CANADA

DEPARTMENT OF MINES AND TECHNICAL SURVEYS

OTTAWA

Mines Branch Investigation Report IR 58/108

FINE AGGREGATE PRODUCTION
NATIONAL SLAG LIMITED
HAMILTON, ONTARIO

by

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Note: This report relates essentially to the samples as received. It shall not, nor any correspondence connected therewith, be used in part or in full as publicity or advertising matter.

June 26, 1958.

FINE AGGREGATE PRODUCTION

NATIONAL SLAG LIMITED

HAMILTON, ONTARIO

National Slag Limited of Hamilton, Ontario produce expanded slag aggregate for use in concrete. They are faced with the problem of obtaining an increased proportion of -100 mesh in the fine size range of their aggregate and requested assistance from the Industrial Minerals Division.

At present the plant is producing about six per cent -100 mesh in the -1/4 in. fraction of their product. It is desired to increase this amount to about 12 per cent and to determine the best type of equipment necessary to accomplish this purpose. The company particularly requested that a hammer mill be investigated as a possible method to produce the required additional fines.

From the flow sheet provided by the company the primary crusher is a No.2836C bonded scale rolls, and the secondary crusher, a 4-ft. Symons short head cone. Both crushers are in closed circuit with screens. The final product consists of a -3/8 + 1/4-in. coarse sized aggregate, and a -1/4-in. fine sized aggregate.

Description of Sample

The company has shipped several 1000-2000 lb. bulk samples of the expanded slag aggregate to the Industrial Minerals for this and other investigations. For the work described below only the -3/8 + 1/4-in. size has been used.

Equipment and Methods

It appears evident from a study of the problem that some additional unit of equipment in the fine crushing range is necessary to produce the extra -100 mesh material required. The two most practical possibilities are the hammer mill and the double smooth faced rolls.

Both of these crushing units were used to assess their characteristics in reducing expanded slag. With the hammer mill 1/8 and 3/16-in. grates were used; in separate tests settings of the rolls were varied with different rates of feed. The products from each test run using the two types of crushers were evaluated in terms of a screen analysis. The feed for each test run consisted of 70-lb. of -3/8 + 1/4-in. expanded slag.

TABLE I

SCREEN ANALYSIS OF FEED

ON	% Retained	Cum.% Pass.
3/8"	0	100.0
1/4"	4.2	95.8
# 4 mesh	75.6	20.2
# 8 "	20.2	
	100.0	

RESULTS

(1) Hammer Mill

The hammer mill used is a No.00 with a 5 x 6 in. feed opening. The aggregate was choke fed as is usual practice with hammer mills.

TABLE II

HAMMER MILL PRODUCTS

ON	1/8" Grates % Ret.	1/8" Grates Cum.% Pass.	3/16" Grates % Ret.	3/16" Grates Cum.% Pass.
4 mesh	0.0	0.0	7.5	92.5
8 "	1.1	98.9	23.2	69.3
14 "	17.4	81.5	21.1	48.2
28 "	20.1	61.4	14.1	34.1
48 "	17.4	44.0	10.5	23.6
100 "	15.2	28.8	8.6	15.0
-100 "	28.8	-	15.0	-

These results are also plotted on the accompanying graphs.

(2) Rolls

A 12 x 12 in. smooth faced double rolls was used in the tests. The following operating variables were used for the trial runs.

A - rate of feed --- 300 lb/hr
and rolls set at 1/16 in. spacing

B - rate of feed --- 300 lb/hr
and rolls set at 1/32 in. spacing

C - rate of feed --- 330 lb/hr
and rolls set at 0 - 1/32 in.

D - rate of feed --- 270 lb/hr
and rolls set as in "C"

Note: The 0 - 1/32 in. setting refers to a condition where the two rolls are not quite touching.

TABLE III

ROLLS CRUSHER PRODUCTS

	A		B		C		D**	
ON	% Ret.	% Pass*	% Ret.	% Pass	% Ret.	% Pass	% Ret.	% Pass
4 mesh	5.5	44.5	1.1	98.9	0.7	99.3	0.7	99.3
8	57.3	37.2	0.8	98.1	0.9	98.4	6.5	92.8
14	20.9	16.3	18.7	79.4	6.3	92.1	3.8	89.0
28	6.4	9.9	34.2	45.2	32.8	59.3	12.1	76.9
48	3.6	6.3	17.0	28.2	23.2	36.1	25.6	51.3
100	2.3	4.0	11.1	17.1	14.2	21.9	19.0	32.3
-100	4.0	-	17.1	-	21.9	-	32.3	

* Cumulative per cent passing.

