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## Densification of $\text{As}_2\text{O}_3$

There are several ways in which the bulk density of  $\text{As}_2\text{O}_3$  can be increased. Controlled sublimation from a gas, cold surface condensation, crystallization from a mother liquor, extrusion of a paste, roll compaction, disc or drum pelletizing, and shaker tables have all been examined for use at Giant at one time or another.

There are 2 machines in the boneyard at Giant, a paste extruder and a pan pelletizer. It is surmised that these were once used to test densification of baghouse dust for underground storage. So far there is no documentation to show the results of testwork, or indeed that any testwork ever took place.

In 1975 Falconbridge Metallurgical Lab tested crude baghouse dust in a flat roll compactor with addition of 3% water. Bulk density was increased from 26 lb/ft<sup>3</sup> to 109 lb/ft<sup>3</sup>. They also examined the use of a hydraulic plunger compactor and a paste extruder. The roll compactor was determined to be the best alternative.

Larry Connell and Bryan Cross conducted crystallization testwork in 1979 on baghouse dust. Outside testing was done at Struthers-Wells and the crystallized product had a bulk density of about 125 lb/ft<sup>3</sup>.

Shipments of crude baghouse dust in drums from Giant were densified by vibrating the drums on shaker tables as they were being filled. As the entrained air escaped and the material compacted in the drum, the density increased from about 30 lb/ft<sup>3</sup> to about 50 lb/ft<sup>3</sup>.

Samples of purified  $\text{As}_2\text{O}_3$  from pilot plant studies was sent to Ferro-Tec and Ludman machine in 1988 for compaction testing. Both companies produced high quality button compacts on a laboratory press. Only Ferro-Tec was willing to test the material on a full size compactor in their shop however, and their tests confirmed that a bulk density of at least 106 lb/ft<sup>3</sup> could be achieved in a roll compactor with the addition of 3% water and 30 tons of roll pressure. Ferro-Tec also tested densifying the purified dust using pin agglomeration followed by pan pelletizing. The experiment was only partially successful in that lignin rather than water was required as a binder, and the pellet density achieved was only 77 lb/ft<sup>3</sup>.

Furukawa, a Japanese company offered to sell their  $\text{As}_2\text{O}_3$  sublimation technology to Giant for a fee of approximately \$206,000 in 1988. The key to their ability of producing dense crystal from direct sublimation was in the design of a second stage condenser, with which they could apparently control the rate of sublimation and crystal formation. The fee was felt to be too high at the time.

Cold surface condensation can be used to plate a film of arsenic trioxide directly from the gas phase onto a cold surface, from which it can be scraped off as a dense, high purity flake. Patent and literature searches done by consultant Ron Hatch turned up

## COMPACTION SUMMARY

only small scale apparatus not suitable for an industrial application. Current investigations indicate that the equipment is available, but is very inefficient and expensive. More information is being sought but it seems more and more likely that technology from an earlier age might be more suitable. Two examples are shown below.

Anaconda used a primitive type of cold surface condensation in their arsenic trioxide plant, which was built at Anaconda, Montana in 1904. Essentially crude arsenic trioxide was fumed from a wood fired furnace and carried through brick flues to the condensing chamber. The chamber was 8 ft high, 16 ft wide, and 240 ft long, divided into small kitchens by partitions spaced every 7 feet. The fume took a zig-zag course through the kitchens, causing them to come in contact with the cold walls and ceiling, condensing out the arsenic. There was a small door into each kitchen from the outside, which permitted periodic removal of the deposited arsenic. The dust might have to be reprocessed to bring the product quality to minimum standard, 95 to 99% pure. Unfortunately the paper from which the above information was taken did not include any reference to bulk density of the product.

Asarco used a similar idea until quite recently. Their process used four Godfrey roasters connected to three kitchens having multiple stalls (15 stalls, 5' wide, 51 ft long) .To quote from Asarco's description "Generally speaking, saleable  $\text{As}_2\text{O}_3$  is deposited in the back half of the kitchens, dust deposited in the front half is rerouted. All arsenic is pulled from the kitchens using a double drum hoist and scraper. A heavy crystalline deposit of  $\text{As}_2\text{O}_3$  forms on the walls and arches of kitchens and must be dug out every 8-12 months." Again there is no mention of bulk density, but a 'heavy crystalline deposit' indicates that this portion of the condensate at least, will have a high bulk density.

In January 1997 a quote was obtained from Ferro-Tec for a compactor having a roll pressure of 30 tons and a throughput of 1.0 to 1.5 tph. The price was \$187,000 US and delivery could be made 16 - 18 weeks following placement of an order.

The full compaction plant, including 40 ton feed storage bin, live bottom feeder, weigh belt, dust collection system, discharge conveyor, and tubular drag conveyor is estimated at \$577,000.