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HEAP LEACHING AND SILVER RECOVERY AT THE STATE OF MAINE

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ABSTRACT

The large scale cyanide leaching of several large dumps has been in continuous successful operation at the Tombstone site for more than four years. This paper presents a description of the leaching of silver ores at the State of Maine property near Tombstone, Arizona. It includes discussions of preliminary test work, site selection and pad preparation; heap construction, reagent preparation, solution application systems and leaching operations; solution recovery, precipitation and refining; and the analytical control procedures.

Ore selection is on the basis of metal solubility or percent extraction rather than total grade. Safety precautions and flood and disaster controls are paramount.

Pictures of equipment and plant layout and flow diagrams depict each phase of the operation from raw ore to 999-fine bullion.

INTRODUCTION

The first successful heap leach of silver ores in the State of Arizona has been under continuous operation since early 1976 at the State of Maine Mine, two miles southwest of Tombstone, Arizona. The silver produced from leaching old mine dumps at this property was the first in the Tombstone mining district to achieve a 999+ purity.

While cyanide leaching of silver and gold ores is a time-proven accepted practice, a relatively new method of treatment called "heap" leaching was employed. Heap leaching is a comparatively inexpensive fast way to recover precious metals from low grade material.

SYSTEM DESCRIPTION

Using material from old mine dumps or from current open pit mining, the ore is stacked or heaped on a prepared base and sprayed with dilute cyanide solution. The solution percolates down through the ore dissolving the metal and is collected, filtered to remove all suspended particles and all or nearly all dissolved oxygen is removed before zinc dust is added to precipitate the silver and gold. A simple filter collects the metal precipitates which are then melted and refined and cast into anodes and further refined by electrolysis.

HISTORY

In 1878 John Escapule arrived in Tombstone to photograph the activity for the San Francisco Chronicle and stayed to locate the State of Maine Mine (S/MM). Heap leaching requires relatively few workers per ton of ore treated and economy of work force is one of the outstanding features of this method. Being entirely family owned and operated, paperwork and expenses at the State of Maine have been greatly reduced and a closely-knit, efficient work force is the result.

Detailed production figures from the S/MM prior to 1976 are not available but published estimates[1] range from two to three hundred thousand dollars, almost all in silver.

By mid 1981 there was an estimated 50,000 tons of ore under leach at three locations on the S/MM property.

Elsewhere in the Tombstone area, there are three other major heap leach operations with a total of over one million (estimated) tons under leach. There are no flotation or gravity operations, but one company is considering the use of hyposulphite as a leaching agent.

GEOLOGY

The country rocks in the Tombstone district range from pre-Cambrian to Quaternary in age. At the S/MM in the western-southwestern part of the district, the important ore bodies, predominantly silver with very little gold (average ratio 200:1), occur in a quartz latite porphyry and in Mesozoic sediments. Geographically, in the Tombstone district, ore with significant gold values seems to be restricted to the northeastern part.

The ore in the State of Maine appears to be in narrow stringers in the crushed sericitized rock in a fault zone, with wall rock alterations (mainly sericitization) extending only a few feet from the vein. All of the rock in the fissured zone weathers to a brownish or reddish color with some rather strong stains of manganese in some areas. Very little copper staining is evident and assay maps indicate that only small concentrations of lead are present in the S/MM area.

Extensive development (seven levels off an inclined shaft) resulted in several large dumps; total - about sixty thousand tons with recoverable values averaging 0.01 ounces of gold per ton and 2.0 ounces of silver. An additional estimated fifty thousand tons of broken ore are available in old stopes and fill material underground.

MINERALOGY

Studies of the mineralogy of the Tombstone district have shown a large number and variety of lead, silver and zinc minerals plus manganese, tellurium, molybdenum, and vanadium.

The silver minerals in the State of Maine ore are predominantly halides: cerargyrite with a little bromyrite and embolite plus some native silver and argentiferous galena. Some manganese, principally polianite and pyrolusite, occur in quantities of economic importance in several areas. The silver is frequently complexed with the manganese and, if so, lower extractions result. The silver-manganese minerals are resistant to cyanide leaching and the bulk of the silver can be recovered only by the Russell or Patera or similar process in which the manganese is first rendered soluble and removed. Difficult settling and filtration problems usually result and the treatment is inordinately expensive. Also, neither flotation or gravity separation tests have been successful on these refractory manganese silver ores.

TEST WORK

In heap leaching the controlling factor as to whether or not a particular batch of ore is to be added to the heap is not the total precious metal content but rather the amount of precious metal which can be made soluble in the leaching solution in a reasonable time. Batch tests as described below cannot only determine reagent consumption and extraction data but also observations can be made as to the character of the ore under leach. Preliminary testing is the key to a successful leach operation, particularly if some of the ore is gathered from various old mine dumps in the district. Each potential lot of ore must be tested and evaluated individually.

