroxides that go back into solution again at high pH shown. These metals are know as amphoteric for their ability of being soluble at both extremes of the pH scale.

THE PRIME PROCESS FOR TOTAL RECOVERY OF PURE GOLD & SILVER FROM ORES.

While this process may seem complicated, in reality it is very simple when compared to the limitations imposed by other processes. This is a four phase system comprising a liquid state, a selective solid metallic state, selective solid hydroxyl and selective liquid hydroxyl states. These four states are controlled by only four chemicals. The chemicals in addition to these are for control and testing.

****

The ore should be pulverized to at least 300 mesh, or finer if possible. The following components can be expanded to any volume if necessary. All components can be added dry to the tap water.

IN LEACHER

2 liters or quarts of water.

200 grams of C5_____

5 to 20 grams of C14_____, or eliminated if silver not factor and slower leach can be permitted.

Up to 1 lb. of ore can be leached in above if metal present is only moderate.

NOTE: 291.66 grams (10 assay tons) is used for assay. 1 milligram is to 29.16 grams what 1 troy ounce is to 2000 lb. ore. For assay draw off 1 liter of pregnant liquor, arrive at the concentrate (following) weigh, double the weight and move the decimal point one place to left. This gives exact wt. as troy oz per ton. The reason for using only 1 liter is to avoid having to filter out the mud. Letting it settle for 1/2 hour or so will usually give clear liquor when siphoned off. If liquor from the negative electrode cylinder is to be used be sure and include this in the total volume present in the leacher, otherwise the assay will show slightly less metal than is actually present.

IN THE NEGATIVE ELECTRODE CYLINDER (3)

Fill with a saturated solution of C5_____just above the water line in the leacher. For mining operation apply optimum D.C. of 1 to 3 watts per six square inches of electrode area. More can be tolerated for assay. The limit is heating and/or bombardment of colloidal particles off the electrodes. This can be detected from the oily film appearing on the surface of the leach liquor which refuses to be stirred into the liquor.

With C15_____ in squeeze bottle, periodically puff a jet of vapor over the surface of the leach liquor. When a white cloud forms this means one of several conditions. a) C21_____is higher than can be absorbed by the combination of metals within the ore, or b) current is too high for the metals present. Reduce current to 1/2 and after 15 minutes only a faint trace of vapor should show. If moderately high current produces no vapr after a long period suspect exhaustion of C5 . Add a little & hold

steady. If gassing begins again you ran out of C5, if it doesn't you have a very rich ore indeed. Continue to gas point when current is decreased almost to zero. This technique is identical to charging a lead/acid battery and also with reference to the battery it is vitally important that the current/voltage taper is complete otherwise unreacted metals will be left in the ore, the same as acid is left behind in the battery if the charge is not complete.

When leach period is complete, remove M-3 and cylinder with contents. Remove M-1. Using pH indicator paper add cylinder liquor to leach until pH therein is at least 7 - 8, but not below 7 or not above 10. If contents of cylinder is not enough add C8_____ slowly. Stir and allow leacher to rotate for at least 15 minutes until complete reaction has time to conclude and all metals except gold and silver have become solids and thoroughly mixed with the mud.

Allow to settle which should produce a clear liquor in 15 minutes or so, or filter if desired. You will have a metal values in solution in the mud also and these can be rinsed out completely if so desired. For assay only 1/2 the liquor is used.

NOTE: All haze must be eliminated or impurities will be present in the recovered metals. Proper pH of at least 8 will usually do this automatically.

Transfer liquor to a clean beaker or vat and begin stirring, adjust pH with C9_____ only, to between 5 & 7. I have devised this in that manner so that in large applications it takes only minute amounts of titrating chemicals to effect selective changes and drop out unwanted metals, especially with respect to gold and silver.

I will mention this several times before I am through: The most important item is to keep a surplus always of C5 since the chart shown and all other separations ans suspensions are dependent upon presence of this chemical in surplus. Withou a surplus this entire process is void.

