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MADISON SQUARE AREA
Report A-2901 (S)
PERFORMANCE OF CHIPPED MAGNESIUM Versus
HAMMERMILLED MAGNESIUM IN THE BOMB
REDUCTION OF TETRAFLUORIDE - I
2 June 1945 ✓

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Report A-2901
(Special)

PERFORMANCE OF CHIPPED MAGNESIUM

Versus

HAMMERMILLED MAGNESIUM
IN THE BOMB REDUCTION OF TETRAFLUORIDE

MADISON SQUARE AREA
MANHATTAN DISTRICT
CORPS OF ENGINEERS

2 June 1945

CLASSIFICATION CHANGED TO

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DATE 12-9-55

H. F. Canale

Chief, Declassification Branch *mcl*

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UNITED STATES ATOMIC ENERGY COMMISSION

PERFORMANCE OF CHIPPED MAGNESIUM
VERSUS HAMMERMILLED MAGNESIUM IN
THE BOMB REDUCTION OF TETRAFLUORIDE
[PART] 1

June 2, 1945

Madison Square Area
Manhattan District
New York, N. Y.

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For The Atomic Energy Commission

H. F. Canale
Chief, Declassification Branch

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Introduction and Abstract

A program has been sponsored by the Madison Square Area to secure a source of magnesium other than ground New England Lime crowns. The reason for this is twofold: (1) the over-all quality of present New England Lime magnesium is quite variable resulting in erratic biscuit yields. It is also found to be high in nitrogen; (2) in case of an emergency breakdown at New England Lime, production of uranium would be seriously threatened, since it is impossible to stockpile magnesium crowns because of the formation of nitrides and oxides and since no other sources of magnesium of suitable quality are available. But since it is possible to produce magnesium billets of uniform quality and to store them indefinitely without appreciable nitride or oxide build-up, it was felt that if magnesium powder suitable for the reduction step could be produced from billets, then both of the above mentioned problems could be solved quite simply.

The O. Hommel Company, of Carnegie, Penna., supplied Mallinckrodt Chemical Works with three types of magnesium chips or powder (Type 84, 85B, and 87B) formed by machining magnesium ingots. This material was tested and compared with standard New England Lime magnesium in a series of reduction runs. A new type of powder (type 93) developed by the O. Hommel Company during the course of the first experiment was also sent to Mallinckrodt Chemical Works for preliminary testing. As this was superior to the other types tested, a large batch was made up and sent to both Electro Metallurgical Company and Mallinckrodt Chemical Works in order to confirm the preliminary results obtained by Mallinckrodt Chemical Works alone. Type 93 proved to be as good as standard New England Lime magnesium, but the high price quoted by O. Hommel made its use prohibitively expensive.

The reports from Mallinckrodt Chemical Works and Electro Metallurgical Company on the various types of magnesium powders tested throughout the program are presented below.

A. Report from Mallinckrodt Chemical Works on Three Types of Magnesium Powder produced by O. Hommel Company. These are Type 84, 85B, and 87B. Report is dated 19 January 1945.

Discussion

The three trial lots of magnesium received from the O. Hommel Company are classified by them as types 84, 85B, and 87B, and for simplicity will be so designated throughout this report. Of these different grades of magnesium only types 85B and 87B appear to be usable in a practical manner. The 84 magnesium is so bulky that its use would limit the charge to about one-half the present amount used in each bomb. In addition, this bulkiness presents difficulties in making and holding a homogeneous mix of green salt and magnesium. There does not seem to be much difference between types 85B and 87B based on a visual

inspection, although a screen analysis shows the former to be slightly coarser. The chip magnesium is quite different in form and appearance from hammermill magnesium. The chip magnesium is principally and quite uniformly polyhedral-shaped pieces which are bright and shiny, whereas the regular hammermill magnesium is about half polyhedral particles (smaller in size) and half sliver-shaped particles which are dull in appearance.

The only specifications requested were on the magnesium particle sizes. These were given as follows:

Table I

Tyler Standard Screens

	Per Cent On					Per Cent Thru 48
	8	10	24	35	48	
Type 1	11.0	32.4	53.3	2.7	0.4	0.2
Type 2	2.3	21.2	64.1	11.6	0.6	0.2
Type 3	0.0 per cent on 12; 96.6 per cent thru 12 on 48					

Pictures of the four different types of magnesium are included in the Appendix.

The hammermill magnesium used in this test series was processed in the standard manner, which includes knifing, separating into the three fractions - "on 20", "on 30", "on 50" -, mixing the three fractions individually, and then recombining the fractions in the ratio of sixteen pounds of "on 20" to five pounds of "on 30" to one pound of "on 50".

One-third of each of three New England Lime lots was used to secure a standard magnesium as representative as possible-- the three lots used being 236, 238, and 241. The completed composite batch is identified as N418E and will be so designated throughout this report.

The complete chemical and physical analyses of the magnesium used in this test are given below

Table II

Chemical Analysis (Spectrographic)

Type Magnesium	Impurities (as ppm)					
	Cd	Fe	Mn	Pb	Zn	Boron
84	0.39	16	37*	4.8	540	LO.5
85B	0.42	10	36*	3.6	520	LO.5
87B	0.52	10	39*	3.6	540	LO.5
N418E	0.87	7	14	5.2	570	LO.5

* All three types from O. Hommel exceed the limit of 25 ppm on manganese; however, for the purposes of this experiment the Army has approved the use of this material.

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(a) Screen Analysis

Table III

U.S. Standard Screens

<u>Type Magnesium</u>	<u>Per Cent On</u>					<u>Per Cent Thru 50</u>
	<u>10</u>	<u>20</u>	<u>30</u>	<u>40</u>	<u>50</u>	
84	0.2	53.2	28.2	10.0	6.8	2.4
85B	13.4	73.3	5.9	3.6	2.3	2.3
87B	7.2	85.5	4.0	1.6	0.9	0.5
N418E	0.0	65.1	21.2	9.7	3.1	1.2

(Screen analysis made using Ro-tap shaker for 30 minute period)

(b) Bulk Analysis

Table IV

<u>Type Magnesium</u>	<u>Pour Specific Volume (cc/gram)</u>	<u>Shake Specific Volume (cc/gram)</u>
84	8.40	5.45
85B	1.25	1.05
87B	1.28	1.10
N418E	1.34	1.13

Pour specific volume is determined by measuring the bulk of a weighed portion of magnesium immediately after carefully pouring the magnesium into a 250 ml graduate. Shake specific volume is determined by measuring the bulk after settling the magnesium as much as possible in the graduate.

(c) Hydrogen Evolution Test

Table V

<u>Type Magnesium</u>	<u>Rate H₂ Evolved (ml/ 3 minutes)</u>
84	63.9
85B	24.6
87B	28.2
N418E	31.4*
(Standard)	34.1

*Ordinary range on New England Lime magnesium is from 28 to 34 ml per 3 minutes.