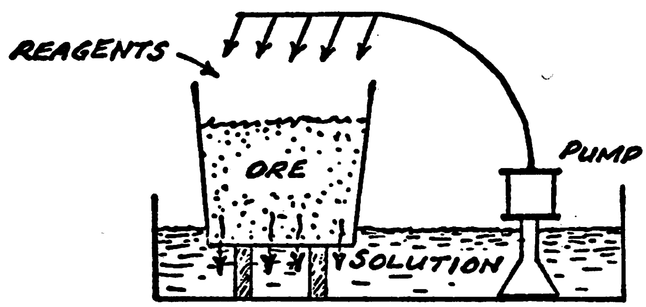
Barrel Test

50 pounds ore
3 gallons water
11 grams caustic (1 lb. per ton of ore)
11 grams cyanide (NaCN)

A 5-gallon container with a perforated bottom sits in a tray (bathinette) with a small circulating pump from an air conditioner.

Add caustic; e.g. pure slacked lime, $Ca(OH)_2$, until solution has a pH of at least 10 or better. Then add cyanide; sodium cyanide, NaCN.

Run percolating solution over the ore in the bucket for 24 hours and take small samples of OFF solution for testing. Add fresh water to system so as to make up for losses from evaporation and sampling.



Continue to take samples every 24 hours until precious metal values in solutions level off (do not increase). Titrate for free cyanide in the OFF solution and check the pH each time a sample is taken. Adjust pH to 10 or better each time and add more cyanide each time as needed.

This test will tell:

Reagent consumption
Extractions versus time
Percolation rates
Amenability to cyanidation percolation

Shaker Test

42 grams ore (pulverized)
42 ml of cyanide solution (2 pounds of cyanide per ton of solution at pH 10 or better

Add a flake or two of caustic before adding the cyanide solution.

Place in 125 ml flask, shake for 30 to 60 minutes. Filter and assay the solution for soluble precious metals.

This test will tell quickly if values will go into solution.

Agitation Tests

Can be in a variety of ways: a small 1 or 2 pound test in a bottle on rolls or in a cement mixer (about 25 pounds).

Add caustic to a unit pH of 10, then add cyanide.

To determine optimum leaching for that particular ore, tests should be done at different grinds with different concentrations of reagents. An idea of retention time can be determined from the periodic removal and assay of clear preg solution samples.

This type of test should be done only on higher grade ores.

Tests at the S/MM on certain batches of ore which contained clay and fine material indicated that better and faster extraction of metal values was achieved if the material could be pelletized or agglomerated prior to loading on the heap. Barren preg, at a pH of 10 and strong in cyanide, was sprayed on crushed ore on a moving belt. Pellets form as the belt moves, tilted at an angle of about 50 degrees from the horizontal. Leaching time was roughly cut in half to attain the same extraction.

SITE SELECTION AND PREPARATION

Criteria for site selection were:

1. Proximity to the ore to be leached.
2. Natural slope drainage that required minimal devegetation and grading. At S/MM a 8 to 9 percent slope was found to be the most satisfactory.
3. No interference or impoundment of streams or natural run-off.
4. Availability of utilities (especially water) and accessibility to roads.
5. Room for expansion, if desired. Size is determined by the amount of ore to be leached. An area 100 by 100 feet will hold about 4000 tons of ore stacked to 5 feet high.

At the S/MM all criteria were met in a succession of separate pads. All the OFF solutions could be collected in one preg storage pond and processed by one precipitation unit.

Subsurface hydrology and the proximity of Tombstone city water wells demanded that all plant solutions and run-off had to be controlled and contained on the property. Consequently, not one but two earth and rock dams were constructed within (1) 100 yards and (2) 250 yards downstream from the site. Each was lined with an impermeable clay bottom as described later. See pad construction.

Each dam was lined with clay and rock cover and was of sufficient size to contain the volume of run-off water from a 100-year flood plus the total of all solutions in the proposed leaching operation.

This demonstration of good faith and cooperation with the State Water Engineer's Office helped establish excellent rapport with that state agency and the Water Quality Control officials.

A willingness to work with county, state, and federal officials has been helpful in the State of Maine start-up and in subsequent operations.

PAD CONSTRUCTION

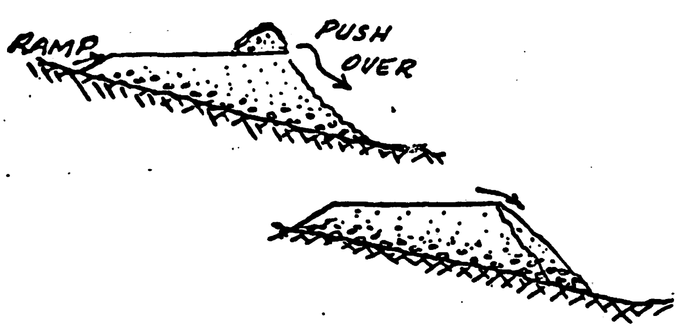
After the site was prepared, a pad base consisting of about 15 inches of mill slimes or a fine bentonitic clay from an old nearby tailings pond was laid down. The pad was constructed slightly larger than the dimensions of the heap to go on it; i.e., about