With the liquor being stirred continuously in the beaker or vat begin slowly adding C1_____. At first you may or may not develop a slight yellow tint or a richer tint with more gold present. Then suddenly a black cloud will begin to develop. Allow the solution to reach equlibrium and add just enough more of C1 to give a slight milky appearance. This will take several minutes to develop to maximum milky density so go very slow on the last stage of adding C1. If too muc C1 is added it is only wasted but does no harm otherwise since it is removed with mild heat in the final stages. A slight overage of C1 is indicated where C3 is to be used as the flocculent. C3 is the quickest and cheapest. Otherwise C2 _____ may be used for flocculation which is much slower. 10-15 drops C3 liter is sufficient. Do not add more than this unless the suspension becomes "stubborn", then add C2, saturated solution, about 10cc per liter of liquor.

Continue stirring and in a few minutes to 1/2 hour (sooner with C3) the black floc can be seen in the white or dark background. Continue stirring until the liquid clears and black snow is evident throughout. Cease stirring and allow to settle in a large separtaory funnel or beaker. Extract concentrate at bottom of funnel only after ALL floc has settled. As a high speed substitute use a Millipore filter system (I will provide info on request) This has problems in assay but should work swiftly for mine runs. To continue---

For maximum effectiveness of the floc technique do not allow stirring device to drag over the container surface since this breaks up the floc continuously. The smaller the floc the slower it is to settle out. With Millipore it doesn't matter.

Silver floc is always small as compared to gold.

****

Now for the final stage of recovery and purification of the metals gold and silver --- and watch this carefully, there is no substitute.

Alternately flood with C16 and allow to settle several times. Then switch to C17_____ several times and allow to settle. Decant and test decanted C17 for C5_____ by using C10_____. Repeat until there is no indication of C5 after 60 seconds with C10 solution.

This previous paragraph may be avoided when Millipore is used but here again--for assay purposes--we might have problems, it is too early for me to tell for sure here.

SILVER

Now apply C18_____ to the concentrate in sufficient volume to extract all silver. Stir several times and allow to settle. After at least 30 minutes pour C19_____ off into 10 percent C20, if silver is to be saved for assay or mine run, Repeat washing until there is no indication of C18 when C20 is used as an indicator. The repeat washing to be done with C17_____

To recover pure silver from C20, rinse out electrolyte several times with C16 _____ only. Pack wet sponge in graphite crucible. Slowly heat to dryness or there will be an explosion which will scatter the contents. Reduce to metallic ingot by raising temperature to melting point of silver. This should yield spectrally pure silver if you followed the procedure.

NOTE: Where large masses of silver are leached and gold showsonly a trace not worthy of recovery or separation, colloidal silver can be treated the same as gold & silver except that it is safer to precipitate with C11. Again 10-15 drops per liter is sufficient. -----Also the silver floc recovered may be treated identical to the final gold conversion following except do not expect silver to present the bright look at the temperature gold assumes its yellow. Colloidal silver temperature will have to be about doubled in order to realize the granular silver stage.

GOLD

The clean black gold sponge remaining will probably have traces of C12_____ remaining. Place this mass in a graphite crucible. Carbon is too coarse and will hold gold granules. Raise heat VERY SLOWLY or an explosion will occur and C22 can be formed. After dryness, increase temperature until colloids begin to weld together. The gold will then turn brown, red and finally yellow as temperatur is slowly increased. The cause of this penomenon is clumping of particles.

Increase heat to a dull red or black red -- very slowly -- so that the yellow stage is obtained without loss of colloidal particles to atmosphere. From here you may go on to melt and ingot. If colloidal gold is heated too quickly or before the particles have had time to adhere to one another, colloidal gold and silver will simply vanish into atmosphere. Many researchers have been fighting this for years and wondering where the money went.

This gradual increase of heat will vaporize all traces of C12_____ and it will be necessary to heat the sides of the crucible to the same temperature in order to prevent condensation of C12 and subsequent re-contamination of the go Your gold remaining will be from 999 plus fineness to spectrally pure if you have followed this carefully.

This concludes the prime purpose of this process. After the notes that follow you will find briefs on the remaining metals shown on the chart. Those metals and the methods for recovering them are a by-product of the above process and at this time have not been completed for mine runs except that their compounds may be recovered and converted to metals easily since in the forms they present they are easy to convert with heat and proper fluxes. I use them primarily for assay purposses at this sage.

NOTES:

WARNING: Do not allow any liquid C15 to get into the liquor at any stage since gold and silver since azides and fulminates will form which not only interfers with final recovery but presents a dangerous hazard. They are all violently explosive even in minute amounts.

