

Giant
YELLOWKNIFE MINES LIMITED

MEMO TO: S. E. El-Alfy
CC: K. Blower
FROM: K. Morton
DATE: January 6, 1988
SUBJECT: ARSENIC TRIOXIDE PARTICLE SIZE

From recent discussions with Mr. Chalkley of R.P.C., it is evident that they are having some problems with design of the condenser for the pilot plant. The main difficulty to overcome is to keep all surfaces hot to prevent crystal growth or to keep As fume away from cold surfaces until crystallization is complete. Although it is possible to achieve this through flash condensation (rapidly introducing large amounts of cooling air tangentially into the gas stream) crystals produced would be extremely fine, probably similar to the existing 80% <2 micron.

One major objection to fine crystals is the low bulk density which leads to excessive shipping and/or storage costs. As we have experienced in past arsenic shipments, the volume of the shipping container may be exceeded before the allowable GVW is achieved. This is not so serious if there is no penalty for underweight shipments but this is not considered likely.

Another problem with fine crystals is the difficulty in handling without creating high ambient dust levels. Strict occupational health regulations make this a very important consideration, not only to us but to potential customers as well. A relatively coarse, free flowing, dust free product is preferred.

Recognizing the desirability of producing a dense, dust free product, we should consider the options available to us.

1. Efficient condenser design, promoting crystal growth in the gas stream while avoiding As_2O_3 accretions on condenser surfaces.
2. Surface condenser, deliberately forming crystals on condenser surfaces and mechanically removing the resulting flake.
3. Compaction of fine particulate in briquetting press. Tests done by F.M.L. in 1975 show that density can be increased at least threefold by pressing at 8,000 lbs. with the addition of 3% water.

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Option 1 seems to be the most desirable though technical problems may be too much for us. Chemical Engineers Handbook states: -

"Change of Vapour to Solids - This rate is controlled by the rate of heat removal from the gas phase and from solids formed in the gas phase. This step is not usually rate controlling unless the crystal form and size of condensed solids are important.

Heat Flow from the Condensed Solids - This rate will be controlled by conduction when indirect cooling alone is used. Unless means are provided to avoid the build-up of a condensed layer of solids on the cooling surface of the condenser in simple sublimation, with passage of time the rate limiting mechanism is likely to become conduction from the condensed solid. Rapid cooling by injection of a cool quench gas directly into the condenser - yields a snowlike crystalline form of the solids and reduces the amount of scale formed on the condenser surface.

Equipment - The state of development of sublimation is much more advanced than that of condensers. Solids condensing equipment often consists of nothing more than field fabricated tanks equipped with mechanical scrapers, brushes or vibrators for removing the condensed solids."

From this it appears that Option 2 is common practice, though perhaps not so much when dealing with highly toxic gases and solids. One possibility for a mechanical apparatus is a rotary drum with external cooling and large diameter grinding media to break up scale formed on the walls. Grinding media should be abrasion resistant to prevent Fe contamination of final product. Operation would probably be cyclical to promote crystal growth.

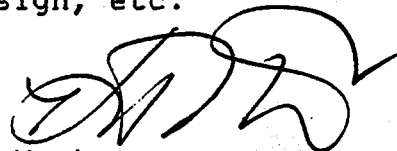
The third alternative, compaction of fine particulate has the advantage of being a proven process and has the capability of producing any size particle desired. It can also be used if necessary to compact current production baghouse dust to reduce underground storage requirements. A possible disadvantage is the problem of dust control. The more recent machines have much better dust control than earlier models but screening of the broken flake produced by the compactor is another potential source of dust.

All three options are actively being considered and several steps have been taken towards selection of the best alternative.

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1. R.P.C. has designed a condenser for the pilot plant that will theoretically produce a dense crystalline product through controlled cooling. Their design incorporates features from S. Fekete's concept and from the Hatch Associates patent for condensation of As_2O_3 fume.
2. Isko Heat Exchangers Limited of Montreal, designers and manufacturers of condensers, have been asked to comment as to what they feel would be a suitable condenser design. From a telephone conversation with design engineer, Ishy Kahn, they don't foresee any difficulty.
3. Kamarek Greaves, manufacturers of compactors, have offered to conduct further compaction tests on pilot plant product and have sent product literature for our examination.

Though we should keep our options open, I think the next step is to await pilot plant results. If the condenser cannot produce crystals of adequate size and density we should proceed with modifications, compaction tests, redesign, etc.



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