

## FALCONBRIDGE NICKEL MINES LIMITED

INTER-OFFICE MEMORANDUM

DATE: May 28, 1979

TO: D.J. Emery

COPIES TO:

FROM: H.T. Evans

SUBJECT: GIANT YELLOWKNIFE ARSENIC PROJECT

As discussed at our meeting on Friday, May 25, 1979, I have made some notes on the hydrometallurgical refining of arsenic trioxide. These notes are based on a very cursory review of the literature and are recorded to protect, where applicable, technical concepts that may have potential commercial application.

1. The hot water leach process is known to be operated commercially. In the event that the arsenic trioxide produced is off-white, it can usually be decolorized by passing the pregnant solution through a bed of activated charcoal.

The rate of dissolution in water is reported to increase in the presence of either hydrogen or hydroxyl ions. The latter appear to have the more pronounced effect. The presence of the hydrogen ion (acid solution) is said to augment the solubility of arsenic trioxide.

R.M. Chapin (Jnl. Ind. Eng. Chem. 1918, 10, 522) recommends preparing solutions by using an excess of the 'crude' oxide and making the final crystallization "from a slightly hydrochloric acid solution."

2. Arsenic trioxide is also soluble in solutions of oxalic, tartaric and other organic acids. As in the hot water system, pure arsenic trioxide crystallizes on cooling a hot saturated solution of arsenic trioxide in oxalic acid.
3. R. Suchy and J. Michel (U.S. patent 1532454 - 1925) dissolved crude arsenic trioxide in a solution of sodium carbonate and reprecipitated the trioxide with carbon dioxide.
4. Aqueous solutions of the alkali hydroxides and aqueous ammonia dissolve arsenic trioxide and, depending on the concentration of alkali, arsenites may be formed.

At low concentrations of alkali the solid phase in equilibrium with the saturated solution is arsenic trioxide. The slope of the solubility curves show a rapid increase in solubility of arsenic trioxide as the alkali concentration increases to the point where the solid phase becomes the alkali arsenite. Temperature has the same effect on these systems as it does in the water system; therefore, it should be possible at low concentrations of alkali to recover arsenic trioxide from saturated solutions prepared at elevated temperatures. The use of alkaline solutions, however, have limitations among which the following are considered the more serious:

- (a) their ability to dissolve extraneous oxides, e.g. those of antimony or in an ammoniacal system even heavy metals might be solubilized,
- (b) the difficulty in completely removing the alkali from the product without extensive washing and the accompanying loss of product.

The use of ammonia as the alkaline medium would overcome the second limitation as heat could be used to remove the ammonia.

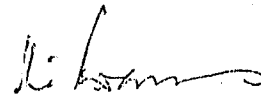
In view of the relatively high vapour pressure of ammonia, precautions must be taken in the leaching stage to minimize potential losses. The physical parameters, pH, vapour pressure, etc. of ammoniacal solutions have been established and, if necessary, could be advantageously applied in the development of a flowsheet. This would be particularly true in the crystallizing circuit which represents a potential area of water imbalance resulting from the application of steam distillation.

Ammonia has been used as a solvent for arsenic trioxide and Berzelius (1817) found that it dissolved freely in a hot solution and that redeposition occurred on cooling. Similar results had been obtained earlier by de Lassone (1775) who evaporated a solution of the trioxide in ammonia. Kessler (1855) is reported to have tried to eliminate antimony from arsenic trioxide by dissolution in aqueous ammonia, evaporating the filtered solution and subliming the residue. This, apparently, was not successful and later investigators (Wohler 1857) have also reported failure in the same endeavours.

Probably the most reliable work on the aqueous systems of arsenic trioxide with the alkalis and ammonia is that of Schreinemaker and de Baat (1915-1920).

5. Flotation could be used to upgrade certain residues; however, its point of application in the circuit requires careful consideration to avoid introducing environmental disposal problems.

Should you feel the above need to be augmented or clarified in any way, perhaps you would let me know.



H. T. EVANS

HTE:ld