For full delivery of colloidal products reduce pH to just below 7. Call it 6. Below pH 3, C1 will be wasted in mine runs.

If at least a trace of C14 is not present, silver will be lost in the leach.

Pregnant liquors of pH4. 5 or under will appear yellow. at pH 5 and above even heavily pregnant liquors are clear. Follow this procedure and IGNORE COLOR OF COLLOIDAL CLOUD. It has no meaning.

If after many hours (24 or so) with a lot of metals present, no gassing occurs, suspect exhaustion of C5. Add 50 grams, wait a while & test with C15. Cloud should appear unless metals are be reacted upon. Use same current after adding C5 as you had before.

Liquor cannot be re-cycled to leacher if C2 has been used as flocculent. It can be reused if C3 or C11 is used. Never us C9 for flocculent.

For instant tests involving gold and/or silver colloids use foils such as gold leas (Elquest store) Place in C7_____. Foils go into solution instantly. Always use sequence--1st part of C7, foil, then 2nd part of C7. EXTREME DANGER HERE, DO THIS OUTSIDE, DO NOT INHALE, MOVE pH BACK TO 7-8 BEFORE RETURNING IT INSIDE BUILDING.

Direct current power supply can be half wave or pure D. C. to 14 volts. 5 to 10 volts for leach is optimum. Current should not go above . 5 amps maximum, on leacher or electrodes will suffer.

THE FOLLOWING IS FOR ATTAINMENT OF PURE METALS AND THEIR COMPOU
FOR FIRE ASSAY AND MINE RUNS, OTHER THAN GOLD AND SILVER.

OBSERVE THE CHART ATTACHED: After conventional leach cycle.

PLATINUM:

In the presence of C5
Set pH at 3--4.5
Add C1 and C2
Precipitate floc and rinse with C4 to stand C10 test.
Discard liquor with Fe, Ni, Zn etc.
Add C3 to colloidal concentrate, soak for 30 min.
Precipitate with C2, discard liquor containing Ag, Pb, Cu.
Wash to stand C10 test with C4.
Dissolve precipitate in C7, 1st component, colloids, 2nd component.
In presence again of C5 again, Adjust pH to 8-9 with C8, precipitate of platinum will appear as white cloud.
Pre-weigh filter paper (finest grain available of Millipore.)
Filter out white platinum residue, discard solution which might contain gd
Dry, not over 212°F, weigh, subtract paper and 34 from molecular wt. 22
of platinum hydroxide.
The remaining weight is metallic platinum

COPPER:

In the presence of C5.
Set pH at 3--4.5. If pH 6 or above is reached, test is ruined.
Add C1 to precipitate Au, Ag, Pt, Cu, Pb as colloids. Use in slight surplu
Floc with C11
Discard liquor containing Fe, Ni, Zn etc.
In presence again of C5 re-dissolve colloids in C7 as with platinum above.
Adjust pH to 13 with C8.
Pre-weigh filter paper.
Filter out copper hydroxide, discard liquor or save for lead determinatio
Dry and weigh as with Pt. above. Subtract 34 from molecular weight 97.5
of copper hydroxide. This gives remaining weight as metallic copper.

LEAD:

In the presence of C5
Using the liquor from previous copper test,
Adjust pH to 7-9.
Pre-weigh filter paper, filter out white precipitate and weigh as with copper removing 34 from a molecular weight of 241.43 for lead hydroxide
Remaining weight is metallic lead.

ZINC:

After precipitation of gold, silver, copper and lead from previous tests if zinc is present it will always be left behind in solution along with iron and nickel. This liquor may be set aside or the first five top metals extracted a s colloids from the liquor with C1.
To determine zinc---in the presence of C5, adjust pH to 11.5 or above.
Filter and treat exactly as with copper and lead previous paragraphs i. e.
Adjust pH to 7-9, zinc will appear. Subtract again 34 from molecular weight of zinc hydroxide (99.40) to arrive at metal as with lead of Cu.

BASIC CHEMICALS REQUIRED FOR MINE AND ASSAY APPLICATION FOR TOTAL RECOVERY OF PURE GOLD AND SILVER FROM ALL ORES.

General--- C1, C5, C9, C3, C14, C2 and/or C11. C8 is obtained from leach liquor.

Leach chemicals are: C5, C14, and C8.
Extraction and refinement chemicals are C1, C2 and/or C11, C3 and a small amount of C4 or C17.

