IS THERE A FUTURE FOR PRODUCTION OF ANTIMONY OUTSIDE CHINA

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HISTORY OF ANTIMONY PRODUCTION IN THE UNITED STATES

• Antimony was mined in the late 1800’s and early 1900’s to produce metal for
  • hardening lead in bullets
  • storage batteries
  • Bearings
  • plumbing fixtures
  • produce oxide used as a white pigment in paint
  • a flame retardant
  • variety of other compounds

• Antimony is a “strategic metal” that was used in large amounts during World War I and II for ordnance and flame retardants.

• During these war years, it was mined at the:
  • Sunshine Mine in north Idaho
  • Stibnite Hill Mine at Thompson Falls, Montana (USAC)
  • Yellow Pine Mine in Central Idaho

• During World War II, United States mines were unable to meet the demand for antimony and Mexico became a principal supplier. The U. S. Geological Survey was sent to evaluate the Mexican deposits.
HISTORY OF ANTIMONY PRODUCTION IN THE UNITED STATES

• Until 1970 domestic producers included:
  • National Lead
  • Harshaw Chemical
  • Chemtron
  • M & T Chemical
  • McGean Chemical
  • and others

• They processed sulfide concentrates and hand sort from:
  • Bolivia
  • Mexico
  • China
  • South Africa
  • and other countries

• With the advent of the Clean Air Act in 1970, the feed supply became either crude antimony oxide or antimony metal from these same sources.
Until 1975, when the “maintenance-free” calcium lead battery was introduced, deep-cycle lead storage batteries used more antimony than that being used for flame retardants.

Thereafter, the demand for antimony oxide for flame retardants began to dominate.

A smaller market existed for sodium antimonite used as a fining agent for cathode ray tubes, television bulbs but this industry moved to the Far East for economic reasons.

Realizing that the domestic producers were making large profits by fuming crude oxide and metal, the Chinese raised the price of their crude oxide and metal and lowered the price of their finished oxide systematically forcing everyone out of business in the U.S. except USAC that sourced non-Chinese raw material.
WHY THE CHINESE DOMINATE WORLD SUPPLY AND WHY THIS MAY CHANGE

• The Chinese supply the world with more than 92%, or 350,000,000 ppy, of all the finished antimony products for four reasons:
  • First, China has had huge reserves of clean stibnite ore primarily in Hunan Province.
  • Second, they have dominated the metallurgy of antimony and at one time operated more than 250 smelters.
  • Third, environmental and human rights legislation and enforcement have been lax.
  • Fourth, the cost of manpower has made mines considered uneconomic in other parts of the world economic in China.

WORLD PRODUCTION AND RESERVES OF ANTIMONY 2011 (metric tons)

<table>
<thead>
<tr>
<th>SOURCE</th>
<th>MINE PRODUCTION 2012</th>
<th>MINE RESERVES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bolivia</td>
<td>4,000</td>
<td>310,000</td>
</tr>
<tr>
<td>China</td>
<td>150,000</td>
<td>950,000</td>
</tr>
<tr>
<td>Russia</td>
<td>3,300</td>
<td>350,000</td>
</tr>
<tr>
<td>South Africa</td>
<td>5,000</td>
<td>27,000</td>
</tr>
<tr>
<td>Tajikistan</td>
<td>2,000</td>
<td>50,000</td>
</tr>
<tr>
<td>Other Countries</td>
<td>13,100</td>
<td>150,000</td>
</tr>
<tr>
<td>World total</td>
<td>180,000</td>
<td>1,837,000</td>
</tr>
</tbody>
</table>
WHY THE CHINESE DOMINATE WORLD SUPPLY AND WHY THIS MAY CHANGE

• We see changes may affect this:
  • First, the high-grade stibnite deposits of Hunan Province are almost depleted. They are now mining lower grade deposits with impurities that would probably be uneconomic if it were not for the silver content. Historically the Chinese sourced their raw material from China. They are now importing close to 40% of their raw materials from other countries including Russia, Australia, Tajikistan, Myanmar, and South America. They are paying more for raw material and having to pay for the removal of precious metals in the raw materials.

  • Second, their smelters are being consolidated for geographic purposes and efficiency, but few if any, are equipped with sulfur dioxide scrubbers and these may become mandatory.