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The test is a modification of the procedure followed by du Pont (See Report A-1053). Two grams of the "thru 10, on 20" mesh magnesium (obtained from screening on a Ro-tap a sample of charge magnesium) are dissolved in 100 ml of water and 50 ml of 4 per cent ammonium acetate solution. The quantity of hydrogen given off in the first three minutes is measured and compared with a standard sample of magnesium run in the same manner on the same day.

Four trial runs, two of each of the usable types, were fired, giving the following results:

Table VI

<u>Type Magnesium</u>	<u>Mesh Size</u>	<u>Furnace Number</u>	<u>Control Temperature (OF)</u>	<u>Preheat Time</u>	<u>Per Cent Yield</u>	<u>Biscuit Rating*</u>
87B	As received	1	1250	2:14	97.4	1
87B	As received	1	1275	2:20	96.9	1
85B	As received	1	1325	1:58	96.9	1
85B	As received	11	1325	2:00	81.2	2

* For an explanation of "Biscuit Rating" see Report A-1060, Section 1E, page 7, 8.--Ed.

From the results obtained, three observations were made:

- (1) The magnesium used as received will give satisfactory yields under the present plant operating conditions.
- (2) The furnaces must be set to a control temperature about 100°F higher than the setting used for regular hammermill magnesium to give corresponding firing time. This is undoubtedly due to the relative coarseness of the O. Hommel magnesium compared to our regular New England Lime magnesium.
- (3) More runs would be required to determine if the magnesium was at fault in the instance of the fourth trial run given above.

Procedure

The test program is divided into six parts or groups, the first four groups being identical as regards materials, order of packing, and furnaces used. Group five was made using more magnesium fines in the liner, while group six was made using more magnesium fines and also packing and firing in a different order than that followed in the first five groups.

The following purposes were in mind when setting up the test program in group form:

- (1) Each group consisted of 24 runs; 6 runs of O. Hommel type 85B, 6 runs of O. Hommel type 87B, and 12 runs of New England Lime Standard N418E. This gave the maximum number of test shots in a group using the same lot of green salt and the same batches of lime for the liner.
- (2) Each group (of the first four groups) was fired in the same four furnaces set to give an approximately two-hour preheat time on all types of magnesium. The loading and firing schedule was arranged to fire each type of magnesium in each of the four furnaces. To eliminate as much as possible variation due to the adjusting of control temperatures, just two of the four furnaces were raised in temperature in each group.
- (3) In recasting the test biscuits, the four best biscuits from each set of six (fired in the same furnace) were used together, making a single heat to provide the remelt yield for each type. The remaining two biscuits of type 85B and the remaining two biscuits of type 87B were combined to give an additional remelt result. The remaining biscuits from the two N418E sets were combined in a similar manner and recast together to give an additional remelt result.

The magnesium remaining after completing the first four groups was used in two supplementary groups (five and six). The following changes were made in an effort to better the yields in these last two test groups:

- a). About 0.5 per cent more magnesium fines were used in the bottom portion of the lime liner.
- b). The firing time was shortened from two hours to approximately one hour and forty-five minutes.
- c). The loading schedule in group six was so arranged that all of the standard runs were packed and fired first; all four furnace control temperatures were then raised, and the O. Hommel magnesium runs were packed and fired.
- d). In group six, furnace 3 was used instead of furnace 6.
- e). Graphite plate tops were used on all 27 runs of group six.

Summary of Data

The individual results in each group are given in the following table. (The complete data on each run, together with the analysis of materials used in each group, are included in the Appendix, Section VII.)

Table VII

Group No.	Date Packed and Fired	Type Magnesium	Furnace No.	Biscuits No.	Range		Avg Yield	Remelt Yield on best 4	Over-all Yield*
					Low Yield	Top Yield			
I	12/6	N418E	1	6	93.0	96.9	94.9	96.2	91.3
		85B	2	6	85.9	92.9	90.7	95.5	86.6
		N418E	5	6	92.7	96.4	94.6	95.1	90.2
		87B	6	6	90.9	95.1	93.5	96.5	90.2
II	12/8	85B	1	6	93.2	97.4	95.8	95.7	91.7
		N418E	2	6	91.6	97.4	95.8	96.3	92.3
		87B	5	6	94.3	97.7	95.8	96.4	92.4
		N418E	6	6	86.9	97.3	94.8	96.6	91.6
III	12/12	87B	1	6	93.0	98.4	96.6	95.9	92.6
		N418E	2	6	88.9	97.5	93.8	95.7	89.8
		85B	5	6	92.3	97.6	95.9	96.8	92.8
		N418E	6	6	89.8	98.2	95.0	95.9	91.1
IV	12/13	N418E	1	6	85.9	97.8	93.0	95.4	88.7
		87B	2	6	86.4	97.8	94.1	96.6	90.0
		N418E	5	6	89.9	97.8	94.7	96.5	91.4
		85B	6	6	73.1	90.5	82.2	94.4	77.6
V	12/18	N418E	1	6	81.5	99.2	92.7	95.7	88.7
		85B	2	6	85.4	97.5	93.1	96.1	89.5
		87B	5	6	94.9	98.8	97.1	96.5	93.7
		N418E	6	6	79.3	98.8	86.7	95.8	85.1
VI	12/21	N418E	-	12	89.2	98.2	96.0	96.9**	93.0
		85B	-	6	75.9	98.2	89.8	95.5	85.8
		87B	-	6	87.0	97.2	90.9	95.4	86.7

* Over-all yield equals biscuit yield times remelt yield.

**Remelt average on the best eight biscuits.

Several comments should be made concerning the results given in the table above.

- 1). The first runs of O.Hommel magnesium in group one failed to fire, and it was necessary to make a second heating to start the reaction. This would account for the slightly lower yields obtained on these biscuits.

- 2). In group five, the first two runs of N418E were apparently fired by error in furnace 2 instead of furnace 1 while the first two runs of 85B were fired in furnace 1 instead of furnace 2. If these runs are omitted, the remaining four runs of N418E average 94.1 per cent and the remaining four runs of 85B average 96.5 per cent.
- 3). Throughout the period during which this test program was in progress, furnace 6 was not heating satisfactorily. This trouble is most evident in group 4, set 4, where the biscuit yield averaged only 82.2 per cent.