Minor chemicals are: C1, C10, C14, C11 & C15. Other C numbers listed are chemicals which are either the same as above or are compounds generated during the process.

EQUIPMENT NEEDED (see drawing of leacher attached)

Leacher
1 glass or rubber lined tank rotating at the angle shown 2 to 6 rpm.
2, M-1 partly submersed in leach tank
3, Pyrex cylinder closed at bottom end with M-2.
4, An M-3 extending almost to M-2 and equal in area to submersed portion of M-1.

One tank capable of receiving clear pregnant liquor.

One slow speed stirring device for same.

One steep sided funnel for settling out gold and silver precipitate with a valve or other means at the bottom for drawing off precipitate. For tunning assay you may decant carefully.

One beaker for receiving decanted concentrates.

One plastic squeeze bottle with internal tube cut off above liquid line to be partly filled with C15 and used as an indication to determine leach end point.

One reel of pH paper, range 3 to 11 or more.

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34 Colonia Miramonte
Scottsdale, Ariz. 85253
(602) 948-5117

EXTRACTION AND EVALUATION OF PLATINUM (among others.)

Set liquor at PH3 but not more than 4 if iron is present.

Colloid with hydrosulfite

PPT with separan

Filter through Polyvic, discard liquor containing iron, zinc nickel etc.,

Rinse ppt on filter with distilled to withstand silver nitrate test.

With no vacuum on filter, steep ppt for 1 hour in nitric acid.

Pour resulting liquor into beaker if Ag, Cu or Pb is to be evaluated.

NOTE: In case Ag is wanted, shift PH to 8 to ppt Cu and Pb.

Wash original ppt on filter with distilled to again stand silver nitrate test.

Dissolve colloids remaining in Purex 5 cc, Hcl 1 cc and add potassium bromide.

Adjust pH to 8-9 with NaOH.

Ppt of platinum hydroxide will appear as a white cloud.

Pre-weigh filter, ppt is filtered out and will be light gray to tan in color.

Subtract paper weight and 34 from molecular wt of 229.25 (Pt hydroxide) to give answer.

Remaining liquor contains gold, react, filter and weigh as metal.

If liquor contains gold, reset pH at 7. Use hydrosulfite with usual procedure.

