PULSE BLOWBACK FILTER SYSTEM FOR THE SEPARATION OF ANTIMONY-ARSENIC DURING FUMING OF CRUDE ARSENIC TRIOXIDE BAGHOUSE DUST

Prepared for:

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Attention: Mr. K. Morton

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RG:cem

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1.0 INTRODUCTION

RPC has recently completed the experimental work in connection with a study of the fuming of crude arsenic trioxide baghouse dust for Giant Yellowknife Mines Ltd. The program included testing of both current crude baghouse dust and dust stockpiled underground during operation of the Giant Yellowknife roaster.

A continuous pilot plant, incorporating the principle features of the conceptual flowsheet developed from the results of the bench-scale testwork, was constructed at RPC. A key component of the flowsheet was a high temperature baghouse (hot baghouse), using woven ceramic fibre filters, capable of sustained operation at elevated temperatures (1150 °C). The hot baghouse was used to separate the non-volatile components of the feed material from the gas phase containing the arsenic trioxide. Subsequent cooling of the gas phase yielded a high quality arsenic trioxide product.

Baghouse dust from current production was successfully treated in the pilot plant over a temperature range of 260 °C to 450 °C, the feed rate varying from 5 kg/h to 16 kg/h. A continuous run of 252h duration was successfully completed during which more than 2000 kg of current production baghouse dust was treated. A high quality arsenic trioxide product, meeting the specification with respect to antimony and iron content, was consistently produced.

The study has demonstrated successfully the process concept for the treatment of current production crude baghouse dust. The arsenic trioxide product meets the chemical specifications for the marketing of the product. Of the gangue elements in the feedstock, iron and antimony are present at the highest concentrations. The specification for the elements in the final product is 0.02% and 0.2% respectively. Current production crude baghouse dust contains 0.7 to 3.0% Fe and 0.1 to 0.2% Sb.

When stockpiled crude baghouse dust, containing 3 to 5% Fe and 2 to 3% Sb, was treated, the final product failed to meet the antimony specification. Under all conditions examined in the test program, greater than 50% of antimony in the feedstock reported to the final product, which itself comprises more than 20% by weight of the original feed. An additional series of tests using 0.5 micron porous metal elements in place of the woven ceramic filter bags was successful in reducing the antimony levels to less than 0.1% (down to 0.03%).

The hot baghouse, designed for woven ceramic filters with conventional cold baghouse pulse blowback cleaning, was modified for the sintered metal testwork. The original tubesheet and bag retainers were replaced with a tubesheet modified to accept sintered metal filters. The Micropul pulse blowback system would not have been effective and cleaning of the elements (8-2.5" x 48" x 0.5 micron) was carried out by means of a butterfly valve, which when acutuated forced condenser air back through the filter. This method of cleaning the filter elements was effective, however, timing and budgetary considerations did not allow for the installation of a proper pulse blowback system.

Sintered metal filters, depending on the type and grade of alloy selected, are utilized at temperatures ranging from 230°C to 925°C. Typical particulate removal efficiencies of 99.99% up to 99.999% are achievable using this type of filter medium. Sintered metal filters are available from various suppliers from 0.5 to 100 microns nominal opening. Finer sizes down to 0.1 microns are also available. Filter elements come as either single elements or clusters of three or more. Individual elements generally measure 2.5" in diameter by 48" in length (other sizes are also available) and are equipped with venturi nozzles for pulse blowback.

Typical air to cloth (or sintered metal) ratios vary with the dust loading, generally 8-10 ACFM gas/ft^2 filter area. Selection of mesh size is dependent on the particular application.

Subsequent to the success of the sintered metal testwork at RPC, Giant Yellowknife personnel visited a commercial operation in Huston, Texas utilizing Pall Corporations' high temperature pulse blowback filtration technology. Their experience with the sintered metal filters clearly demonstrated that high temperature gas filtration can be done effectively, provided that careful plant design is combined with good operating practice.