A study of the first four groups in which all materials, method of packing, and average firing times were held the same gives the following summary:

Table VIII

Type Magnesium	No. Runs	Average Per Cent	Range of Yields Per Cent	Remarks
N418E	48	94.6	85.9-97.8	
85B	24	91.2	73.1-97.6	
87B	24	95.0	86.4-98.4	
85B	18	94.1	85.9-97.6	Omitting set 4, Grp. 4
85B and 87B	42	94.6	85.9-98.4	Omitting set 4, Grp. 4

Recasting results on the best 4 biscuits in each set gave the following results:

	No. Heats			
N418E	8	96.0	95.1-96.6	
85B	4	95.6	94.4-96.5	
87B	4	96.1	95.6-96.5	
85B	3	96.0	95.5-96.8	Omitting set 4, Grp. 4
85B and 87B	7	96.1	95.5-96.8	Omitting set 4, Grp. 4

Over-all results obtained by multiplying biscuit and remelt yields are as follows:

N418E	90.8	88.7-92.3	
85B	87.2	77.6-92.8	
87B	91.3	90.0-92.6	
85B	90.4	86.6-92.8	Omitting set 4, Grp. 4
85B and 87B	90.9	86.6-92.8	Omitting set 4, Grp. 4

Conclusions

The conclusions made on the basis of this test series may be summarized as follows:

- (1) O.Hommel magnesium, type 84, is impractical to use because of its bulkiness.
- (2) Of the two usable O.Hommel types, 87B averaged 0.9 per cent higher than 85B in biscuit yields (95.0 per cent compared to 94.1 per cent). The recasting yield of 87B was 96.1 per cent against a 96.0 per cent yield. for type 85B.
- (3) Compared with New England Lime magnesium, O.Hommel magnesium type 87B is 0.4 per cent better than N418E, while O. Hommel type 85B is 0.5 per cent poorer than N418E.
- (4) The use of O. Hommel magnesium of the present particle size requires a considerably higher furnace control temperature than that required for New England Lime hammermill magnesium. This causes more scaling and internal pitting (and consequently, high-iron biscuits) of the bomb shells used for O. Hommel runs.

It is somewhat difficult to make definite conclusions based upon the test series just completed for two reasons:

- (1) Considerable data are available on the behavior of New England Lime hammermill magnesium because of its being used for the past eight months, whereas only some 50 runs have been made with the O. Hommel magnesium. Further O. Hommel trials would probably indicate improvements which could be made to better the yields and consistency of yields.
- (2) The average of the trial runs in the groups was lower than regular production runs made during the same period. It is felt that this trouble was due chiefly to furnace difficulties and, secondarily, to the fact that N418E inadvertently was inferior to the normal New England Lime magnesium being used at the present time.

In considering O. Hommel magnesium in the light of its consistency as a material, only an extensive use would permit an accurate observation to be made. However, the O. Hommel magnesium has excellent possibilities of being quite uniform from lot to lot since it is so clean in appearance relative to the crude New England Lime hammermill magnesium.

The Madison Square Area has just recently arranged for the preparation of an additional 500 pounds of chip magnesium (type 93) which will be made finer than type 87B but still coarser than the New England Lime magnesium (coarseness based on screen analysis). The finer magnesium is believed to be

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more desirable than either type 85B or 87B, since it will require a lower furnace control temperature.

We believe that the O. Hommel magnesium can be used satisfactorily in the reduction step, although further work is needed to ascertain the optimum conditions for its use.

B. Report from Mallinckrodt Chemical Works dated 16 February 1945 on series of runs made with O. Hommel magnesium type 93.

Object

To test the fourth type of chip magnesium (type 93) submitted to Mallinckrodt Chemical Works by the O. Hommel Company.

Summary and Conclusions

Under the present operating conditions there appears to be little, if any, difference between the O. Hommel magnesium, type 93, and the New England Lime hammermill magnesium. The summary below shows an over-all figure of 94.3 per cent for O. Hommel magnesium as against 94.0 per cent for the New England Lime magnesium. It is believed that even this difference would disappear if an extended trial series were carried out.

The O. Hommel magnesium has recently taken on additional merit since new evidence indicates that magnesium of low nitrogen content gives better re-casting yields. At the present time, the New England Lime hammermill magnesium contains 2 to 5 times as much nitrogen as the O. Hommel magnesium.

Of the three usable types of magnesium, type 93 is preferred primarily because of the lower furnace control temperature required. The complete test program (of all eight groups) shows this type as giving the best biscuit yields; however, it is quite likely that other factors than magnesium influenced these results.

Since running groups seven and eight an adjustment has been made on the green salt-magnesium mixer which has virtually eliminated the occasional bad yields which heretofore unaccountably occurred during regular production as well as during the test groups.

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Table IX

Group	Magnesium Lot (Type)	No. Biscuits	Average Per Cent Yield	No. Biscuits	Average Per Cent Yield	Range
Prelims.	OH 93	2	97.5	2	97.5	97.2 - 97.8
VII	OH 93	10	97.4	9*	98.0	97.7 - 98.3
	NEL 320	14	96.7	13**	98.1	97.6 - 98.9
VIII	OH 93	10	94.6	8***	97.2	95.2 - 98.2
	NEL 304	15	97.9	15	97.9	96.8 - 98.7
<hr/>						
Prelims. †	OH 93	22	96.0	19	97.6	95.2 - 98.3
VII and VIII	NEL 320,304	29	97.3	28	98.0	96.8 - 98.9

* Omitting a yield of 92.5 per cent.

** Omitting a yield of 79.0 per cent.

*** Omitting yields of 83.0 and 84.9 per cent.

Table X

Group	Magnesium Lot (Type)	Biscuits in Heats*		Heats		Over-all** Average
		No.	Yield Av.	No.	Average	
VII	OH 93	8	98.1	2	97.1	95.2
	NEL 320	12	98.1	3	96.4	94.7
VIII	OH 93	8	97.3	2	96.1	93.4
	NEL 304	12	98.0	3	95.2	93.3
<hr/>						
VII and VIII	OH 93	16	97.7	4	96.6	94.3
	NEL 304,320	24	98.1	6	95.8	94.0

* Used the best biscuits in the test heats

**Over-all equals biscuit yield times remelt yield

Discussion

Since the first six magnesium test groups were made and fired, several changes have been made to improve the consistency of results. The major change has been the extended trials of electrically-fused dolomite (EFD) for the entire liner. The uniformity of results obtained while using this material has been very encouraging since we are having trouble getting low carbon dioxide and low boron lime from Ste. Genevieve. Adjustments have been made on the furnace control instruments which have resulted in more nearly duplicating the heating cycle in all six furnaces. Another factor helping the furnace control is the placement of the bombs farther down inside the furnace, giving a consequent tighter seal around the top of the bomb.

The two test groups (VII and VIII) were packed and fired in the standard manner using electrically-fused dolomite (2 per cent magnesium fines in the bottom pad and eight inches up the side walls; no fines in the remainder of the side walls). The preliminary test shots were made with our regular liner, which is a combination of Ste. Genevieve lime in the bottom and electrically-fused dolomite in the upper 18 inches of the side walls. No attempt was made to distinguish the runs by furnaces, although the O. Hommel runs were fired in furnaces No. 1, 3, and 4 only.