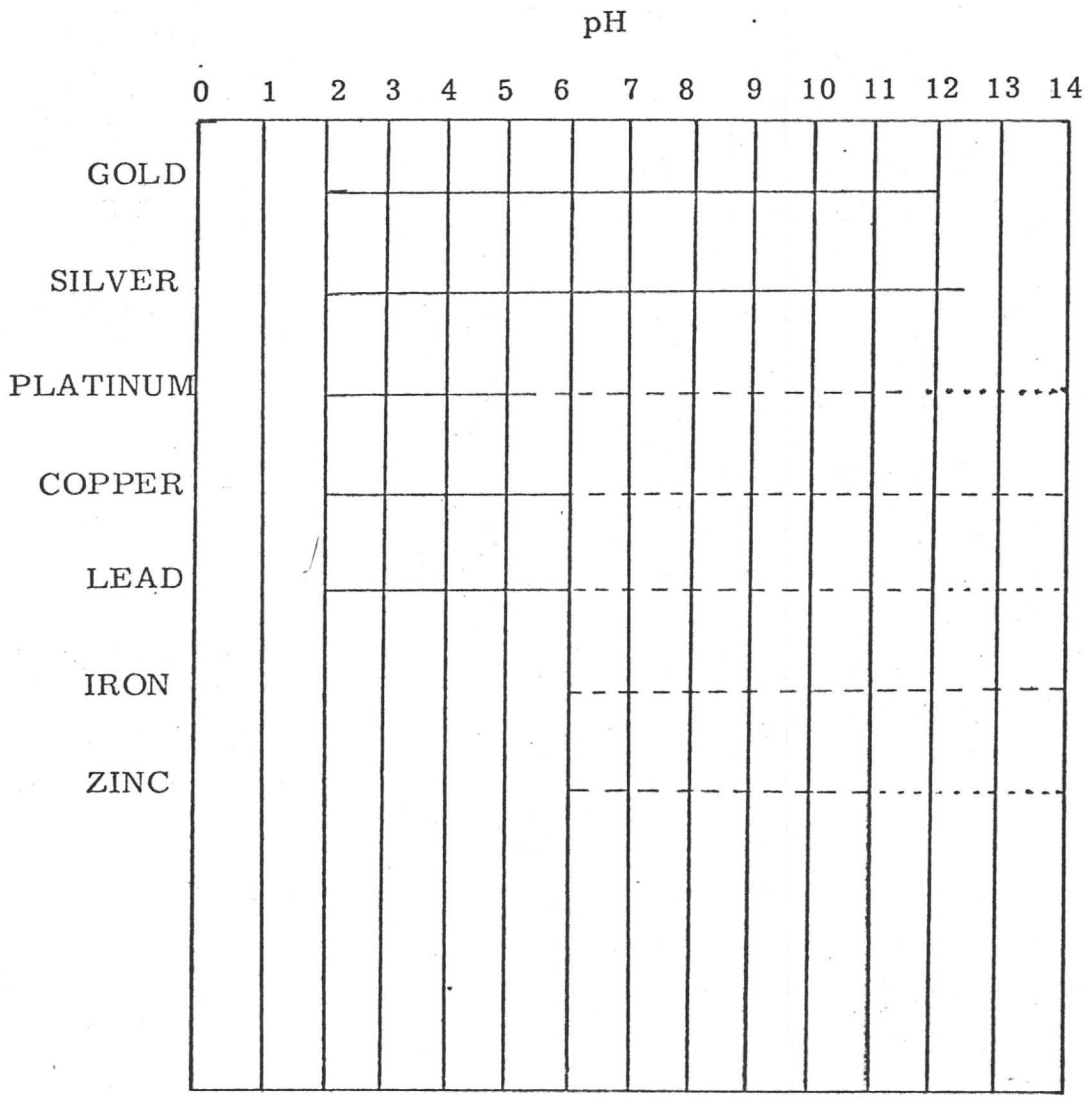
Sept. 29, 1967

CODE

	C1	Sodium Hydro-Sulfite ($Na_2S_2O_4$)
	C2	Oxalic or aluminum sulfate in saturated solution. 10cc min per liter
	C3	Nitric acid (drops) when used as flocculent. 10-15 drops per liter
	C4	Distilled water
	C5	Sodium chloride (NaC1). For cathode or negative cylinder use saturated solution/ 35 grams per 100 cc tap water.
	C6	Silver Chloride
Test	C7	5 parts chlorox or Purex to 1 part Hc1. Add chlorox first, then Hc1. Caution violent release of chlorine and hypochlorous acid. Do not inhale.
	C8	Sodium Hydroxide (NaOH), 2 normal made by mixing 80 grams to 1 liter distilled. For mine run use liquor from negative/cathode cylinder.
	C9	Hydrochloric acid (Hc1)
Test	C10	Silver nitrate, about 1/4 gram to 1 oz distilled in dropper bottle. This is used as indicator in drops to tell when all traces of C5 and other salts are out. Otherwise when C3 is used to solubilize silver from gold, C6 will form and permanently contaminate gold. This is insoluble.
	C11	Sulfuric acid H_2SO_4.
	C12	Sulfur.
	C13	Hydroxide Solids of the metals.
	C14	Potassium bromide. This holds silver in solution in presence of C5 and also increases speed of leach of other metals.
Test	C15	Ammonium hydroxide. (kitchen ammonia will do)
	C16	Tap water.
	C17	Distilled water.
	C18	Nitric acid when used to dissolve silver from gold.
	C19	Silver nitrate as formed from C18 and silver.
	C20	Sodium chloride when used as an indicator for C19
	C21	Chlorine gas.
	C22	Gold sulfide.
	M1	Graphite or carbon rod, large arc lamp type ok.
	M-2	Fine pore pyrex glass frit disc fused to pyrex tubing end.
	M-3	Nickel strip.

Note both M-1 and 3 are permanent unless M-3 is consumed by too high current which produces oily black film on top of leach that refuses to mix.

PROCESS FOR RECOVERY OF PRECIOUS METALS



KEY: Solid lines indicate metals released from solution by _____

Dashes indicate pH change alone precipitate these metals instantly as hydroxide solids. - in presence of C5

Dots indicate metal hydroxides that go back into solution again at high pH shown. These metals are know as amphoteric for their ability of being soluble at both extremes of the pH scale.