  • Third, the cost of environmental compliance and human right compliance is increasing.

  • Fourth, the cost of manpower is increasing substantially.
FUTURE GROWTH INDUSTRIES THAT WILL HIKE ANTIMONY DEMAND

• Growth in demand for antimony metal will be for lead-acid batteries and for ordnance.

• Demand for deep-cycle batteries is increasing, and the technology is well known and simple.

• The domestic and world-wide demand for ordnance is significant.

• No viable substitute for the synergistic antimony-halogen system has been found after years of research.

• As a consequence, the demand for antimony oxide will increase with population growth, increased automotive production, and housing growth.

USES OF ANTIMONY (U.S.G.S.)

<table>
<thead>
<tr>
<th>USES</th>
<th>PERCENTAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flame retardants</td>
<td>36</td>
</tr>
<tr>
<td>Transportation including batteries</td>
<td>23</td>
</tr>
<tr>
<td>Chemicals</td>
<td>16</td>
</tr>
<tr>
<td>Ceramics and glass</td>
<td>12</td>
</tr>
<tr>
<td>Others, including semi-conductors and solar cells</td>
<td>13</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
</tr>
</tbody>
</table>
Canadian production is a smelter byproduct from mines all over the world that will increase as lead and zinc prices increase. The Beaverbrook Mine in Newfoundland was purchased, operated, and subsequently shut down by the Chinese due to depleted reserves.

In the United States, the time, cost, and uncertainty of permitting raises questions about the opening of the Yellow Pine and Stibnite Hill properties.

Although Mexico once ranked second in the world as an antimony producer, the country has produced very little in the last 20 years. Limited production following World War II was due to limited ore dressing facilities and no viable smelters.

To be a viable antimony producer, a company must control its raw material source. This leaves Australia, some properties in South and Central America, but most importantly, Mexico. USAC followed in the footsteps taken by the U. S. Government during World War II and began developing deposits in Mexico.
MEXICAN PROPERTIES IN PRODUCTION

LOS JUAREZ PROPERTY, QUERETARO

• At the Los Juarez property USAC relied on a Mexican Government publication. The paper reported a reserve of 1,000,000 metric tons containing 253 grams per ton silver and 1.8% antimony in 40 hectares (100 acres).

• The deposit was interpreted as a manto (layered) deposit up to 5 meters thick.

• Although USAC used the report to start mining, it was disallowed by the S.E.C. as a basis for reserves.

• Detailed mapping and sampling delineated jasperoid mineralization over an east-west strike length of 3.5 kilometers with a maximum width of 1 kilometer.

• Unlike most Mexican deposits, this deposit is primarily all sulfide.

• Preliminary exploration indicates that it could be a deep-seated jasperoid.

• USAC controls this property directly. The weighted average feed grade of 1261 tons recently milled from the open pit was 0.55% antimony, 5.12 ounces of silver (159.23 grams) per metric ton, and 0.050 ounces (1.555 grams) of gold per metric ton.
MEXICAN PROPERTIES IN PRODUCTION

LOS JUAREZ PROPERTY, QUERETARO

At the Los Juarez property USAC relied on a Mexican Government publication, Consejo de Recursos Minerales, Monografia Geologico-Minera del Estado de Querearo, pages 74-75. The paper reported a reserve of 1,000,000 metric tons containing 253 grams per ton silver and 1.8% antimony in 40 hectares (100 acres). The deposit was interpreted as a manto (layered) deposit up to 5 meters thick. Although USAC used the report to start mining, it was disallowed by the S.E.C. as a basis for reserves.
MEXICAN PROPERTIES IN PRODUCTION

LOS JUAREZ PROPERTY, QUERETARO

Detailed mapping and sampling delineated jasperoid mineralization over an east-west strike length of 3.5 kilometers with a maximum width of 1 kilometer. Unlike most Mexican deposits, this deposit is primarily all sulfide. Preliminary exploration indicates that it could be a deep-seated jasperoid. USAC controls this property directly. The weighted average feed grade of 1261 tons recently milled from the open pit was 0.55% antimony, 5.12 ounces of silver (159.23 grams) per metric ton, and 0.050 ounces (1.555 grams) of gold per metric ton.
SIERRA GUADALUPE, ZACETECAS

Currently, the property is being mined by a third party who is delivering 2.5 to 4% sulfide antimony mill feed from dumps at a rate of up to 1,000 tons per month. They can produce up to 3,000 tons per month when they get their explosives permit and resume underground operations. USAC has an option to buy this property.