The O. Hommel magnesium, type 93, is very similar in appearance to types 85B and 87B; the particles are the same shape, but just slightly smaller. This fineness permits the use of a lower furnace control temperature, which is an advantage in itself since it means less scaling of the bomb shell.

The control magnesium is from two different lots - New England Lime 320 and 304. New England Lime lot 320 was used in group VII. This lot was declared by New England Lime to be low in nitrogen, a factor found to be desirable to obtain good remelt yields.

The analyses of the magnesium used are as follows:

Table XI

Chemical Analysis (Spectrographic)

Type Magnesium	Impurities as ppm						Nitrogen
	Cd	Fe	Mn	Pb	Zn	Boron	
OH 93	0.52	8.2	33	3.9	650	LO.5	108
NEL 304	0.64	7.0	15	3.6	600	LO.5	283
NEL 320	0.42	17.0	13	3.0	600	LO.5	333

Table XII

Physical Analysis

A. Screen Analysis

Type Magnesium	U.S. Standard Screens Per Cent On					Per Cent Thru
	10	20	30	40	50	50
OH 93	0.3	70.0	16.0	5.5	2.8	4.3
NEL 304	0.0	49.5	26.4	14.1	6.8	0.3
NEL 320	0.0	55.9	24.6	11.4	5.0	3.2

B. Bulk Density

Type Magnesium	Pour Specific Volume (cc/gram)	Shake Specific Volume (cc/gram)
OH 93	1.19	1.04
NEL 304	1.42	1.14
NEL 320	1.35	1.18

Included in the Appendix are the complete data on each run in both groups and analyses of the lime and green salt used.

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Table XIII

Preliminary Trial Runs- Loaded
and Fired 2/8/45

Run Number	Magnesium Lot (Type)	Mesh Size	Furnace No.	Preheat Time (Minutes)	Control Temp. °F	Yield Per Cent	Biscuit Rating
11, 167	OH 93	As received	1	131	1235	97.2	1
11, 168	OH 93	As received	1	108	1275	97.8	1

C. Report from the Electro Metallurgical Company dated March 29, 1945 on O. Hommel magnesium type 93.

The experimental work on New England Lime billet magnesium processed into chips by the O. Hommel Company has been completed. The results indicate that this magnesium can be expected to give improved remelting recoveries and reduction yields comparable to those realized from New England Lime magnesium. During the running of the test, several variables which influenced the remelting recoveries were introduced inadvertently. One of these variables was a fluctuating moisture content in the dolomite used in the bomb side wall. This factor necessitated changes in the percentage of magnesium fines used in the side wall. Another variable was the difference in nitrogen content of the magnesium fines. Furthermore, it was not practicable to adjust the heating time of O. Hommel reduction runs to correspond to those made with New England Lime, and as a result, the heating period of the best runs averaged slightly longer than that of the control runs. However it is not believed that this latter factor was of major importance.

One series of three test runs made under conditions considered to be ideal in that the reductant magnesium and the fines used in the side wall were both of low nitrogen content, gave a superior remelting yield of 96.9 per cent. These fines had been secured by screening the O. Hommel magnesium and were used with the parent material as reductant. The nitrogen content of these fines was 35 ppm as compared to an average of over 600 ppm for those currently being used.

In Table XIV are given the results from the major portion of the O. Hommel magnesium and two lots of New England Lime material. The bombs were packed and run alternately in order to maintain similar operating conditions

Table XIV

Magnesium Lot No.	Source	Nitrogen Content	No. of Reduc.Runs	Avg.Reduc. Yield	No.of Remelt Runs	Avg. Remelt Yield	Over- all Yield-*
327	OH	20	37	96.3%	12	95.1%	91.6%
326	NEL	427	18	97.4	6	94.1	91.6
329	NEL	177	19	97.3	6	95.2	92.6

* Over-all yield equals product of reduction and remelt yields.

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From the above results it may be seen that although the remelting yield for the O. Hommel type crude metal was equal to the better New England Lime results, the reduction yield was somewhat lower with the O. Hommel type material. It is our belief that this fact should not condemn the O. Hommel material since it is understandable that the optimum technique with this new type of magnesium is somewhat different than with the New England Lime material, with which we are very familiar. It is probably safe to say that with further experience equal reduction yields will be obtained with the O. Hommel magnesium. Furthermore we have reason to believe that in the remelting step crude metal produced by O. Hommel magnesium may give superior results.

In a previous report, the analyses of four lots of helium-treated New England Lime magnesium were given. These lots have been used and their performance records are available. Table XV shows the reduction and remelting recoveries of these lots, and their nitrogen contents

Table XV

Performance of Helium-Treated Lots of New
England Lime Magnesium

NEL Lot No.	A.P. Lot No.	Nitrogen Content	No. of Reduction Runs	Average Reduction Yield	No. of Remelt Runs.	Average Remelt Yield	Over-all Yield*
344	325	332	87	97.1%	24	95.7%	92.9%
345	326	427	81	97.1	22	95.3	92.5
338	328	201	78	97.0	26	96.1	93.2
339	329	177	79	97.3	25	95.2	92.6

* Over-all yield equals product of reduction and remelt yields.

In the above table it is interesting to note that A.P. lot 329 although having the lowest nitrogen content, did not produce exceptional remelting recoveries. In explanation of this seeming incongruity, it should be stated that about one-third of the reduction runs made with this material contained $2\frac{1}{2}$ per cent of fines in the side wall, and an equal number were made with $1\frac{3}{4}$ per cent. A statistical study of remelting data from a two-week period during which the variables of reductant nitrogen and concentration of fines underwent considerable fluctuation has been made. This study indicated that within the range of nitrogen contents included in the four lots above, a concentration of fines above approximately $2\frac{1}{2}$ per cent in the bomb side-wall has a greater influence upon remelting recovery than does the effect of nitrogen in the reductant magnesium. Conversely, with concentrations of fines under $2\frac{1}{2}$ per cent, the major factor affecting the remelting recovery appears to be the nitrogen in the reductant magnesium.

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In the test of O. Hommel magnesium the former factor may have influenced the remelting yields, since $2\frac{1}{2}$ per cent of fines were used for half of the reduction runs made during the experiment. Of course the amount of fines used in the side wall is determined by the amount of water present in the electrically-fused dolomite used for side wall. In the event that this water is considerable, a large concentration of fines has to be used to combat the effect of the water and prevent low reduction yields. On the other hand, as shown above, this procedure, although helping the reduction yield, adversely affects the remelting yield. Obviously the tactics of operation are to maintain an optimum balance between the two effects. We have probably been forcing the reduction step. The fundamental solution is to secure electrically fused dolomite and magnesium with as low as possible concentration of water and nitrogen respectively. The desirable level seems to be already attained with the electrically fused dolomite, which normally averages 0.20 per cent water. On the other hand, the nitrogen in the New England Lime magnesium is much above the desirable level.

