DEPARTMENT OF MINES AND RESOURCES

BUREAU OF MINES

CANADA

Ottawa, April 30, 1946.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 2041.

Fusion Tests on a Sample of Vacuum Pan Salt from the Dominion Tar and Chemical Company Limited, Montreal, Canada.

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Note:
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DIVISION OF METALLIC MINERALS
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Shipment:

A shipment of 100 pounds of fine-grained vacuum pan salt from the Dominion Tar & Chemical Company Limited, Sun Life Building, Montreal, Quebec, was received in the Ore Dressing Laboratories of the Bureau of Mines, Ottawa, on January 24, 1946.

The sample was submitted by Mr. Arthur O. Ponder, President, for the Dominion Salt Company Limited, Sarnia, Ontario.

Purpose of the Investigation:

The purpose of the investigation was to make preliminary small-scale fusion tests on the salt to determine whether a coarse-grained, white, crystalline product could be obtained.

Discussion Re Fusion of Salt:

The problem of producing a coarse-grained white crystalline salt has been under investigation in the laboratories of the Bureau of Mines for several years.

Small batch tests have indicated the possibility of making a satisfactory product, and continuous tests in a pilot plant have confirmed the application of such a method to a limited degree.

There are, however, several factors which must be considered in such a method.

To produce a white salt it is desirable that the salt be free of impurities, or if such is impossible, there are limitations in the amounts which can be commercially treated.

Calcium sulphate in small amounts does not appear to be detrimental. This impurity tends to remain insoluble in molten salt and does not impart colour to the final product.

Iron in any form presents serious difficulties, mainly in producing a marked discolouration. Investigation has shown that as little as 0.01 per cent of ferric chloride added to a chemically pure salt will cause a yellow discolouration unless chemically treated.

Silica, or other insoluble matter not containing iron, does not affect the colour of the salt but may be very objectionable in continuous operation of the furnace. A furnace similar to a reverberatory type is not considered feasible, particularly if such an impurity as silica is present in the salt. A rotary furnace is nearing completion and test work is contemplated to study the effect of design and operation of such a furnace to continuously remove the small amount

(Discussion Re Fusion of Salt, cont'd) -

of insoluble material which in the reverberatory type of furnace accumulates as a solidified sludge and necessitates frequent shutdowns.

Carbon, either resulting from carbonaceous material such as wood chips in the salt or from poor combustion of the fuel, causes grey discolouration in the salt product.

Laboratory tests are conducted in crucibles of various compositions. Iron-free silica crucibles are used to investigate the presence of iron in the original sample. Low iron content can usually be detected by the degree of discolouration.

The majority of tests, however, are done in fireclay assay crucibles. Several preliminary melts are made in order to leach the iron from these crucibles.

Sillimanite containers have proved highly successful, but cost for furnace construction may be prohibitive.

Certain reagents have proved beneficial in counteracting iron and carbon impurities. The maximum amount of these impurities that can be successfully treated has not been definitely established.

It is of interest to note that the alkalinity of sodium chloride salt increases as a result of melting. The alkalinity of various samples of fused salt has a range in pH from 9 to 10.

LABORATORY TEST WORK:

Fusion tests on the sample submitted were made in all types of crucibles previously mentioned, using underfired illuminating gas furnaces.

The chemical analysis of the salt before fusion is shown in Table I.

(Continued on next page)

(Laboratory Test Work, cont'd) -

TABLE I. - Chemical Analysis of Vacuum Pan Salt from Dominion Salt Co. Ltd., Sarnia, Ontario.

		Per Cent
NaCl	-	99.80
CaO	-	0.09
SO_3	-	0.10
Fe_2O_3	-	0.004
Insoluble	-	0.01
MgO	-	Trace.

Using silica crucibles without addition of any reagent, a white opalescent product was obtained. The crucibles showed no sign of precipitated dregs which would occur had the salt contained any appreciable iron or insoluble impurities.

Preliminary fusions were made in a 400-gram fireclay crucible. This curing effect on the crucible resulted at first in a dark yellow salt product, and with additional fusions the products gradually became lighter in colour until, finally, with the iron leached out of the clay a satisfactory white product was obtained.

With the addition of sufficient sodium nitrate or phosphoric acid, it was possible to secure a white salt from the first melt, using a new unleached crucible.

Commercial-grade sodium nitrate and phosphoric acid (85 per cent H_3PO_4) were used. Consistent white products were obtained when either of the two reagents was used. Additions of 0.2 per cent were considered essential to ensure a white salt.

When sodium nitrate is used there remains in the bottom of the crucible a light yellow precipitate. Investigation has shown this to be an iron salt. Due to the low iron content of the vacuum pan salt, the presence of the small amount of this precipitate could be attributed to the iron leaching out of the fireclay crucible.

If phosphoric acid is used no iron precipitate

(Laboratory Test Work, cont'd) -

occurs in the bottom of the melting crucible. Any iron leached from the crucible, or that in the salt, is considered to be converted to a ferric phosphate and be dispersed throughout the salt.

Seven samples of salt products made in fireclay crucibles in the present investigation are being forwarded to the company's Montreal office for examination and comment. The particulars regarding each sample are detailed in Table II.

TABLE II. - Description and Remarks on Samples of Fused Salt Products made from Vacuum Pan Salt, from Dominion Salt Co. Ltd., Sarnia, Ontario.

Sample No.	Remarks
1.	Cast block of salt using no reagent.
2.	Same as No. 1, crushed to minus 3 mesh.
3.	Cast block of salt, using sodium nitrate
4.	Same as No. 3, crushed to minus 3 mesh.
5.	Cast block of salt, using phosphoric acid.
6.	Same as No. 5, crushed to minus 3 mesh.
7.	Cast block of salt, using no reagent. Made under slightly poor operating furnace conditions, in a fireclay crucible not completely leached from its iron-staining impurities.

Table III shows the average screen analysis of the three samples of fused salt, stage-crushed in laboratory jaw crusher and rolls at these Laboratories:

TABLE III. - Average Screen Analysis of Fused Salts Crushed.

Mesh	Weight, per cent
-3 +4	25.6
-4 +6	20.6
-6+10	22.0
-10+20	11.1
-20	20.7

Conclusion:

Preliminary fusion tests on the sample of vacuum pan salt submitted would indicate that a white, opalescent salt can be made by the fusion method. Such a salt, if cast in block form in a cooling conveyor, could be crushed to produce a relatively coarse-grained, hard salt. The percentage of fines made would depend on the size of the product desired, the method of crushing, and the extent of the cooling of the salt blocks before crushing.

Although a white product was obtained without the addition of reagents once the iron was leached from the clay crucible, continuous plant operation would in all probability require the addition of a small amount of reagent to ensure a satisfactory product.

Operating conditions using a reverberatory type of furnace are extremely difficult if there is any appreciable amount of insoluble impurity present which tends to settle out in the furnace.

The Department is not prepared at the present time to state the feasibility of a rotary type of furnace as compared with a reverberatory type.

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