Guadalupe dumps, Zacatecas
MEXICAN PROPERTIES IN PRODUCTION

SOYATAL DISTRICT, QUERETARO

The deposit was the third largest antimony producer in Mexico. Donald E. White (U. S. Geological Survey Bulletin 960-B, *Antimony Deposits of Soyatal District, State of Queretaro, Mexico*, 1948) said that the production (p. 40) was estimated through 1943 at 25,630 metric tons of metal contained. USAC is sourcing oxide mill feed and direct shipping ore (DSO) for the USAC smelter at Madero, Mexico from this property and has exercised an option to buy the property.
GUADALUPANA, QUERETARO

This property was originally mined by Compania Minera Y Refinadora Mexicana, S. A. Estacion Wadley, SLP during World War II and thereafter. It consists of 3 underground levels with extensive drifts, stopes, cross-cuts, and raises. Currently, the mine is operated by a third party and they are supplying DSO and oxide mill feed.

Portal Guadalupana Mine, QRO
MEXICAN PROPERTIES IN PRODUCTION

WADLEY, SAN LUIS POTOSI

According to the U. S. Geological Survey (Bulletin 946-E, *San Jose Antimony Mines Near Wadley, State of San Luis Potosi, Mexico, 1946, Donald E. White and Jenaro Gonzales R.*) by 1943 the “San Jose mines have produced more antimony than any other district in Mexico, and they have been surpassed in production by only one or two other deposits in the world.” By 1943, the recorded production was 57,612 metric tons of contained antimony metal. Since that time the mine has probably produced another 25,000 metric tons of metal.
The mineralization is primarily in five layered deposits or “mantos” that are in a zone approximately 2 kilometers long and a kilometer in width that have been developed by 500 kilometers of drifts and cross cuts. In 1943, the U. S. Geological Survey noted “If the mining of low-grade ore becomes feasible in the future, large tonnages can be blocked out in the mantos and in the veins. In addition dumps resulting from more than 50 years of mining are readily available.
The future of the San Jose mines depends to a large extent upon the development of a milling process by means of which antimony can be extracted from low-grade oxide ore. The mines have been operated for the high-grade deposits -- those that contain ore that can be sorted to an antimony content of at least 30 percent.”
MEXICAN PROPERTIES IN PRODUCTION

WADLEY, SAN LUIS POTOSI

In the late 1990’s a heavy media separator (HMS) plant was installed with a capacity up to 500 tons per day. The plant has been modified to produce a 40-50% antimony concentrate with up to a 55% recovery.

USAC does not claim any reserves by S.E.C. definitions.
MILLING CAPACITY

USAC operates a 150 tpd combination flotation-gravity mill and an oxide-ore circuit at Puerto Blanco, Guanajuato, Mexico. The Company owns and is planning to install another 500 ton mill for its Los Juarez mine. Additionally, USAC is planning to ramp up the 500 tpd crushing circuit at the Wadley mine to mill the Wadley oxide-ore.
MILLING CAPACITY
Puerto Blanco Mill, Guanajuato

Vertical Shaft Impactor (VSI), Puerto Blanco Mill, QRO

Cone crusher, Puerto Blanco Mill, QRO

Ball mill, Puerto Blanco mill, Guanajuato
MILLING CAPACITY

Puerto Blanco Mill, Guanajuato
SMELTING CAPACITY

USAC operates an oxide-sulfide smelter in Mexico with a feed capacity of 130 tpm. It produces, crude oxide or metal, and makes precious metal recoveries. The Mexican production is shipped to the USAC smelter in Montana that produces antimony metal, oxide, tri-sulfide, and precious metals. It also has a precious metal circuit. The Montana smelter produces finished oxide from either crude oxide or metal and can produce up to 12,000,000 pounds of finished antimony oxide annually.
SMELTING CAPACITY

Precious metal recoveries

Silver pour, Mexico

Silver, Montana
CONCLUSION

With a strong demand for antimony, declining Chinese reserves and increasing costs, Mexico with renewed production and a willing work force, will play an important role in the world antimony market.