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A P P E N D I X

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MAGNESIUM TEST GROUP I

Loaded and Fired
12/6/44

Run No.	Magnesium Lot (Type)	Mesh Size	Fur- nace No.	Preheat Time (Minutes)	Control Temp. (°F)	Yield Per- Cent	Biscuit Rating
9330	N418E	16-5-1	1	114	1250	93.0	2+
9331	85B	As received	2	*	1400	89.0	2
9332	N418E	16-5-1	5	119	1210	94.2	2+
9333	87B	As received	6	*	1325	90.9	1+
9334	N418E	16-5-1	1	113	1250	94.8	2+
9335	85B	As received	2	*	1400	85.9	2
9336	N418E	16-5-1	5	121	1210	94.2	2
9337	87B	As received	6	171	1375	94.7	1
9338	N418E	16-5-1	1	105	1250	93.5	2
9339	85B	As received	2	100	1400	93.7	1
9340	N418E	16-5-1	5	122	1210	95.9	2+
9341	87B	As received	6	145	1375	93.4	1
9342	N418E	16-5-1	1	137	1225	95.9	1+
9343	85B	As received	2	121	1375	92.9	1+
9344	N418E	16-5-1	5	128	1210	94.4	2+
9345	87B	As received	6	166	1400	91.9	1
9346	N418E	16-5-1	1	140	1235	96.9	1
9347	85B	As received	2	128	1375	92.4	2+
9348	N418E	16-5-1	5	127	1210	96.4	2
9349	87B	As received	6	150	1425	95.1	2+
9350	N418E	16-5-1	1	120	1235	95.3	1+
9351	85B	As received	2	132	1375	90.3	2
9352	N418E	16-5-1	5	120	1210	92.7	1+
9353	87B	As received	6	129	1400	94.8	2

* Actual preheat time not precisely determinable since first preheating did not set-off the reaction and a second preheat was thus required. The low yields obtained were undoubtedly due to this trouble.

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MAGNESIUM TEST GROUP II

Loaded and Fired
12/8/44

<u>Run No.</u>	<u>Magnesium Lot (Type)</u>	<u>Mesh Size</u>	<u>Fur- nace No.</u>	<u>Preheat Time (Minutes)</u>	<u>Control Temp. (°F)</u>	<u>Yield Per- Cent</u>	<u>Biscuit Rating</u>
9385	85B	As received	1	121	1375	97.4	1
9386	N418E	16-5-1	2	121	1225	97.1	1+
9387	87B	As received	5	112	1350	95.5	1
9388	N418E	16-5-1	6	112	1250	96.5	1+
9389	85B	As received	1	119	1375	96.6	1
9390	N418E	16-5-1	2	120	1225	91.6	1+
9391	87B	As received	5	111	1350	97.7	1
9392	N418E	16-5-1	6	124	1250	97.1	1
9393	85B	As received	1	120	1375	95.0	1+
9394	N418E	16-5-1	2	130	1225	97.4	1
9395	87B	As received	5	107	1350	96.5	1
9396	N418E	16-5-1	6	130	1250	97.3	1
9397	85B	As received	1	135	1375	96.9	1
9398	N418E	16-5-1	2	112	1235	96.0	2
9399	87B	As received	5	118	1350	94.3	1+
9400	N418E	16-5-1	6	112	1260	94.4	1+
9401	85B	As received	1	129	1375	95.7	1+
9402	N418E	16-5-1	2	123	1225	95.3	1+
9403	87B	As received	5	120	1350	95.3	1+
9404	N418E	16-5-1	6	110	1250	86.9	2+
9405	85B	As received	1	120	1375	93.2	1+
9406	N418E	16-5-1	2	120	1225	97.2	1+
9407	87B	As received	5	130	1350	95.3	1+
9408	N418E	16-5-1	6	106	1250	96.3	1+

MAGNESIUM TEST GROUP III

Loaded and Fired
12/12/44

<u>Run No.</u>	<u>Magnesium Lot (Type)</u>	<u>Mesh Size</u>	<u>Furnace No.</u>	<u>Preheat Time (Minutes)</u>	<u>Control Temp. (°F)</u>	<u>Yield Per-Cent</u>	<u>Biscuit Rating</u>
9478	87B	As received	1	106	1375	93.0*	2
9479	N418E	16-6-1	2	121	1235	97.5	1
9480	85B	As received	5	123	1350	92.3	1+
9481	N418E	16-5-1	6	122	1235	89.8	1+
9482	87B	As received	1	113	1350	98.1	1
9483	N418E	16-5-1	2	116	1235	88.9	1+
9484	85B	As received	5	130	1350	95.9	1
9485	N418E	16-5-1	6	127	1235	98.1	1
9486	87B	As received	1	117	1350	96.0	1
9487	N418E	16-5-1	2	115	1235	95.2	1
9488	85B	As received	5	112	1350	96.9	1
9489	N418E	16-5-1	6	132	1235	97.4	1
9490	87B	As received	1	112	1350	97.4	1+
9491	N418E	16-5-1	2	116	1235	97.1	1
9492	85B	As received	5	122	1350	95.3	2
9493	N418E	16-5-1	6	124	1250	98.2	1+
9494	87B	As received	1	119	1350	98.4	1
9495	N418E	16-5-1	2	126	1235	93.9	2
9496	85B	As received	5	120	1350	97.6	1+
9497	N418E	16-5-1	6	124	1250	93.7	1+
9498	87B	As received	1	125	1350	96.7	1
9499	N418E	16-5-1	2	121	1235	90.3	2+
9500	85B	As received	5	110	1350	97.4	1
9501	N418E	16-5-1	6	124	1250	92.7	1+