5 feet all around. Subsequent experiments have shown that this base is most effective if it is spread while slightly damp, 2 or 3 inches at a time and rolled or compacted between each application. A multi-stage build-up is the recommended procedure to insure an impermeable base. The final stage of pad construction is the addition of a layer of several inches of ore crushed to minus 1-inch and spread evenly over the clay base at about a 9 percent slope. Some operators favor the use of welded plastic sheeting of about 10 mil thickness, laid on a clay base and covered with gravel and/or fine sand. The most recent pad base now being installed at the S/MM will employ a reinforced plastic on a clay base and a clay and crushed ore cover. In any case, it is essential that an absolutely impervious barrier be emplaced and maintained so as to completely contain the leach solutions from the heap. Pad construction and pond linings were a major point of inspection by governmental agencies both Federal and County.

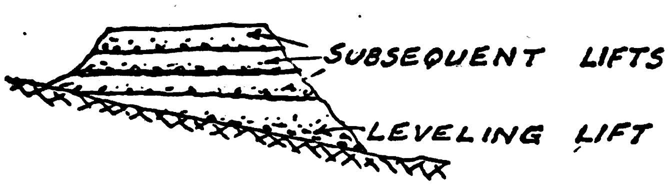
No solution leakage problems have been encountered at the S/MM due to pad base failure. The integrity of all pads and pond linings has been maintained completely.

LOADING THE HEAP

After the pad is constructed, the ore is placed on the pad with a 1½ yard loader in 5 foot lifts. Loading the heap should be done so that the coarse is at the bottom of the pile and the finer material is at the top. This allows for better solution distribution and decreases the possibility of vertical channels of solution flow through the heap. To do this a ramp is started up to the final level of the lift. Ore is dumped on the edge of the ramp and pushed over. This lets the larger rock roll to the bottom and the finer rock stays at the top.



A leveling lift will have to be put down first, then all subsequent lifts will be an even thickness throughout.



After each lift is loaded, the ore is ripped to loosen the areas compacted by machinery. After each lift is leached, the ore is ripped before loading the next lift.

About 800 tons of ore could be loaded in one day, taking 6 working days per lift.

WHY 5 FOOT LIFTS?

The cyanide solution works best if there is an ample supply of oxygen in the solution. Using rainbird plastic sprinklers, the solution is broken down into a spray, allowing oxygen from the atmosphere to be dissolved into the solution.

Frequently, it has been found that the amount of dissolved oxygen is depleted after it has percolated 10 feet into the heap. Beyond this point the cyanide solution will not dissolve the silver or gold effectively. For this reason no lift should be more than 10 feet thick. Also, shallower lifts usually work better for finer material.

PREGNANT SOLUTION PONDS

Pregnant solution moving under the ore heap, along the pad, flows through a small decantation pond. This small pond is used to let some of the solids settle out before entering the main pregnant solution storage pond. Solution is decanted off the top of this small pond through a stand pipe into the main pond. When the solution is very slimey (for example, after heavy rains or a new batch of clayey ore is added to the heap), a mixture of water and lime is added into the decant pipe. This helps to settle some of the slimes and also helps maintain pH control.

The main pregnant solution pond was constructed with a capacity of 400,000 gallons just below the ore heap and the small decantation pond. The bases or liners in these ponds were prepared in the same way as the pad. The pond is designed to hold all solution from the leaching system (72,000 gallons), plus the added volume of water from a 100-year rain over the leach area. A second large dam with a impervious lined pond has been constructed below the main pond to collect and control all cyanide solutions and run-off that could overflow from the primary leach area. This second pond provides additional insurance against accidental overflows in the system.

The values contained in the main pond vary from the time cyanide is first added to the new batch ore until 6 to 8 weeks later, when a new lift of ore is needed for leaching.

Solution from the first days of leaching will have the highest values, ranging from 0.8 to 1.0+ ounces of silver per ton of solution. After 10 to 14 days, values usually drop to about 0.3 to 0.4 ounces of silver per ton of solution. The heap becomes "passive". At this time the heap may be allowed to drain and to aerate. It is then ripped to a depth of 4 or 5 feet with a single scorpion ripper behind a D-8 CAT. Spacing of the ripper pattern is about 6 feet. The pregnant solution then assays 0.6 to 0.8 ounces per ton coming OFF the heap.

After 6 to 8 weeks, depending upon the amount of fines in the heap, values in the solution drop to about 0.3 ounces per ton. The average value in the pregnant solution pond during this 6 to 8 week period is about 0.5 ounces per ton. The plan is always to leach the heap until an economic cut-off point has been reached. Then after ripping again, another 5 foot lift is added and leaching continued in the same manner. While the upper lift is undergoing its initial leach phase, the remaining values in the lower lift(s) are slowly being worked on, if oxygen and free cyanide (in solution) are available.

