

GIANT YELLOWKNIFE MINES LIMITED
P.O. Bag 3000
Yellowknife, N.W.T.
X1A 2M2

FAX COVER PAGE

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ATTENTION: ROSS GILDERS (506) 452-1395 RPC

FROM: R. MORTON

NO. OF PAGES TO FOLLOW: 6 (Excluding This Cover Page)

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If there is a problem with this transmission, or if you wish to contact us, following are our numbers:

Telephone: 403-873-6301 ext. 128
Fax: 403-873-2980
Telex: 034-45514

JAN H. REIMERS AND ASSOCIATES INC.

Métallurgical Consulting Engineers

221 LAKESHORE ROAD EAST, OAKVILLE, ONTARIO, CANADA, L6J 1H7

Principals:

W. R. Snelgrove, P. Eng.


John C. Taylor, O.S.M., P. Eng.

Telephone: (416) 845-5301

Telex: 06-982354

Fax: (416) 845-3423

Oct. 7, 1988

To: 
Giant Yellowknife

From: *W. R. Snelgrove, Reimers & Assoc.*

Pages *5 + this cover*

Kent:

Here is Jim Hattman's assessment.

His recommendation 3 is what RPC have

tried with some success and 2 is also worth

a trial but I don't think No. 1 is practical.

Regards

Dix

ARSENIOUS OXIDE RECOVERY AND PURIFICATION FROM GIANT YELLOWKNIFE BAGHOUSE DUSTIntroduction

Giant Yellowknife Mines Limited is processing old baghouse dust from earlier arsenopyrite roasting operations to recover arsenious oxide for sale and generate a residue for recovery of its gold by cyanidation. Essentially, the process involves fuming the baghouse dust in a sand-bed-filled fluid bed reactor (FBR) to sublime the arsenious oxide. It then passes through a baghouse maintained at a temperature above that at which arsenious oxide will condense but ostensibly below the temperature at which any other impurities would be volatile.

Initial studies were performed with baghouse dust containing approximately 0.2% antimony. This material produced a arsenious oxide product within the tentative antimony specification of 0.2% Sb. However, when baghouse dust containing containing 0.7% Sb was tested, most of the antimony again reported in the final fume. This cannot be explained on the basis of the volatility of Sb_2O_3 which is compared with that of arsenious oxide in table I shown below.

Vapor Pressure of As_4O_6 and Sb_4O_6 versus Temperature

Temperature ($^{\circ}$ C)	Vapor Pressure (mm Hg)	
	Sb_4O_6	As_4O_6
200	$<10^{-6}$.87
300	3.3×10^{-6}	89.78
400	.001	2328*

* extrapolated value.

The antimony contamination is due rather to the formation of volatile vapor phase complex Sb-As-O compounds formed between Sb_2O_3 and As_2O_3 in the presence

of As_2O_3 gas or vapor. See New Chemistry For The Recovery and Separation of Arsenic and Antimony by T. Li and J.P. Hager, in the proceedings of the Reinhardt Schuhmann International Symposium on Innovative Technology and Reactor Design in Extraction Metallurgy, publisher, The Metallurgical Society, Warrendale, Pennsylvania.

A review of the above article shows an enhancement of 387 times in the vapor pressure, in effect, of Sb_4O_6 in the presence of 10 mm Hg vapor pressure of As_4O_6 vapor and a temperature of 427°C , equivalent to an antimony oxide content in the final arsenious oxide product of 15% Sb_2O_3 . Thus a mechanism for interdicting the formation of these compounds must be developed or alternatively, the As_4O_6 content of the gas phase must be maintained at a sufficiently high concentration to dilute the antimony content enough to produce a product meeting the antimony specification of 0.2%. Some scenarios for control of the antimony content are discussed below.

Techniques for Reducing the Antimony Content of Arsenious Oxide Fume

Control of the Antimony Content by Dilution

A review of the article by Hager and Li shows that although a significant increase in antimony oxide vapor pressure does occur, it is still only 1.52 mm Hg compared to 4780 mm Hg (an extrapolated value) for arsenious oxide under the same conditions of temperature (700°K). Therefore, provided the increase in antimony is not proportional to the vapor pressure of arsenious oxide (data in the above article only shows the relationship up to 10 mm Hg of arsenious oxide) it may be possible by adding enough heat to the fluidizing gas to increase the arsenious oxide content of the gas stream sufficiently to dilute the antimony to an acceptable specification (0.2% antimony in the arsenious oxide product). If the gas stream is saturated with arsenious oxide some superheating of the vapor will be required after the gases leave the fluid bed to avoid deposition of arsenious oxide at cool spots in the system. The actual temperature and arsenic oxide loading possible can be calculated by assuming adiabatic vaporization of arsenious oxide in the gas stream. At present the loading is greatly below the saturation pressure of arsenious oxide in the gas stream;

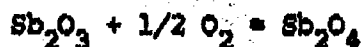
therefore, unless equipment or other process considerations prevent it, a test should be performed to evaluate this technique for antimony control.