* Blew out flange

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MAGNESIUM TEST GROUP IV

Loaded and Fired
12/13/44

<u>Run No.</u>	<u>Magnesium Lot (Type)</u>	<u>Mesh Size</u>	<u>Fur- nace No.</u>	<u>Preheat Time (Minutes)</u>	<u>Control Temp. (°F)</u>	<u>Yield Per Cent</u>	<u>Biscuit Rating</u>
9513	N418E	16-5-1	1	115	1235	94.6	1+
9514	87B	As received	2	106	1375	86.4	1+
9515	N418E	16-5-1	5	120	1210	97.1	1
9516	85B	As received	6	110	1375	84.6	2
9517	N418E	16-5-1	1	117	1235	89.3	1+
9518	87B	As received	2	109	1350	97.4	1
9519	N418E	16-5-1	5	117	1210	91.1	2
9520	85B	As received	6	112	1350	85.7	2+
9521	N418E	16-5-1	1	121	1235	95.1	1+
9522	87B	As received	2	116	1350	89.2	2
9523	N418E	16-5-1	5	140	1210	97.8	1
9524	85B	As received	6	112	1350	90.5	1+
9525	N418E	16-5-1	1	123	1235	97.8	1
9526	87B	As received	2	117	1350	97.7	1
9527	N418E	16-5-1	5	118	1225	96.1	2+
9528	85B	As received	6	120	1350	74.0	2+
9529	N418E	16-5-1	1	120	1235	85.9	2+
9530	87B	As received	2	120	1350	97.8	1
9531	N418E	16-5-1	5	120	1225	89.9	2+
9532	85B	As received	6	121	1350	85.2	2+
9533	N418E	16-5-1	1	114	1235	95.1	1+
9534	87B	As received	2	108	1350	96.2	2+
9535	N418E	16-5-1	5	111	1225	96.2	1+
9536	85B	As received	6	121	1350	73.1	3

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MAGNESIUM TEST GROUP V

Loaded and Fired
12/18/44

Run No.	Magnesium Lot (Type)	Mesh Size	Furnace No.	Preheat Time (Minutes)	Control Temp. (°F)	Yield Per Cent	Biscuit Rating
9654	N418E	16-5-1	1	123	1225	88.5	2+
9665	85B	As received	2	92	1350	94.1	2
9656	87B	As received	5	107	1350	98.8	1
9657	N418E	16-6-1	6	111	1225	91.6	2+
9658	N418E	16-5-1	1	120	1250	89.9	1+
9659	85B	As received	2	106	1325	97.5	1
9660	87B	As received	5	111	1325	97.3	1
9661	N418E	16-5-1	6	116	1225	79.3	3+
9662	N418E	16-5-1	1	108	1265	98.8	1
9663	85B	As received	2	111	1325	97.1	1+
9664	87B	As received	5	108	1325	96.7	1+
9665	N418E	16-5-1	6	114	1235	87.3	2
9666	N418E	16-5-1	1	107	1265	99.2	1
9667	85B	As received	2	103	1325	97.2	1
9668	87B	As received	5	122	1325	97.9	1
9669	N418E	16-5-1	6	118	1250	79.6	2+
9670	N418E	16-5-1	1 (?)	153	1265	98.0	1+
9671	85B	As received	2 (?)	75	1325	87.0	1+
9672	87B	As received	5	100	1325	96.8	2
9673	N418E	16-5-1	6	120	1250	98.8	1
9674	N418E	16-5-1	1 (?)	156	1275	81.5	2
9675	85B	As received	2 (?)	78	1300	85.4	3
9676	87B	As received	5	102	1325	94.9	2
9677	N418E	16-5-1	6	105	1250	83.5	3

(?) Through error runs 9670 and 9674 appear to have been fired in furnace #2 judging from the preheat times, while runs 9671 and 9675 appear to have been fired in furnace #1.

MAGNESIUM TEST GROUP VI

Loaded and Fired
12/21/44

<u>Run No.</u>	<u>Magnesium Lot (Type)</u>	<u>Mesh Size</u>	<u>Fur- nace No.</u>	<u>Preheat Temp. (Minutes)</u>	<u>Control Temp (°F)</u>	<u>Yield Per Cent</u>	<u>Biscuit Rating</u>
9742	N418E	16-5-1	2	113	1160	98.0	1
9743	N418E	16-5-1	3	110	1190	97.4	1
9744	N418E	16-5-1	1	118	1250	92.6	1+
9745	N418E	16-5-1	5	112	1225	97.1	1
9746	N418E	16-5-1	2	111	1175	97.7	1+
9747	N418E	16-5-1	1	107	1265	97.8	1
9748	N418E	16-5-1	3	113	1200	97.0	1
9749	N418E	16-5-1	5	113	1235	89.2	2+
9750	N418E	16-5-1	2	104	1175	98.1	1
9751	N418E	16-5-1	1	108	1265	98.2	1
9752	N418E	16-5-1	3	106	1200	91.1	2+
9753	N418E	16-5-1	5	112	1235	97.6	1+
9754	85B	As received	2	110	1300	98.2	1
9755	85B	As received	1	108	1375	90.2	2+
9756	85B	As received	3	113	1325	75.9	3
9757	85B	As received	5	117	1325	84.8	2
9758	85B	As received	2	105	1300	98.0	1+
9759	85B	As received	1	121	1375	91.4	2+
9760	87B	As received	3	101	1325	97.2	1
9761	87B	As received	5	116	1325	87.0	2+
9762	87B	As received	2	109	1300	90.4	2+
9763	87B	As received	3	106	1325	91.5	1+
9764	87B	As received	1	101	1375	91.5	2
9765	87B	As received	5	116	1325	88.0	2+

MAGNESIUM TEST GROUP VII

Loaded and Fired
2/8/45

Run No.	Magnesium Lot (Type)	Mesh Size	Fur- nace No.	Preheat Time (Minutes)	Control Temp. (°F)	Yield Per Cent	Biscuit Rating
11,210	NEL 320	16-5-1	4	105	1200	97.9	1
11,211	NEL 320	16-5-1	3	103	1190	98.3	1
11,212	OH 93	As received	1	130	1250	98.0	1
11,213	OH 93	As received	4	120	1210	98.0	1
11,214	NEL 320	16-5-1	2	120	1290*	98.3	1
11,215	NEL 320	16-5-1	3	120	1190	79.0	3
11,216	NEL 320	16-5-1	6	120	1250	98.2	1
11,217	OH 93	As received	1	110	1275	97.8	1
11,218	OH 93	As received	4	105	1215	98.2	1
11,219	NEL 320	16-5-1	2	110	1300*	97.7	1
11,220	NEL 320	16-5-1	3	102	1200	97.6	1
11,221	NEL 320	16-5-1	6	103	1265	98.4	1
11,222	OH 93	As received	1	107	1275	92.5	2
11,223	OH 93	As received	4	100	1210	98.1	1
11,224	NEL 320	16-5-1	2	110	1300*	97.8	1
11,225	NEL 320	16-5-1	3	108	1200	98.1	1
11,226	NEL 320	16-5-1	6	108	1250	97.6	1
11,227	OH 93	As received	1	105	1275	98.3	1
11,228	OH 93	As received	4	102	1200	98.1	1
11,229	NEL 320	16-5-1	2	105	1300*	98.0	1
11,230	NEL 320	16-5-1	3	98	1200	98.5	1
11,231**	NEL 320	16-5-1	1	101	1275	98.9	1
11,232	OH 93	As received	1	103	1275	97.7	1
11,233	OH 93	As received	4	116	1200	97.7	1

* Furnace # 2 is operated at a higher control temperature since no manual period is used in this furnace (an experimental feature only).