PLANT OPERATION

Solution from the pregnant storage pond is pumped into a clarifier filter where any remaining slimes are removed from the solution.

After clarification, the solution is run through a vacuum chamber to remove the dissolved oxygen (deaeration).

As the solution leaves the vacuum chamber, zinc dust is introduced and precipitation of the silver and gold takes place almost immediately. At this point the cyanide strength should not be excessive because some of the precipitated precious metal values may redissolve before they can be removed from the circuit in the precipitation filter. The solution with the suspended solids then passes through another filter to remove the silver and gold precipitate. The barren preg solution flows out of the precipitate filter and into a barren solution storage tank. Here samples are taken to determine the amounts of silver and gold remaining in solution.

Cyanide and caustic are added to bring solution back up to the desired pH strength and free cyanide.

Solution from this tank is then pumped back through the sprays and onto the heap.

Titrating for cyanide concentration is done with standard silver nitrate reagent on the pregnant solution coming OFF the heap. This is to determine how much free cyanide is left in solution after leaching. If the solution does not show any cyanide, then all of the available silver and gold may not be taken into solution. When the solution shows that some cyanide is present (usually a few hundredths of a pound per ton), then the available silver and gold is being taken into solution. But, as mentioned before, an excess of cyanide may redissolve silver and gold from the precipitation filter. For this reason, fresh cyanide is added only after precipitation before the barren preg goes back onto the heap.

REFINING

Precipitates mixed with diatomaceous earth from the precipitation filter unit are dried in a filter press and mixed with borax and soda ash. This mixture is then melted in a diesel-fired furnace and cast in a silver doré cone. This cone is then melted in another furnace into an anode 7 inches by 9 inches by ½ inch thick for electrolytic refining.

The silver doré anode is refined to 999+ fine silver crystals using silver nitrate electrolyte and stainless steel cathodes in an electrolytic refining cell. The silver crystals are scraped off the cathodes, rinsed, dried, and melted again into 10 ounce bars or whatever size is on order. Each bar is stamped 999 fine and the S/MM logo added.

999 FINE

The gold is collected with the other impurities from the bottom of the cell and is chemically recovered by using a nitric acid bath to dissolve everything but the gold. This small amount of gold is collected and when enough has been processed, it is melted into 1.5 ounce bars.

TYPICAL OPERATING DATA

Leach 4000 to 5000 tons per lift
Heap size: 180 by 100 feet, 5 feet high
300 tons of solution in 24 hours (50 gpm)
Fresh water make-up 50 tons (worst conditions: dry, hot, windy day and night)
Values in preg solution, ounces of silver per ton of solution:

- First 16 hours - 0.8 to 1.0
- 10 to 14 days - 0.3 to 0.4
- After ripping - 0.6 to 0.8
- At shut down - 0.3
- Average 6 to 8 weeks - 0.5

Pump out decant pond about every two years due to slime build-up.

Precipitates from the Merrill-Crowe precipitation filters average about 50 percent silver. Most of the remainder is diatomaceous earth (silica) used in the filter media.

Use a flux mix of 30 percent borax and 3 percent soda ash (dry weight) when smelting the precipitates. The raw silver anodes measure 7 inches by 9 inches by ½ inch.

