Division of
Mineral Dressing
and
Process Metallurgy

552 Booth Street,
Ottawa, Ontario,
July 25th, 1951.

Memorandum to: Mr. R. J. Traill,
Chief of Division.

Re: Visit to Yellowknife, N.W.T., to investigate disposal of arsenic trioxide produced during roasting of arsenical concentrates.

- -

I attach copies of a report which embodies the conclusions drawn from my survey of the arsenic disposal problem at Yellowknife. The trip to Yellowknife was made at the request of Mr. G.E.B. Sinclair, Northern Administration and Lands Branch, whose department paid all the expenses involved.

There are at present three operating mines at Yellowknife. The Con mine is roasting concentrates, catching the arsenic trioxide produced by a wet impinger system developed by themselves, and storing the wet slurry in a surface pond. Clear solution from the pond is pumped back to the impinger for re-use. Since water evaporates both from the pond and in the impinger, water will have to be added to the system from time to time to maintain a suitable volume.

The pond is formed partly by natural rock, grouted where necessary, and partly by a concrete dam. Its size is roughly 300 ft. by 100 ft. It is said by the Con

management to be water-tight, although no effort appears to have been made to establish this by sampling nearby waters. The capacity of the pond was estimated at about six years at present rate of production of arsenic trioxide, which is 3-4 tons per day. By raising the dam, about twenty years production can be stored.

The Con management claimed that the use of stainless steel and lead had solved their corrosion problem. The pond water contained only 0.1 g/l. sulphuric acid. The operation was said to be entirely satisfactory, and about 92-94% efficient. It was estimated that with the knowledge now in their possession, a similar system could be built for $125,000, not including the storage pond which would cost $75,000. The operating cost was estimated at $15 per day.

The Giant Yellowknife mine is currently producing about 4 tons of arsenic trioxide per day, none of which is being caught. They are, however, building a Cottrell precipitator which will catch the arsenic trioxide in a dry condition. This will then be stored underground in a permafrost zone quite away from the active mine workings.

Giant management stated that the Cottrell precipitator and buildings would cost $300,000, and underground storage for two years production of arsenic trioxide would cost an additional $30,000. They estimated that they could excavate underground at a cost of $1.50 ton of rock moved.

The Negus mine is not roasting at present, but plans to install a Dorrco roaster to roast their stockpiled concentrates. Their problem, and their proposal for dealing with it, is described in the attached report.

The writer visited all three mines in company with Mr. K. J. Christie, Chief Mining Inspector, Mr. S. Homulos, Mining Inspector, both of the Northern Administration and Lands Branch, and Dr. K. Kay, of the Dept. of National Health and Welfare. We discussed the

..... 3

problems with the management in each case, and examined the facilities both on surface and underground. Finally, we discussed the situation among ourselves.

The attached report was drafted at Yellowknife by the present writer, and it is believed that Mr. Christie, Mr. Homulos and Dr. Kay are in general agreement with what is set down.

Copies of the report have been sent to Mr. Sinclair and to Mr. Christie at Yellowknife.

K W Downes

K. W. Downes.

Encl.

DISPOSAL OF ARSENIC TRIOXIDE AT NEGUS MINE, YELLOWKNIFE, N.W.T.

(Conclusion drawn from a visit to Yellowknife, N.W.T., July 9 - 12, 1951)

Negus mine is currently producing and stockpiling an arsenical concentrate. The management now proposes to install a Dorrco roaster which will be used to roast these concentrates. For the first eighteen months after installation the roaster will treat both current and stockpiled concentrates. By the end of this time the stockpile will all have been treated, and the roaster will thereafter operate on current production.

The roasting of this arsenical concentrate will produce a fume of arsenic trioxide, and Negus mines is obliged, in common with the Giant Yellowknife and the Con Mine, to find some means of catching and disposing of this fume. The Negus management concedes, and the present writer concurs, that the best method of catching and disposing of the arsenic trioxide is by a Cottrell precipitator or bag house, the dry material being stored underground in a permafrost zone. This method is being adopted by the Giant Mine, a Cottrell being under construction at the present time.

However, the Negus management contends that they cannot afford the expense of a Cottrell precipitator. They also assert that a bag house, which would be cheaper, cannot be used in their case, because of the high sulphur dioxide content of the roaster gases produced by the Dorrco roaster. Tests by the Dorr company indicate that the sulphur dioxide content will be about eight percent. Thus Negus feels that they are obliged to adopt the wet collection method now used by the Con Mine.

In the case of the Con mine, the wet collection method using the C.M. and S. impinger is claimed to operate

satisfactorily, and at high efficiency. The arsenic trioxide is obtained mixed with water as a slurry, which is presently pumped out to a surface pond, said to be watertight. The solids settle out in the pond, and the clear water, containing however dissolved arsenic trioxide, is then pumped back to the impinger for re-use. This method of disposal has been in operation for about six months. It appears to be satisfactory, although no organized campaign has been arranged to search for leakage of arsenic-bearing solutions from the pond.

Unfortunately, any pond placed on the Negus property would, if any leaks occurred, drain toward Yellowknife bay, from which drinking water is drawn. Negus, therefore, proposes to set up a pond underground using an opening to be slashed out in the present mine workings, 100 feet long, 10 feet wide, and 100 feet deep. They feel that such an opening can be made leak-proof by grouting and suitable damming of the drifts.

The writer feels that any method of wet storage of arsenic trioxide should be regarded as experimental, especially since no careful search for leaks has been made in the case of the Con mine. Even though no leaks can be detected at present, there is the long-term action of the solutions on concrete and rock minerals to be considered. An additional hazard appears to exist in the underground storage proposed by Negus, since the upper 50 feet of the site selected will be in permafrost. The consequence of this is that after the storage site is filled and closed up, freezing will set in. The effects of the expansion produced by freezing are impossible to predict.

It must be observed that the freezing can be prevented by a change of storage site to an area outside the permafrost zone. This would not alter the fact, however, that

the wet storage of arsenic trioxide is relatively untried, and may yet lead to difficulties through leakages. The problem of permanently and completely stopping the action of circulating waters underground may be more difficult than the Negus management anticipates.

In view of the success claimed for the Con surface storage, perhaps no impediment should be placed in the way of Negus if they wish to adopt it, in the absence of evidence to the contrary. It is possible that, although no suitable surface storage appears to exist on Negus property, a site could be leased from Con for the purpose, having drainage away from Yellowknife bay.

The present writer feels, however, that dry storage underground in a permafrost zone is the best solution. It is felt that, if a Cottrell is too expensive, wet collection may not be the only alternative. A bag house should be considerably cheaper and, although Negus claim it to be unsuitable in their case, it is not certain that an exhaustive examination of this possibility has been made. New synthetic fabrics are available today, and, in addition, the possibility of diluting the roaster gases with outside air may not have been explored.

It is felt, therefore, that Negus should be encouraged to go to dry storage underground in a permafrost zone if at all possible. Failing that, surface storage of the wet slurry as adopted by Con may be admissible, and, perhaps could hardly be denied. The writer is not prepared to assert that underground wet storage would be impracticable, provided it were located quite outside of any permafrost area, so as to avoid the expansion which would occur as the slurry froze. It does appear, however, to endanger the mine workings more than the wet surface storage.

It is certain that other mines will open in the

N.W.T., and that the problem of arsenic disposal will arise again and again. It appears most advisable, therefore, that a definite policy be arrived at if at all possible, so that the mines involved will know in advance what conditions must be met.

K. W. Downes.

K. W. Downes.

KWD:EBM