** This run was loaded on 2/8 and fired on 2/9/45

MAGNESIUM TEST GROUP VIII

Loaded and Fired
2/12/45

Run No.	Magnesium Lot (Type)	Mesh Size	Fur- nace No.	Preheat Time (Minutes)	Control Temp. (°F)	Yield Per Cent	Biscuit Rating
11,303	NEL 304	15-6-1	5	108	1235	98.3	1
11,304	NEL 304	15-6-1	2	109	1300	98.2	1
11,305	NEL 304	15-6-1	1	100	1250	97.8	1
11,306	OH 93	As received	3	115	1200	96.3	1
11,307	OH 93	As received	4	120	1200	83.0	1 $\frac{1}{2}$
11,308	NEL 304	15-6-1	5	105	1235	97.1	1
11,309	NEL 304	15-6-1	2	104	1300	98.4	1
11,310	NEL 304	15-6-1	1	101	1275	98.7	1 $\frac{1}{2}$
11,311	OH 93	As received	3	104	1215	84.9	1 $\frac{1}{2}$
11,312	OH 93	As received	4	100	1225	97.4	1
11,313	NEL 304	15-6-1	5	105	1235	98.0	1
11,314	NEL 304	15-6-1	2	103	1300	98.4	1 $\frac{1}{2}$
11,315	NEL 304	15-6-1	1	90	1250	97.9	1
11,316	OH 93	As received	3	117	1215	95.2	1
11,317	OH 93	As received	4	108	1225	98.2	1
11,318	NEL 304	15-6-1	5	101	1235	98.0	1
11,319	NEL 304	15-6-1	1	103	1235	96.8	1
11,320	NEL 304	15-6-1	2	99	1300	98.6	1 $\frac{1}{2}$
11,321	OH 93	As received	4	106	1225	97.7	1
11,322	OH 93	As received	3	108	1215	97.9	1
11,323	NEL 304	15-6-1	5	100	1235	97.7	1
11,324	NEL 304	15-6-1	1	96	1235	96.8	1
11,325	NEL 304	15-6-1	2	110	1290	98.0	1
11,326	OH 93	As received	4	108	1225	98.1	1
11,327	OH 93	As received	3	125	1215	97.1	1

RECASTING GROUP I

<u>Biscuit No.</u>	<u>Furnace No.</u>	<u>Magnesium Lot (Type)</u>	<u>Remelt Yield</u>
338	1	N418E	
342	1	N418E	
346	1	N418E	96.2
350	1	N418E	
331	2	85B	
339	2	85B	
343	2	85B	95.5
351	2	85B	
336	5	N418E	
340	5	N418E	
348	5	N418E	95.1
352	5	N418E	
337	6	87B	
341	6	87B	
345	6	87B	96.5
353	6	87B	
330	1	N418E	
332	5	N418E	
334	1	N418E	95.1
344	5	N418E	
333	6	87B	
335	2	87B	
347	2	87B	96.0
349	6	87B	

RECASTING GROUP II

<u>Biscuit No.</u>	<u>Furnace No.</u>	<u>Magnesium Lot (Type)</u>	<u>Remelt Yield</u>
385	1	85B	
389	1	85B	
393	1	85B	95.7
397	1	85B	
386	2	N418E	
394	2	N418E	
402	2	N418E	96.3
406	2	N418E	
387	5	87B	
391	5	87B	
395	5	87B	96.4
399	5	87B	
388	6	N418E	
392	6	N418E	
396	6	N418E	96.6
408	6	N418E	
401	1	85B	
405	1	85B	
403	5	87B	96.6
407	5	87B	
390	2	N418E	
398	2	N418E	
400	6	N418E	95.4
404	6	N418E	

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RECASTING GROUP III

<u>Biscuit No.</u>	<u>Furnace No.</u>	<u>Magnesium Lot (Type)</u>	<u>Remelt Yield</u>
482	1	87B	
486	1	87B	
494	1	87B	95.9
498	1	87B	
479	2	N418E	
483	2	N418E	
491	2	N418E	95.7
495	2	N418E	
484	5	85B	
488	5	85B	
496	5	85B	96.8
500	5	85B	
481	6	N418E	
485	6	N418E	
489	6	N418E	95.9
493	6	N418E	
478	1	87B	
490	1	87B	
480	5	85B	94.3
492	5	85B	
487	2	N418E	
499	2	N418E	
497	6	N418E	95.6
501	6	N418E	

RECASTING GROUP IV

<u>Biscuit No.</u>	<u>Furnace No.</u>	<u>Magnesium Lot (Type)</u>	<u>Remelt Yield</u>
517	1	N418E	
521	1	N418E	
525	1	N418E	95.4
529	1	N418E	
514	2	87B	
518	2	87B	
526	2	87B	95.6
530	2	87B	
515	5	N418E	
519	5	N418E	
523	5	N418E	96.5
531	5	N418E	
516	6	85B	
524	6	85B	
528	6	85B	94.4
532	6	85B	
513	1	N418E	
533	1	N418E	
527	5	N418E	94.2
535	5	N418E	
522	2	87B	
534	2	87B	
520	6	85B	94.2
536	6	85B	

RECASTING GROUP V

<u>Biscuit No.</u>	<u>Furnace No.</u>	<u>Magnesium Lot (Type)</u>	<u>Remelt Yield</u>
658	1	N418E	
662	1	N418E	
666	1	N418E	95.7
670	1	N418E	
655	2	85B	
659	2	85B	
663	2	85B	96.1
667	2	85B	
656	5	87B	
660	5	87B	
664	5	87B	96.5
668	5	87B	
657	6	N418E	
665	6	N418E	
669	6	N418E	95.8
673	6	N418E	
654	1	N418E	
674	1	N418E	
661	6	N418E	94.2
677	6	N418E	
671	2	85B	
675	2	85B	
672	5	87B	94.6
676	5	87B	

RECASTING GROUP VI

<u>Biscuit No.</u>	<u>Magnesium Lot (Type)</u>	<u>Remelt Yield</u>
742	N418E	
743	N418E	
744	N418E	96.9
745	N418E	
746	N418E	
747	N418E	
748	N418E	95.7
750	N418E	
749	N418E	
751	N418E	
752	N418E	96.0
753	N418E	
754	85B	
755	85B	
757	85B	95.5
758	85B	
760	87B	
761	87B	
763	87B	95.4
764	87B	
756	85B	
759	85B	
762	87B	93.7
765	87B	