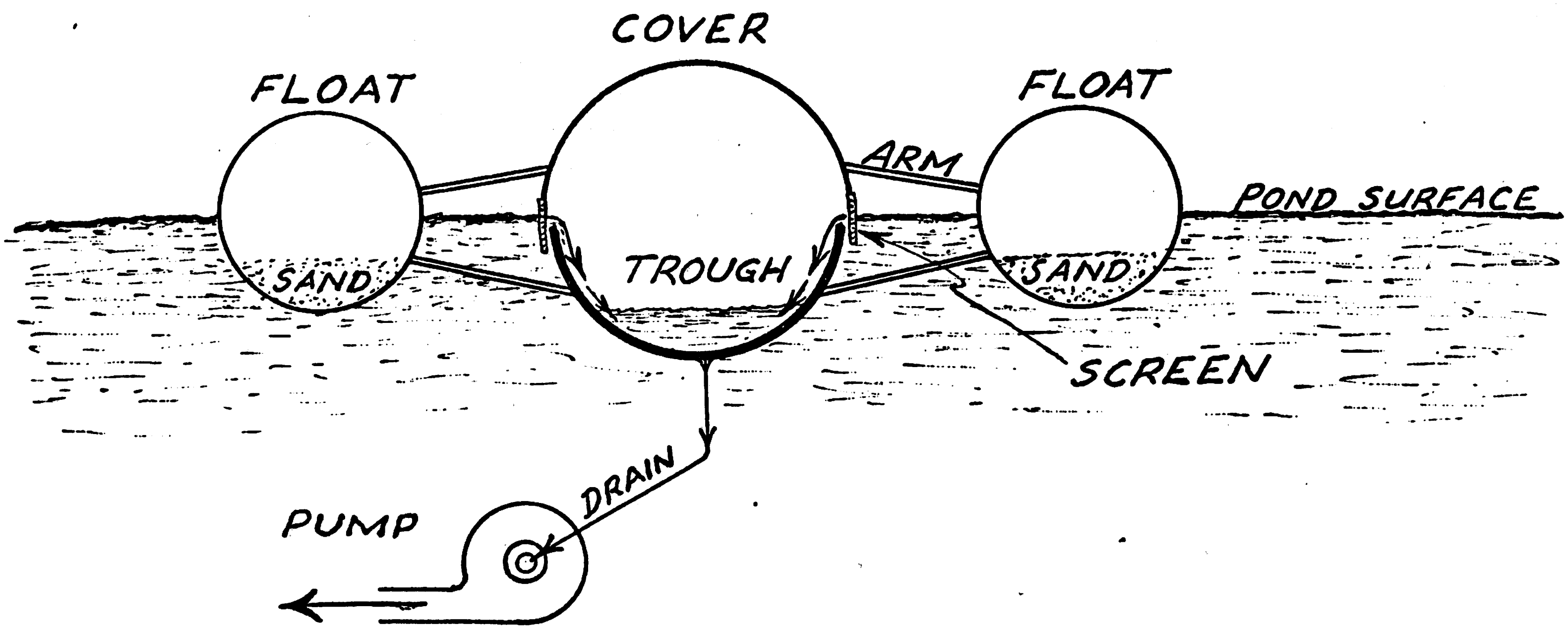
Power requirements for the refining cell are 1.8 to 4 volts and 10 amperes D.C. per anode in cell. Power varies with the number of anodes in the cell. Capacity, 6 anodes.

The pH of the barren preg solution ON to the heap is maintained at 10 or slightly better in order to stabilize the cyanide. The free cyanide in the ON solution is dependent upon the determination of how much is coming OFF. Pregnant solutions coming OFF the heap should show between 0.01 and 0.05 pounds of free cyanide per ton of solution. If less, increase the strength of ON solution in an appropriate amount.

The integrated heap leaching and Merrill-Crowe precipitation circuit required a minimum of operating labor; e.g., one full time worker and one part-time helper per 8 hours, 3 shifts per day, seven days a week.

POND SKIMMER

END VIEW



SKIMMER

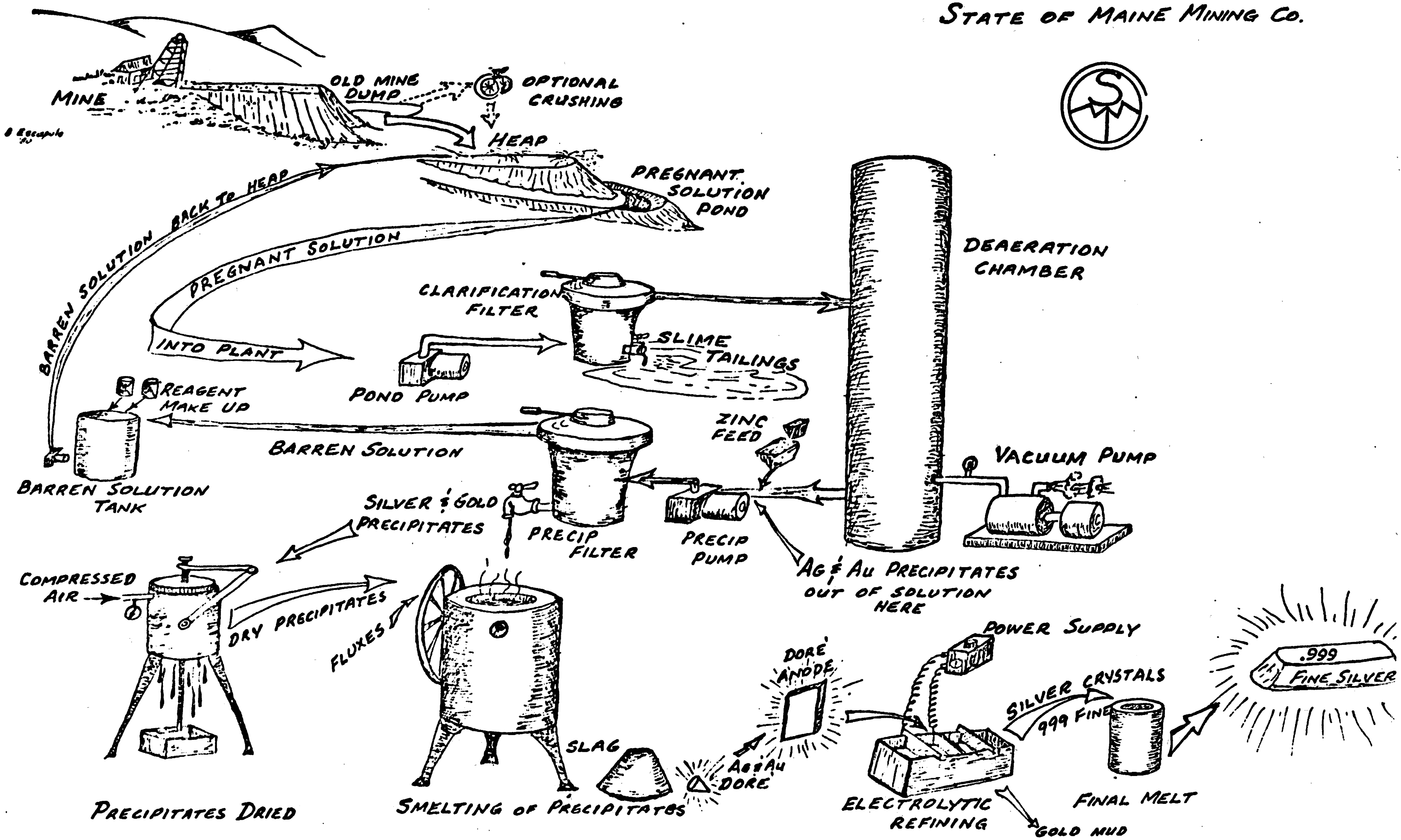
Notes: The trough is 8 to 20 feet long, with closed ends, supported by two outrigger floats, one on each side. The floats are attached to the trough and to the cover with several outrigger arms spaced on each side. The precise levelling and adjustment of trough lip below the pond surface is made by adding sand as a ballast to the two floats.