Oxidation of Sb_2O_3 to Sb_2O_4 to Suppress its Volatility

The formation of volatile Sb-As-O compounds can occur only if antimony is present in the tri-valent form. Therefore conversion of antimony to either the tetra-valent or the penta-valent state will eliminate the formation of volatile antimony-arsenic-oxygen compounds. Antimony trioxide is readily converted to antimony tetroxide by oxygen at temperatures greater than about 500 °C. In fact, the tri-valent oxide is purported not to exist as such at temperatures between about 500 and 1000 °C in an oxidizing environment. This fact is well known to the processors of antimony sulfide (stibnite) concentrates, who are compelled to perform their roasting below about 500 °C to avoid the formation of the undesirable Sb_2O_4 . Knowledge of roasting technology employed in converting stibnite to antimony trioxide should prove useful in controlling the antimony content of the fumed arsenious oxide.

Two different techniques for antimony oxidation may be applicable; oxidation in the fluid bed reactor, and oxidation in the gas stream downstream of the fluid bed reactor, after it is now longer in contact with the baghouse dust.

Oxidation in the Fluid Bed Reactor-Oxidation in the fluid bed reactor can be accomplished by ensuring sufficient oxygen in the fluidizing gas (10% should be sufficient) for oxidation of the tri-valent antimony to take place. The temperature should be high enough to drive the reaction to completion. Based on the reported temperature of 450 °C in the air entering the FBR, and the assumption of adiabatic heating of the air by combustion of propane in the airstream, and no significant heat losses, the oxygen content of the fluidizing gas should be about 17-18% oxygen. Heating of this gas to 600-650 °C by additional combustion with propane will still leave sufficient oxygen to ensure oxidation of the antimony to the quadri-valent form. The reaction is:



A major concern with this procedure in the oxidation of the As_2O_3 to the pentavalent state and its subsequent reaction with iron oxides to form non-volatile ferric arsenate as shown below.



Formation of ferric arsenate is undesirable for two reasons; first, it reduces the amount of arsenious oxide product produced, second and probably more important, the extraction of gold in the subsequent cyanidation is reduced due to the blocking of the calcine pores with ferric arsenate. However, due to the simplicity of this oxidation procedure, testwork should be performed to determine if a combination of oxygen partial pressure and temperature exists where oxidation of antimony is substantially complete and little or no formation of ferric arsenate occurs.

Oxidation Downstream of the Fluid Bed Reactor

To eliminate the possibility of ferric arsenate formation, fuming of arsenious oxide can take place at a low temperature in the fluid bed reactor under a substantially neutral atmosphere and hot oxidizing gases can be added downstream in the flues. This technique although somewhat more complex mechanically, will eliminate the possibility of ferric arsenate formation and allow the use of higher temperatures and oxygen concentrations than could be tolerated in the presence of the iron oxide bearing calcine in the fluid bed reactor. It should be noted that this practice allows the formation of the volatile antimony-arsenic oxides then decomposes them downstream of the fluid bed reactor, as opposed to the process discussed immediately above in which the formation of the volatile antimony compounds was prevented. Because of this fact, antimony is reprecipitated into the gas stream and may be more difficult to remove and collect in the hot baghouse.

Conclusions and Recommendations

- * Antimony is present in the arsenious oxide product due to the formation of volatile vapor phase compounds of Sb-As-O.

- * These volatile compounds are only formed with tri-valent antimony; therefore, elimination of tri-valent antimony by oxidation to the quadri-valent state will substantially reduce or eliminate antimony contamination of the arsenious oxide product.
- * Three possible methods for reducing the antimony content of the final arsenious oxide fume should be considered for testing:
 - 1) Fuming of arsenious oxide at very high fume loading in order to dilute the antimony content of the product.
 - 2) Increase the oxygen concentration and temperature in the FBR sufficiently to oxidize tri-valent antimony to the tetra-valent state. This may result in the formation of an unacceptably high amount of ferric arsenate with the attendant disadvantages of less arsenious oxide product and poorer gold extraction in the subsequent cyanidation of the calcine.
 - 3) Operate the FBR at low temperature (350-450°C) and oxygen concentration and decompose the volatile Sb-As-O vapor phase species by introduction of hot oxidizing gas downstream of the reactor. Complete interception of the Sb_2O_3 fume in the hot baghouse may be difficult to achieve.