** In this run a large proportion of the +8 mesh fraction consisted of compacted aggregates of finer sizes. The grading shown does not therefore give a true representation of the grading.

Discussion and Conclusions

The problem of increasing the amount of -100 mesh in the fine size range of the aggregate appears best resolved by diverting part of the plant flow to a separate fine crushing unit. The best size and type of unit to do the job is dependent on the maximum size, grading and amount of feed to the unit, and this in turn will of course depend at what point in the flow line of the plant the crusher is placed.

The best location for an additional crusher will depend on the physical lay-out of the plant. However, consideration of three principal points in this regard are necessary for efficient and low cost operation: (1) feed to the new mill should be kept down to the smallest practical size, (2) the feed should contain a minimum of fines, and (3) the quantity of feed should be reduced to a minimum consistant with the production of the required fines. Observance of these points will permit the selection of the smallest practicable crusher which can be operated at least power consumption.

In the flow sheet of the plant provided by the company the screen sizes in the crushing runs were not given. Nevertheless a study of the existing flow sheet indicates that the feed for a fine crusher might be taken from the bottom deck of the vibrating screens which are fed by the #3 conveyor belt.

The results of the work completed in this investigation indicate that a hammer mill using 1/8 in. grates would appreciably increase the proportion of -100 mesh available. The 3/16 in. grates would not be effective in treating only a fraction of the total feed. These observations refer only to the size of feed treated, i.e. -3/8 + 1/4 in. A very important factor in the use of hammer mills is the high maintenance cost due to the abrasive wear. It is our opinion the slag would be highly abrasive compared to limestone which is often crushed by means of hammer mills.

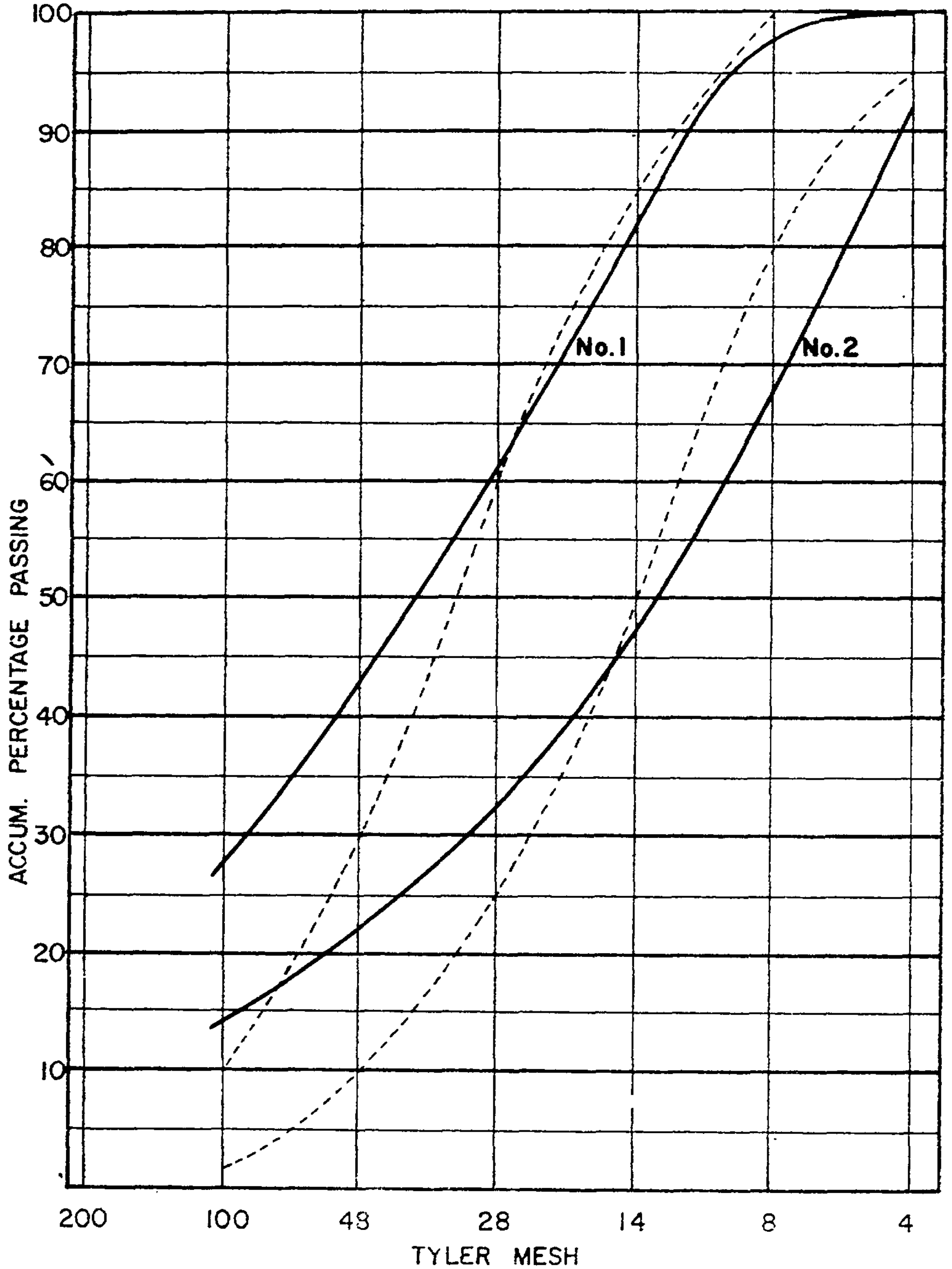
The rolls also were found to be effective in reducing the expanded slag to a high proportions of -100 mesh. It is apparent from Table III that the set of the rolls and the rate of feed are important in governing the grading of the product. The size of the rolls with respect to the size of feed is also important. A larger size rolls would of course take larger feed and produce results comparable to those obtained here.