This skimmer pulls the top 1/8 inch of solution off the surface; therefore, maximum aeration and since it is screened and covered, there are no birds, bugs, or debris in the recovered solution.

Further, there is a minimum of silt or suspended solids trapped and taken off in the out-flow.

When pumping from strong preg storage ponds to the precipitation unit, care should be exercised to avoid any air entrapment by vortices, cavitation, or stirring in of extra air. Any extra air puts an unnecessary load on the deaeration unit.

FLOW SHEET OF HEAP LEACH OPERATION
FROM MINE TO 999 FINE SILVER
STATE OF MAINE MINING CO.



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1. Butler, B.S., Wilson, E.D., and Rasor, C.A. "Geology and Ore Deposits of the Tombstone District, Arizona", Arizona Bureau of Mines, Bulletin No. 143, 1938, 114 pp.

State of Maine Mining Company

P. O. BOX 453 TOMBSTONE, ARIZONA 85638 PHONE 457-3601

CHARLES ESCAPULE LOUIS ESCAPULE

Cyaniding silver and gold ores is not a new practice, however, some of the methods in use are comparatively new. One such method is to "heap leach" low grade ores. It is a cheap, fast way to recover precious metals from old dumps or open pit mining operations. The term "heap leaching" was probably coined by the copper mining industry, whereby low grade ore is stacked (heaped) on a prepared base (made impervious) and sprayed with a leaching agent, in the case of silver and gold, a dilute cyanide solution. The solution percolates down through the ore, dissolving the metal and collected for subsequent stripping.

Several methods of recovering the dissolved metals are used, such as carbon absorbtion, electrowinning, etc. but the simplest way is by use of powered zinc or aluminum metal. In order for this method to work efficiently certain criteria must be met, first, the solution must be filtered to remove all suspended particles and, second, all or nearly all dissolved oxygen must be removed before adding zinc dust to precipitate the silver and gold, at which time it is a simple matter to filter and collect the metal.

The precipitation plants we have designed and currently manufacturing for sale are rated at 12, 65, 100, 150 and 300 tons of solution per day (24 hours).

They are the Merrill-Crowe type, using zinc dust as the precipitant.

The 300 TPD plant comes complete with three 500 gallon reagent storage tanks, mix pump and 2 hp pump for the spray system. The 150 TPD plant comes with three 300 gallon reagent storage tanks and 1 1/2 hp pump for the spray system. The 65 TPD and 100 TPD plant do not come with tanks as 55 gallon drums can be used for this purpose. A 3/4 hp and 1 hp pump comes with a 65 TPD plant and a 100 TPD plant respectively, for the spray system.

Plants are built on a rigid steel skid type frame for easy handling and transporting. The largest plant weighs less than a ton and the 65 TPD plant around 900 pounds.

They are easily operated by one person, requiring very little attention.

All components are designed for outdoor use and a shelter, although recommended, is not necessary.

12 TPD	1,500.00	Completion	time -	3	weeks
65 TPD	4,500.00	"	"	60	days
100 TPD	5,400.00	"	"	"	"
150 TPD	10,500.00	"	"	"	"
300 TPD	20,000.00	"	"	"	"

Terms - Half down at time of order - Balance at time of pick up.

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THE 12 TPD PLANT

The 12 TPD Plant consists of one clarifier filter and one precipitation filter, deaeration system, zinc feeder and mixing cone, and a 1/3 hp pump used for circulating solutions, all mounted on a steel frame.