Pall Corporation's Scientific and Laboratory Services Scientists, have strongly encouraged Giant Yellowknife Mines to perform a series of actual gas clarification and blowback technique tests in a modified system located at RPC to determine optimum Pall PSS® filter media and mechanical design. Their engineering and laboratory personnel would assist in the function and would share over 40 years of experience in critical high temperature gas blowback and product recovery applications.

1 * Kent Morton of Giant Yellowknife Mines Ltd. has requested verbally that the purification testwork be completed utilizing the Pall sintered metal filters with heated air pulse jet cleaning in a modified vessel. Pall (Canada) Limited will be subcontracted by RPC (Appendix A) as requested by Giant Yellowknife, to provide the engineering and equipment required for modifying the existing hot baghouse to allow testing of their pulse blowback technology. 2 * Mr. Morton has also requested that RPC considers a two stage filtration system for separate collection of antimony trioxide and iron oxide gold calcine.

As Pall Corporation initiated the whole concept which lead to the request for further testwork and they are the clear leaders in the field, no other companies have been invited as subcontractors. The company has also agreed to the stringent schedule which required that most of the test work be completed by March 31, 1990. RPC will be required by Pall Corporation to sign a secrecy agreement in the terms of their agreement.

Note - 2 stage can be simulated by recycle of As_2O_3 product back through the system via a feeder.

2.0 WORK PLAN

2.1 Plant Modifications

RPC's present pulse blowback, high temperature baghouse will be modified to duplicate Pall (Canada) Limited's pulse blowback system. Pall, as subcontractor to RPC, will utilize the existing Micropul hot baghouse general arrangement drawings, provided by RPC to engineer and fabricate a new tubesheet/filter assembly. The assembly will consist of four 10 micron venturi sintered metal filters and form pulse blowback nozzles integrally mounted on a tubesheet sized to fit the existing baghouse shell.

The existing blowback header in the baghouse top will be connected to the new nozzles and filter assembly as engineered by Pall. The present hot baghouse top may require modification if the clearance for the Pall blowback nozzles is not sufficient. Pall will advise RPC as to what changes, if any, are required to the baghouse top.

A monorail/hoist will be added above the hot baghouse to facilitate removal of the baghouse top and tubesheet. The use of the company fork lift in the arsenic contaminated enclosure is no-longer allowed.

The bags in the cold baghouse are frayed and will be changed prior to further testing. A vacuum relief valve will be placed before the rotary positive displacement blower to prevent scrubber water carryover.

2.2 Test Program

The plant will be operated for a period of two weeks (14 days) on a 24 hour basis to test the Pall (Canada) Limited's pulse blowback filtration technology effectiveness to filter antimony and iron oxides solids from the volatile arsenic oxide flue gasses formed in RPC's 6" bubbling fluidized bed test facility. Pall will provide expert personnel from their Scientific and Laboratory Services (SLL) to help during set-up, running and collecting performance data from the test unit.

The pilot plant at RPC consists of a 6" bubbling fluidized bed, hot baghouse, condenser, cold baghouse and venturi scrubber (see flowsheet attached). Feed will consist of a blend of CBH and HBH products from previous runs and -42 mesh silica sand. Feed will be transported pneumatically to the fluidized bed from a live bottom bin hopper/volumetric screw feeder mounted on a weight scale. The propane burner system provides both process heat and low oxygen concentration (0.5-1.5%) desirable to prevent formation of ferric arsenates.