RECASTING GROUP VII

<u>Biscuit No.</u>	<u>Biscuit Average</u>	<u>Magnesium Lot (Type)</u>	<u>Remelt Yield</u>	<u>Over-all Yield</u>
11,212		OH 93		
11,213		OH 93		
11,217	98.0	OH 93	96.6	94.7
11,218		OH 93		
11,223		OH 93		
11,227		OH 93		
11,228	98.1	OH 93	97.6	95.7
11,232		OH 93		
11,211		NEL 320		
11,214		NEL 320		
11,216	98.1	NEL 320	96.5	94.7
11,219		NEL 320		
11,220		NEL 320		
11,221		NEL 320		
11,224	98.0	NEL 320	96.1	94.2
11,225		NEL 320		
11,226		NEL 320		
11,229		NEL 320		
11,230	98.2	NEL 320	96.7	95.1
11,231		NEL 320		

RECASTING GROUP VIII

<u>Biscuit No.</u>	<u>Biscuit Average</u>	<u>Magnesium Lot (Type)</u>	<u>Remelt Yield</u>	<u>Over-all Yield</u>
11,306	96.5	OH 93	96.4	93.0
11,312		OH 93		
11,316		OH 93		
11,327		OH 93		
11,317	98.0	OH 93	95.8	93.9
11,321		OH 93		
11,322		OH 93		
11,326		OH 93		
11,309	98.2	NEL 304	95.5	93.8
11,310		NEL 304		
11,313		NEL 304		
11,315		NEL 304		
11,304	98.0	NEL 304	95.7	93.7
11,318		NEL 304		
11,319		NEL 304		
11,320		NEL 304		
11,303	97.8	NEL 304	94.4	92.4
11,305		NEL 304		
11,308		NEL 304		
11,314		NEL 304		

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The chemical and physical analysis of the lining material used for each group is given below:

Group No.	Batch	Chemical (ppm)						Screen - % on					% thru	% Mag.
		Cd	Fe	Mn	Bor on	% CO ₂	% LOI*	60	80	100	140	200	200	Fines
I	B62	0.42	240	43	9	0.33	1.06	2.8	2.7	3.7	7.5	6.8	76.3	3
	S304	LO.4	260	49	8	0.20	0.90	2.5	2.7	3.8	7.5	8.0	76.1	1
	EFD336	L1.5	215	92	7	0.14	0.62	0.2	0.7	0.9	17.4	10.0	71.0	0
II	B62	0.42	240	43	9	0.33	1.06	2.8	2.7	3.7	7.5	6.8	76.3	3
	S307	0.48	260	55	10	0.26	0.93	2.5	2.8	3.6	7.1	7.2	76.9	1
	EFD338	L1.5	235	91	13	0.10	0.24	0.1	1.2	1.2	10.5	22.5	65.3	0
III	B63	0.40	290	49	11	0.17	0.59	2.4	2.7	3.2	6.5	6.0	79.1	3
	S308	0.40	250	66	13	0.13	0.46	2.6	3.1	3.7	10.0	5.4	75.0	1
	EFD340	L1.5	200	90	11	0.12	0.28	0.0	0.1	0.4	16.0	10.3	72.7	0
IV	B63	0.40	290	49	11	0.17	0.59	2.4	2.7	3.2	6.5	6.0	79.1	3
	S309	0.40	240	52	13	0.13	0.46	2.6	3.1	3.7	10.0	5.4	75.0	1
	EFD341	L1.5	220	91	9	0.09	0.25	0.0	0.1	0.3	13.3	11.7	74.9	0
V	B65	0.42	250	56	12	0.23	0.56	3.5	4.1	4.8	10.0	9.1	68.3	4
	S311	LO.4	240	61	10	0.26	0.58	3.2	3.4	4.8	9.9	7.9	70.8	1
	EFD345	L1.5	205	97	9	0.08	0.31	0.0	0.0	0.4	7.5	12.7	80.0	0
VI	B64	0.43	225	62	11	0.22	0.57	3.3	3.6	4.5	10.8	6.3	71.5	3
	S312	LO.4	210	58	13	0.15	0.56	2.8	3.5	4.5	16.1	7.2	65.8	2
	EFD347	L1.5	195	81	9	0.08	0.30	0.0	0.0	0.3	7.7	11.5	80.5	0
VII	EFD400	L1.5	235	105	11	0.09	0.14	0.0	0.0	0.1	7.2	13.0	79.3	0
	EFD401	L1.5	245	92	9	0.10	0.23	0.0	0.1	0.2	2.4	19.4	77.6	0
	EFD404	L1.5	220	100	8	0.08	0.20	0.0	0.0	0.1	2.7	16.1	80.8	2
	EFD408	L1.5	260	100	9	0.09	0.20	0.0	0.0	0.2	13.4	5.6	80.9	2
VIII	EFD402	L1.5	205	96	8	0.10	0.20	0.0	0.0	0.0	6.7	14.9	78.3	0
	EFD415	L1.5	270	81	9	0.08	0.30	0.0	0.0	0.2	6.3	13.8	79.4	2

* Loss on Ignition

The chemical and physical analysis of the green salt used for each group is given below:

Group No.	Lot No.	Chemical							Screen					% thru
		(ppm)		Per Cent					Per Cent On					
		Cu	Fe	UO ₂ F ₂	AOI*	UF ₄	U	U ₄	60	80	100	200	325	
I	N4205VD79	L1.0	12	1.74	0.06	98.20	75.84	74.50	3.3	5.3	6.6	18.5	8.8	57.3
II	N4205VK88	1.3	13	1.86	0.05	98.03	75.81	74.37	3.7	4.7	6.7	17.9	8.0	58.7
III	N4205VP94	1.3	12	1.74	0.10	98.09	75.79	74.45	4.2	5.4	6.5	17.4	9.9	56.0
IV	N4205VN92	L1.0	10	1.88	0.03	98.11	75.86	74.41	4.3	5.3	7.0	17.0	9.3	57.1
V	N4270VX04	2.3	15	1.34	0.07	98.66	75.90	74.86	3.4	5.5	5.9	18.0	8.5	58.0
VI	N4205VM91	L1.0	12	2.14	0.11	97.86	75.94	74.29	3.9	5.5	6.9	15.8	11.2	56.3
VII	P4187AV25	L1.0	14	1.99	0.09	97.91	75.85	74.31	3.6	4.9	6.1	17.3	8.4	59.1
VIII	P4187BB34	L1.0	11	1.58	0.05	98.34	75.82	74.60	3.6	5.0	6.3	15.3	10.3	59.8

* Ammonium Oxalate Insoluble (UO₂)

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Each pile in the group magnesium picture above weighs two grams--this clearly features the extreme relative bulkiness of the O. Hommel magnesium Type 84.

CONFIDENTIAL

MAGNESIUM
O. HOMMEL
TYPE 84

MAGNESIUM
O. HOMMEL
TYPE 85-B

MAGNESIUM
O. HOMMEL
TYPE 87-B

MAGNESIUM
N.E.L.
LOT N418E

A-2901

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