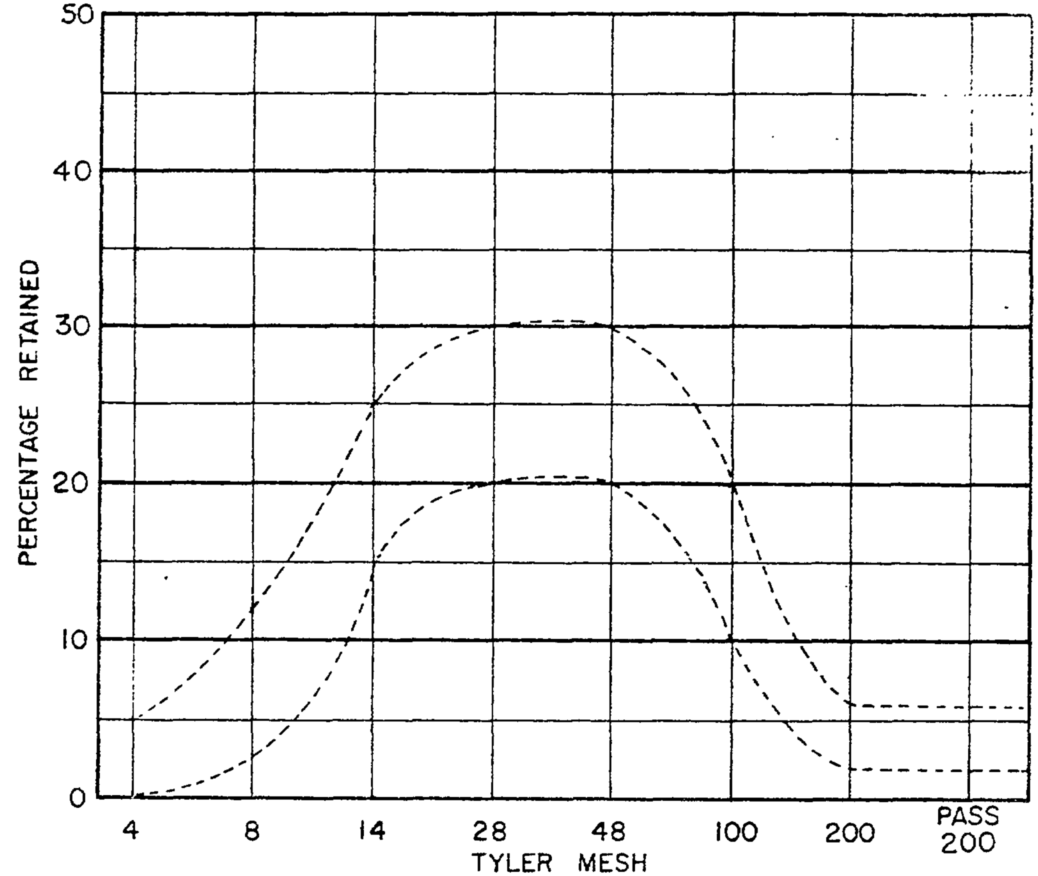
The results of the work completed and conclusions reached are intended to assist the company in reaching a decision on the best type of equipment required to obtain a suitably graded product. Other factors such as costs, physical lay-out of plant, existing load distributions of aggregate, will of course have to be considered.