SPECIFICATIONS

A. Automatic and continuous deaeration.
B. Pressure monitored system.
C. 24 ounce zinc dust hopper capacity.
D. Corrosion proof pump with mechanical seal.
E. Variable rate zinc dust feeder.
F. Automatic internal liquid level control.
G. Steel frame mounted.
H. See-through filters with replaceable cartridges.
I. Power requirements: 1 KVA 110 volts 1 hp 60 hz.

The dimensions of this plant are 2 ft. x 2 ft. x 7 ft. 6 inches high. The weight of the plant is 130 pounds. This plant was designed for test work or for processing small amounts of very high grade ores. This machine is not intended for continuous operation.

F.O.B. State of Maine Mine
Tombstone, Arizona

State of Maine Mining Company

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CHARLES ESCAPULE LOUIS ESCAPULE

The 65 TPD PLANT

The 65 TPD Plant consists of one clarifier filter and pump, one precipitate filter and pump, vacuum deaeration system, zinc feeder and mixing cone, all mounted on a steel frame. Also included is a 3/4 hp pump for pumping solution onto a heap. To save a cost to you, no tanks are provided, as 55 gallon drums can easily be adapted for this purpose.

SPECIFICATIONS

A. Automatic and continuous vacuum de-aeration.
B. Pressure monitored filter system.
C. Corrosion proof pumps with mechanical seals.
D. 4 pound zinc dust hopper capacity.
E. Variable rate zinc dust feeder.
F. Electronic liquid level control in vacuum chamber.
G. Steel skid mounted.
H. Folding vacuum chamber for easy transporting.
I. Rain tight electrical switch gear.
J. No lube vacuum pump.
K. Power requirements: 5 KVA 110/220 volts 1 ph 60 Hz. (or 50 Hz.)

The overall dimensions of this plant are 5' x 3'4" x 7'11" high. The vacuum tank is designed to fold down for transporting, reducing the height to about 4 ft., making it handy for transporting in a pickup or small trailer.

F.O.B. State of Maine Mine
Tombstone, Arizona

State of Maine Mining Company

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CHARLES ESCAPULE LOUIS ESCAPULE

THE 100 TPD PLANT

The 100 TPD precipitation plant consists of one clarifier filter and pump, one precipitate filter and pump, vacuum de-aeration system, zinc feeder and mixing cone, all mounted on a steel frame. Also included is a 1 hp pump for pumping solution onto a heap. To save cost to you no tanks are provided, as 55 gallon drums can easily be adapted for this purpose.

SPECIFICATIONS

A. Automatic and continuous vacuum de-aeration.
B. Pressure monitored filter system.
C. Corrosion proof pumps with mechanical seals.
D. 4 pound zinc dust hopper capacity.
E. Variable rate zinc dust feeder.
F. Electronic liquid level control in vacuum chamber.
G. Steel skid mounted.
H. Folding vacuum chamber for easy transporting.
I. Rain tight electrical switch gear.
J. No lube vacuum pump.
K. Power requirements: 5 KVA 110/220 volts 1 ph 60 Hz. (or 50 Hz.)

The overall dimensions of this unit are 5'5" x 3'6" x 7'9" high. The vacuum tank is designed to fold down for transporting, reducing the height to about 4 ft., making it handy for transporting in a pickup or small trailer.

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Tombstone, Arizona

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CHARLES ESCAPULE LOUIS ESCAPULE

THE 150 TPD PLANT

The 150 TPD precipitation plant consists of clarification pump and filters, vacuum deaeration system, zinc dust feeder and mixing cone, precipitation pump and filters, all mounted on a steel skid. Also included are three 300 gallon steel tanks for reagent storage and spray mix tank plus a 1 1/2 hp pump for pumping the solution onto a heap.

SPECIFICATIONS

A. Automatic and continuous vacuum deaeration.
B. Pressure monitored filter system.
C. Non-corrosive pumps with mechanical seals.
D. 6 pound zinc dust hopper capacity.
E. Variable rate zinc feeder.
F. Electronic liquid level control in vacuum chamber.
G. Steel skid mounted.
H. Rain tight electrical switch gear.
I. Power requirements: 6 KVA 220 volts 1 ph 60 Hz. (or 50 Hz).

The overall dimensions of this plant are 7'2" x 4'4" x 7'10" high.

F.O.B. State of Maine Mine
Tombstone, Arizona

State of Maine Mining Company

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CHARLES ESCAPULE LOUIS ESCAPULE

THE 300 TPD PLANT

The 300 TPD precipitation plant consists of clarifier pump and filters, vacuum deaeration system, zinc dust feeder and mixing cone, precipitation pump and filters, all mounted on a steel skid. Also included are three 500 gallon steel tanks for reagent storage and spray mix tank plus a 2 hp pump for pumping the solution onto a heap and a 1/2 hp pump for mixing reagents.

