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KERR ADDISON MINES LTD.

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KERR ADDISON MINES - ADANAC PROJECT

GROUP TOUR

SOUTHWEST U.S. MINING OPERATIONS

JANUARY 1971

BY PETER STYM

INTRODUCTION

The tour was organized by John A. Wood, Vice-President of Chapman, Wood, & Griswold Ltd., Vancouver, B. C.

The tour was an informative trip and the operations visited were in the main large open-pit mines recently placed into production.

Kerr Addison Mines Limited representatives were:

Mr. J. H. Stovel, President.
Mr. Peter Stym, Adanac Project Manager.

Chapman, Wood, & Griswold representatives were:

Mr. E. P. Chapman Jr., President, Vancouver, B. C. office.
Mr. John A. Wood, Vice-President, Vancouver, B. C. office.
Mr. G. R. Griswold, President, Albuquerque, New Mexico office.
Mr. Jim Melvin, Albuquerque, New Mexico, for the visit solely to the Questa Division, Molycorp.
Mr. D. F. Irving, Albuquerque, New Mexico.
Mr. C. R. D. Miller, Vancouver, B. C.
Dr. A. M. Coode, Vancouver, B. C.
Mr. W. A. Hepenstall, Vancouver, B. C., for the visit to Sierrita and Twin Buttes.

The group was accompanied by:

Mr. John Britton, Consulting Metallurgist, Vancouver, B. C.
Mr. Lyall Ames, Consulting Metallurgist, Port Credit, Ontario.
Mr. E. S. Barton, Senior Vice-President, Sandwell & Company Ltd., Vancouver, B. C.
Mr. John Klimovich, Chief Engineer, Sandwell & Company Ltd., Vancouver, B. C.

Operations visited:

January 4, Sierrita, Duval Corporation, Tucson, Arizona.
January 5, Twin Buttes, Anaconda Copper, Tucson, Arizona.
January 6, AM, Tyrone, Silver City, New Mexico.
PM, Kennecott - Crushing plant, Hurley, New Mexico.
January 8, Molycorp, Questa unit, New Mexico.

The writer made a tour of the above operations in March 1967 and visited the first four listed again in December 1968. Data of interest was noted and documented. Copies of each report are available at the Kerr Addison Mines Limited Adanac Project office in Vancouver.

To minimize repetition, only pertinent changes and other items of interest are recorded in the following.

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SIERRITA - DUVAL CORPORATION

GENERAL

- ore - 0.35% Cu, 0.035 MoS₂.
- Mill treating 60,000 tons per day.
- Pit removal, 180,000 tons per day 7 days per week.
- ore body - 70%, diorite; 30% monzonite.
- 12,000 feet of belt conveying from primary crusher to mill. Belt speed is 700 feet per minute; capacity, 5,000 tons per hour; maximum incline, 14°.
- Less than 10% fines (-5/8" material) in the mine-run ore, particularly diorite, is given as the reason for treatment under 72,000 - ton per day design.
- Action underway to increase tertiary crushing plus ball mill grinding capacities.
- Grinding Index of ore averages 14.
- Treatment of monzonite alone slimes the circuit and recovery is very low - approximately 70%. When treating monzonite ore as a result, blending is necessary.
- Plans are afoot to increase in the near future pit removal to 240,000 tons per day and subsequently to 300,000 tons.
- Total employees, 1,260.

PIT

- Drilling equipment, 60R and 45R units. Diesel-powered units preferred. Drilling pattern, 30' x 30' with 12 1/4" dia. hole, 25' x 25' with 9 7/8" hole. Subgrade drilling, 9 feet 60R provides 350 feet of 12 1/4" dia. hole on the average per shift.
- Utilize P & H 15-yd. shovels. Have experienced considerable failures - shipper shaft assembly, bottom of boom hinge points, travel train of gears, swing bull gears, and other. They believe the current 15-yd. models supplied by P & H incorporates the necessary modifications and improvements.
- Haulage units, 120 - ton Wabco and Darts, with electric wheel motors and 1,000 H.P. engines. Load averages approximately 100 tons. Tire life, approximately 2,000 hours. Truck availability, approximately 75-80%. Slight preference given to Wabco. Recently have placed an order for 8 150-ton Wabco trucks.
- Main ramps, 120' wide - 2 lanes up; 1, down. Maximum gradient, 10%.
- Water is encountered in 90% of their blast holes. As a result, a high percentage of slurry is used. Powder factor, approximately 0.45 lbs./ton.

MILL

- 2 60" gyratory units, - primary crushing. Discharge, - 5".