The plant will be operated at the following parameters.

a) Temperature °C:

Combustor	=	788
Bed	=	500-550
Freeboard	=	480
HBH Inlet	=	450
HBH Outlet	=	[illegible]
Condenser Inlet	=	[illegible]
Condenser Outlet	=	[illegible]
Cold Baghouse Inlet	=	[illegible]
Cold Baghouse Outlet	=	[illegible]

b) Pressures H_2O:

Freeboard	=	-2
HBH Diff.	=	5-10
System Diff.	=	20-25

c) Flows:

Feed Rate	=	10 kg/h
Carrier Gas Flow	=	30 l/m
Condenser Flow	=	40 SCFM
Coolant Flow (Air)	=	10 l/m
Burner Air (Fluidizing)	=	250 SCFM
Propane Flow	=	70 l/m

During the test, samples of HBH products will be collected and tested for gold leachability using 48 hr bottle roll tests. Both CBH and HBH will be assayed for Sb, As and Fe to ensure that the various products meet specification (Sb <0.2%, Fe <0.02% CBH; As, 1% HBH).

The concept of two stage filtration will be investigated by examining the hot baghouse products with the electron microprobe to establish the antimony-oxide association. Preliminary examination (report attached) of high antimony (16-20% Sb) hot baghouse calcine from initial testing in November 1988 suggested that this separation may be difficult. Antimony was always associated with arsenic in euhedral grains 10-30 microns average diameter and arsenic/iron, 1 to 10 micron grains. The high arsenic association, however, may be a result of the low temperatures in the hot baghouse that prevailed during the testing. The hot baghouse will be operated at much higher temperatures during the test program and the existence of this antimony/arsenic association will be confirmed at this time. Batch testing could be carried out in two separate stages if the microprobe examination shows that this concept may be feasible and providing there are sufficient funds remaining in the budget.

3.0 WORK SCHEDULE

The project will commence immediately following notification of approval by Giant Yellowknife Mines Ltd. and a purchase order will be issued to Pall (Canada) Limited who will expedite engineering and fabrication of the tubesheet filter-blowback nozzle assembly.

On the assumption that approval for the project will be given by the client prior to January 29th, 1990, it is proposed that the following work schedule will apply:-

Phase I   Plant Modifications

- Strip down, clean and decontaminate hot baghouse, install new tubesheet assembly as per Section 2.1.

  Start - Early February
  Completion - End February

Phase II   Test Program

- Carry out roaster program to test effectiveness of filtration technology for separation of antimony from volatile arsenic. Collection of data and investigation of two stage filtration concept.

  Start - Mid March
  Completion - Mid April

Phase III   Reporting

- Analysis of results and completion of final report.

  Completion - End May

4.0 COST AND PAYMENT SCHEDULE

RPC will complete the work as outlined in this proposal for the sum of $100,000 (One Hundred Thousand Dollars) which will include the subcontracted cost of work to be completed by Pall (Canada) Limited ($27,250).

RPC will submit invoices according to the following schedule:

a)	Upon receipt of approval to proceed	$10,000
b)	Upon completion of Phase I	$35,000
c)	Upon completion of Phase II	$45,000
d)	Upon completion of Phase III	$10,000

APPENDIX A

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RESEARCH AND PRODUCTIVITY COUNCIL

11.JAN.90

Job: 08008014/0009
Mineralogical Examination of Two Polished Sections

Sample: Hot baghouse, Giant Yellowknife, Dec. 26, 1988

Phases identified:

1. Sb-As (oxide ?) compound.
   Grain size: from below 1 mic. to 100 mic.
   Average grain size: between 10 mic. and 30 mic.
   Largest grains contain abundant inclusions of silicates, quartz, Fe-Sb-As oxides.
   Shape of the grains: frequently euhedral (columnar, tabular), although subrounded and angular shape prevails.

2. Fe-As-Sb compound.
   Forms grains up to 20 mic. Grains between 1 mic. an 10 mic. prevail. It contains variable quantities of As and Sb.

3. Fe-Sb-As-S compound. Grains between 1 mic. and 10 mic. prevail. Grains as large as 20 mic. were also observed.

4. Fe-oxide with variable, low, content of As and Sb. It forms the finest, averaging a few mic., fraction in the sample.

5. Other phases were identified: K-Al silicate, Na-Al silicate, dolomite, Ca oxide/carbonate, trace galena. Size: between 1 mic. and 100 mic.

Prepared by:

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