SPECIFICATIONS

A. Automatic and continuous vacuum deaeration.
B. Pressure monitored filter system.
C. Non-corrosive pumps with mechanical seals.
D. 10 pound zinc dust hopper capacity.
E. Variable rate zinc feeder.
F. Electronic liquid level control in vacuum chamber.
G. Steel skid mounted.
H. Rain tight electrical switch gear.
I. Oil lubed vacuum pump.
J. Power requirements: 8.5 KVA 220 vlts, 1 ph 60 hz. (or 50 Hz.)

The overall dimensions of this unit are 8' x 5' x 7'11" high. While this plant was designed for heap leaching operation, it can be used in any mill system that generates pregnant cyanide solutions.

F.O.B. State of Maine Mine
Tombstone, Arizona

State of Maine Mining Company

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LOUIS ESCAPULE

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Several methods of recovering the dissolved metals are used, such as carbon absorbtion, electrowinning, etc. but the simplest way is by use of powdered zinc or aluminum metal. In order for this method to work efficiently certain criteria must be met, first, the solution must be filtered to remove all suspended particles and, second, all or nearly all dissolved oxygen must be removed before adding zinc dust to precipitate the silver and gold, at which time it is a simple matter to filter and collect the metal.

The two precipitation plants we have designed and are currently manufacturing for sale are rated at 65 and 300 tons of solution per day (24 hrs.).

They are the Crowe-Merrill type, using zinc dust as the precipitant.

The 300 TPD Plant comes complete with reagent storage tanks, mix pump and a 2 HP pump for the spray system. The 65 TPD Plant does not come with tanks as 55 gallon drums can be used for this purpose.

Both are built on a rigid steel skid type frame for easy handling and transporting. The larger plant weighs less than a ton and the smaller around 400 lbs.

Both are easily operated by one person, requiring very little attention.

All components are designed for outdoor use and a shelter, although recommended, is not necessary.

65 TPD	4,000.00	Delivery time - 60 Days.
100 TPD	4,800.00	" " " "
150 TPD	9,300.00	" " " "
300 TPD	18,000.00	" " " "

Terms - Half down at time of order - Balance at time of pick up.

Prices effective through October 1980.

State of Maine Mining Company

P. O. BOX 453
CHARLES ESCAPULE

TOMBSTONE, ARIZONA 85638

PHONE (602) 457-3601
LOUIS ESCAPULE

THE 65 TPD PLANT

The 65 TPD Plant consists of one clarifier filter and pump, one precipitate filter and pump, vacuum deaeration system, zinc feeder and mixing cone, all mounted on a steel frame.

Also included is a ½ HP pump for pumping solution onto a heap. To save a cost to you, no tanks are provided, as 55 gallon drums can easily be adapted for this purpose.

SPECIFICATIONS

A. Automatic and continuous vacuum deaeration.

B. Pressure monitored filter system.

C. Corrosion proof pumps with mechanical seals.

D. 10 lb. zinc dust hopper capacity.

E. Variable rate zinc dust feeder.

F. Electronic liquid level control in vacuum chamber.

G. Steel skid mounted.

H. Folding vacuum chamber for easy transporting.

I. Rain tight electrical switch gear.

J. No lube vacuum pump.

K. Power requirements: 4.5 KVA 110/200 volts 1 ph 60 Hz. (or 50 Hz.)

The overall dimensions of this plant are 5 ft. x 3 ft. 4 inches and 7 ft. 11 inches high. The vacuum tank is designed to fold down for transporting, reducing the height to about 4 ft., making it handy for transporting in a pickup or small trailer.

F.O.B. State of Maine Mine
Tombstone, Arizona

State of Maine Mining Company

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TOMBSTONE, ARIZONA 85638
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CHARLES ESCAPULE
LOUIS ESCAPULE

THE 300 TPD PLANT

The 300 TPD Precipitation Plant consists of clarifier pump and filters, vacuum deaeration system, zinc dust feeder and mixing cone, precipitation pump and filters, all mounted on a steel skid. Also included are three 500 gallon steel tanks for reagent storage and spray mix tank plus a 2 HP pump for pumping the solution onto a heap and a ½ HP pump for mixing reagents.

SPECIFICATIONS

A. Automatic and continuous vacuum deaeration.

B. Pressure monitored filter system.

C. Non-corrosive pumps with mechanical seals.

D. 20 lb. zinc dust hopper capacity.

E. Variable rate zinc feeder.

F. Electronic liquid level control in vacuum chamber.

G. Steel skid mounted.

H. Rain tight lectrical switch gear.

I. Oil lubed vacuum pump.

J. Power requirements: 8.5 KVA 220 volts, 1 ph 60 Hz. (or 50 Hz.)

The dimensions of this unit are 8′ x 5′ x 7′11″ high.

While this plant was designed for heap leaching operation it can be used in any mill system that generates pregnant cyanide solutions.

F.O.B. State of Maine Mine
Tombstone, Arizona