- Coarse ore stockpile, 40,000 tons live load. Operators there consider this storage very low and inadequate.
- 4 secondary, 10 tertiary crushing units.
- 72,000 tons, - 5/8" material, fine ore storage capacity.
- Primary grinding, 14 16 1/2' x 19.0' ball mills
- primary grind, 80% - 60 mesh (= 55% - 200 mesh ?).
- Alkali circuit.
- Reagents and balls fed to mills by gravity from storage.
- Use tailings thickener; discharge, 55 to 58% solids. Tailings pond located approximately 4 miles from concentrator. No reclaim available from tailings pond after 8 months of mill operation. Fresh water for mill pumped a distance of 10 miles. Essential to have thickeners, as no early reclaim from tailings pond possible, evaporation losses are very high in the pond during the hot weather, and a long distance of pumping required for the fresh water.
- Serious wear was encountered on the tailings discharge line after 6 months of use and repairs were underway. The visiting group believe this to have resulted from a line gradient much steeper than 0.5%. It appears as if additional drop boxes were being installed at the time of this visit.
- Copper recovery, 90%; molybdenite recovery, 80%.

TWIN BUTTES - ANACONDA COPPER

GENERAL

- ore grade - 0.7 to 0.8% Cu., 0.01 to 0.02% MoS₂.
- mill treatment, 28,000 tons per day.
- Waste rock and ore removal at the rate of approximately 80,000 tons per day.
- overburden stripping is continuing - pushback effort in the main.
- Grinding Index of ore varies from 10 to plus 20, averaging approximately 12.
- After primary crushing, there is an ore screening complex, to provide pebbles for the grinding mills.
- Power generation planned on site was a failure. Now purchasing power from an outside utility.

MILL

- Fine ore storage, - 5/8", 44,000 tons live.
- Grinding units - 3 sections of 1 rod and 2 pebble mill combinations. Rod mill, 14' x 18'; pebble mill, 14' x 28'.
- Primary grind, 50% - 200 mesh.
- Use steel balls in regrind mills.
- Copper recovery, approximately 75% - ore currently high in oxides.
- 2 400' diameter tailings thickeners. Discharge to tailings pond, 52 to 55% solids. No tailings water reclaimed as yet - dams plus floor highly pervious.
- 124 employees total in the mill - staff, maintenance, plus operators but does not include primary crushing crews.

TYRONE - PHELPS DODGE CORPORATION

GENERAL

- Ore grade, 0.7 to 0.8% Cu.
- Mill treating 28,000 tons per day.
- Daily removal in the pit, 140,000 tons.
- Mill and mine operate 12 consecutive days followed by 2 days off.
- Pit material less than 0.19% Cu is rejected as waste; 0.19% to 0.39% Cu, stockpiled for later leaching; plus 0.39 Cu, treated in the concentrator.
- 24,000 KW is generated on site. Power plant design enables use of fuel mixture 90% natural gas and 10% diesel or entirely diesel.
- Expansion plans are afoot to increase treatment to 45,000 tons per day.
- Design and operation of pit and mill are excellent.

MILL

- Primary crusher, 60" gyratory. Discharge, approximately - 12".
- Coarse ore stockpile, 25,000 live tons, designed with a canopy cover, to reduce oxidation effects.
- 2 secondary crushers, 5 tertiary.
- Fine ore storage, - 3/8", approximately 25,000 live tons.
- Primary grinding - 12 12' x 12' ball mills in operation; 1 ball mill, standby.
- Primary grind, approximately 8% - 65 mesh (= 65% - 200 mesh ?). (Considerable chalcocite in the ore).
- Rougher cells retention time is 16 minutes.
- Cu recovery, 85 to 89% in sulphides; overall recovery, due to oxides, is 80%.
- Concentrate average grade, 23% Cu.
- 4 325' diameter tailings thickeners are in use. Discharge to tailings pond, 47 to 48% solids. Current design requires ~~problematic~~ pumping. For the expansion, it is planned to utilize gravity flow discharge - from the bottom. This latter is considered more efficient and less problematic. Thickener floor is constructed of concrete. Flocculant is used for thickening.
- Tailings line gradient, 0.65%. Elaborate system is in use for tailings impoundment and water reclaim. Reclaim is by decanting. Tailings dam is constructed with cyclones built at their own shop. Slope of dam construction (sands), 3 to 1.
- Fresh water for the mill is pumped a distance of 26 miles.
- Mill - design for dust control and communication (radio system) is excellent.

KENNECOTT - HURLEY, NEW MEXICO

GENERAL

- Jaw crusher, 66" x 84" size, 2,000 tons per hour capacity. Discharge, - 8". An effective TV system incorporated for operator use.
- Jaw crusher operation is followed by secondary and tertiary crushing, reducing material to all - 5/8" size. All - 5/8" material is then reduced to - 1/4" by a battery of rolls crushers.
- Mill treatment, 22,800 tons per day. Ore contains 0.02% MoS₂ and it is recovered as a by product.
- Tailings Thickeners are utilized. Discharge to tailings pond is 35% solids. Water reclaimed from tailings pond. Seepage losses are slight; evaporation losses are high during the hotter months.
- It was noted that the concrete structure to accommodate installation of the jaw crusher is sizeable.