June 26,1958.

V.A.Haw,
Industrial Minerals Division.

SAND AGGREGATE GRADINGS

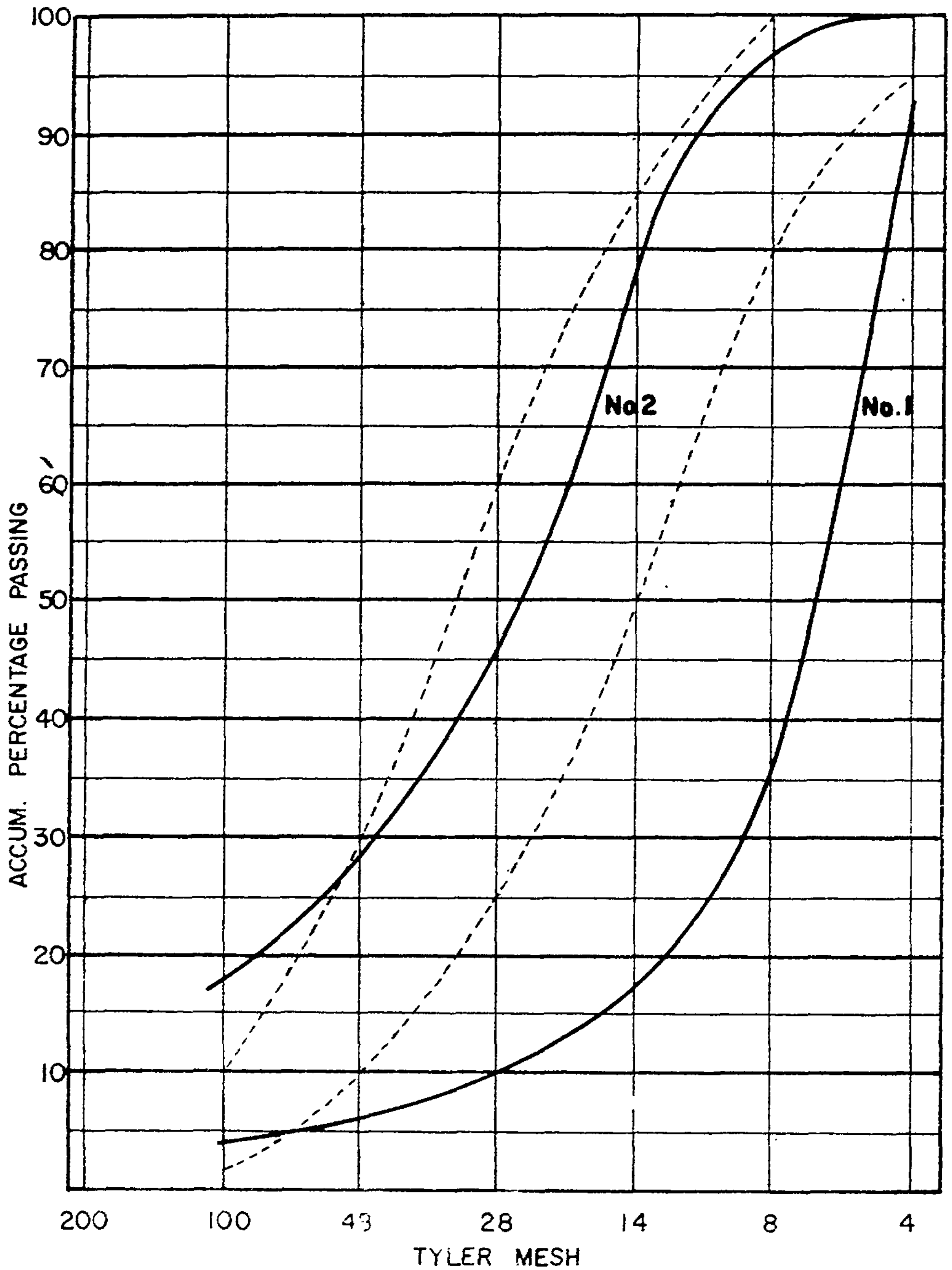


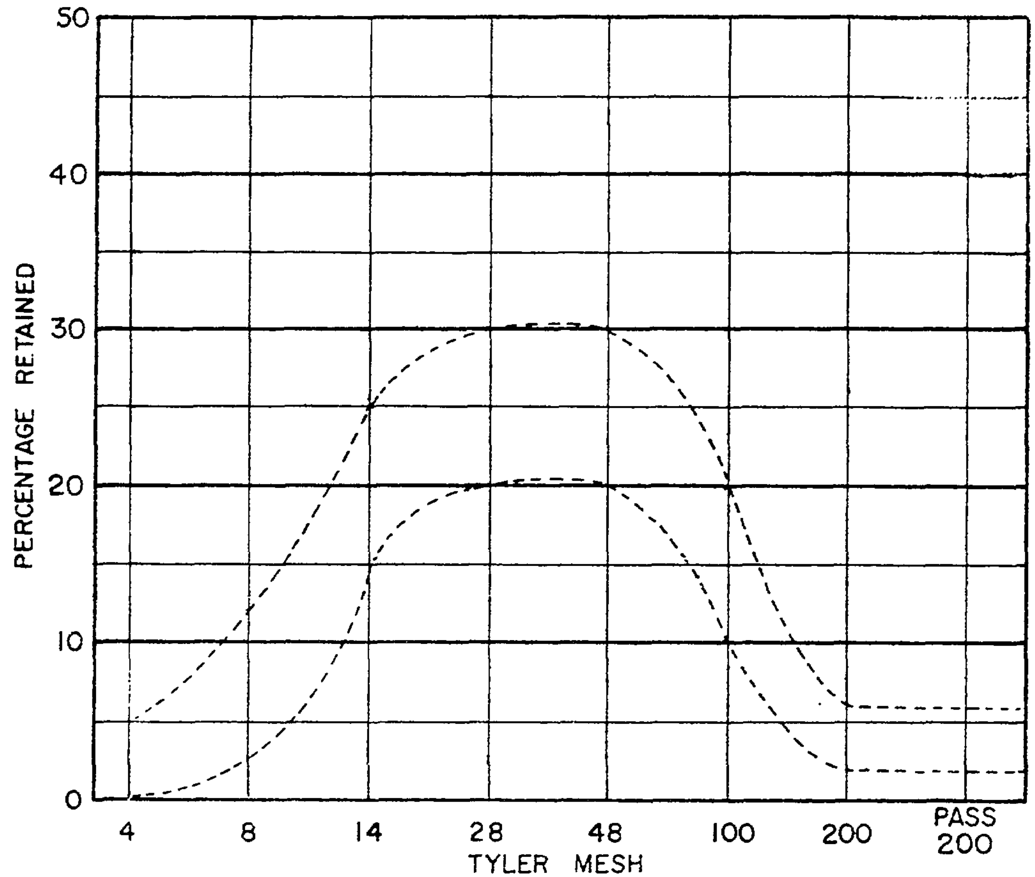


No. 1 - HAMMER MILL 1/8" GRATES