QUESTA UNIT MOLYCORP

GENERAL

- Total daily removal on a seven days per week, 160,000 tons.
- Mill treatment, 16,000 tons per day.
- Mining cut-off grade is 0.10% MoS₂ and there is only limited stockpiling of low grade practised, material grading 0.10 to 0.12 MoS₂. Rapid breakdown of the ore occurs when stockpiled, drastically lowering recoveries.
- Ore grading 0.19% MoS₂ and greater is processed through the crushing plant and is delivered directly to the concentrator. Ore material between 0.10 and 0.19% MoS₂ is upgraded a large part of the time before treatment; this is accomplished by two stages of screening and rejection of mine-run material as waste -- first reject is the +4" size followed by the +1" size, amounting to approximately 15% and 35% of the total volume respectively. Material grading 0.14% MoS₂ is thus upgraded to approximately 0.20 to 0.21% MoS₂ with total reject grading approximately 0.07% MoS₂.
- Electrical power is generated on site by 5 units having a total capacity of 22,000 KW. The machines are designed to utilize a fuel mixture of 90% natural gas and 10% diesel fuel or entirely diesel fuel, similar to Tyrone. Direct cost (labour & fuel) per Kilowatt-hour for the former is 5.6 mills; for the latter, it is estimated at 7.0 mills. Questa pays 11.5 cents per U.S. gallon of diesel fuel delivered at site. Most of the machines have been in operation for a period of 5 years with no problems.
- 5 sources of fresh water supply (for plant plus mill)

- are available within a 2 - mile radius of the plant.
- total employees on the property, 695.

PIT

- Average grade of ore mined, is 0.21% MoS₂.
- 3 17-yd. P&H shovels are in use as well as 10-yd. shovels. The 17-yd. shovels are averaging 14,000 tons per shift, but this is stated to be well below the capacity.
- Diesel as well as electrically-powered rotary drills are in use. Diesel units are preferred for most of the year but cold weather starting presents problems with the diesel equipment.
- Haulage truck availability, 55 to 60%.
- Truck tire life is between 4,000 to 6,000 hrs. This is attributed to the crumbly and soft nature of their rock coupled with the prevailing cooler temperatures throughout the year.
- Total men in the pit is 400; this includes equipment operators, maintenance personnel, and directly related staff. Maintenance comprises 144 hourly-rated employees.

MILL

- Mill treatment grade averages 0.24% MoS₂.
- Fine ore-bin capacity, 22,000 tons - 3/8" material, live load.
- Primary grind comprises 5 ball mills -
 - 3 11' 6" x 14.0"
 - 1 13' 0" x 14.0"
 - 1 15' 0" x 19' 2"
- Primary grind is approximately 45% - 200 mesh (?).
- 8 stages of Molybdenite cleaning coupled with 3 regrinds.
- 75% of the total MoS₂ is floated in the rougher cells in approximately 4 minutes.
- MoS₂ recovery averages 80%.
- Concentrate grade, 89% MoS₂ and approximately 0.40% Pb.
- Concentrates high in Pb are filtered through a -325 mesh screen. Concentrate with 0.8% Pb content can thus be lowered to 0.4%.
- Original design did not include any tailings thickeners. A small discarded internal thickener is now utilized for this purpose intermittently.
- Tailings disposal area is located approximately 7 miles from the plant. Earth embankments have been constructed to impound the tailings. There is no reclaim of tailings water.
- The tailings line consists of 3 10" steel pipe lines; two are in use at anyone time. One section, a distance of approximately 9,000 feet, has a gradient of -3%; this is a high wear and consequently high maintenance cost section. All their lines are in the process of being lined on the inside with a plastic substance called Urethane, which increases the life considerably.
- Total hourly-rated employees in the mill, including primary crushing, consists of 105 employees.

- Two Holo Flite concentrate dryers arranged in parallel are in use, reducing the moisture content to remain between 4 to 6%. The operators here have visited Endako Mines and they believe the roaster-type observed there to be more efficient.

CONCLUSION

This tour afforded all visiting members with an opportunity to view plant design and obtain first-hand information on operational experiences at properties visited. It was most beneficial, in particular, to members of the Adanac Project feasibility team in consolidating design considerations and in firming thoughts regarding selection of major equipment. As with most such trips, the operating officials of the mines visited were most helpful, courteous, and generous with their time.

P. Styr