No. 2 - HAMMER MILL 3/16" GRATES

SAND AGGREGATE GRADINGS

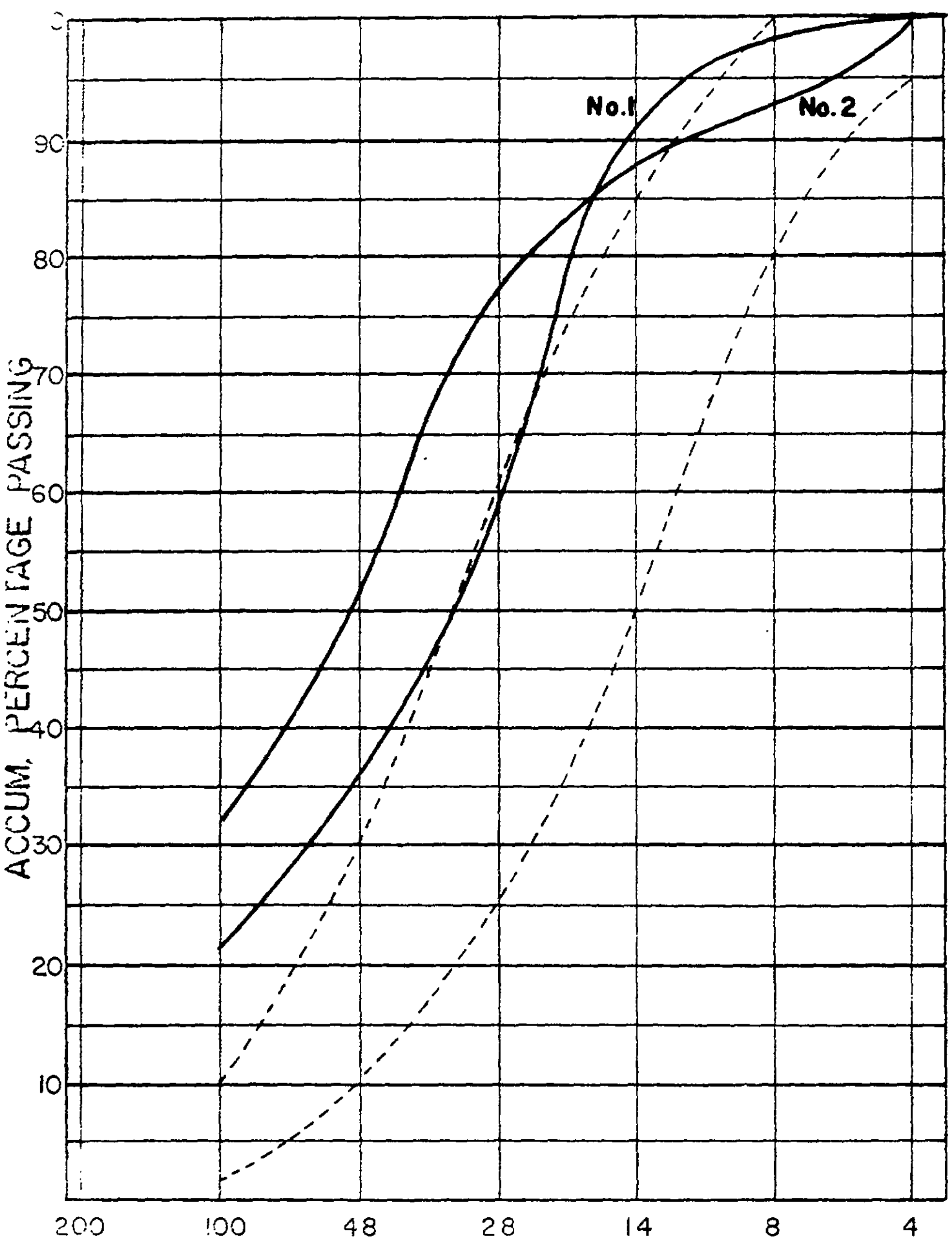




No.1 - ROLLS TRIAL RUN A

No.2 - ROLLS TRIAL RUN B

CHART



ASTM SPECIFICATION LIMITS -----

TABLE

% PASSING				
TYLER MESH				
4 MESH				
8 M				
14				
28				
48				
100				
F. M.				
% VOIDS				

No. 1- ROLLS TRIAL RUN C

No. 2- ROLLS TRIAL RUN D