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O T T A W A May 23rd, 1942.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1233.

Comparative Microscopic Grain Analyses of Three Samples of Standard English Tetryl and Two Samples of Canadian (Defence Industries) Tetryl.

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BUREAU OF MINES
DIVISION OF METALLIC MINERALS

ORE DRESSING AND
METALLURGICAL LABORATORIES

CANADA
DEPARTMENT
OF
MINES AND RESOURCES
MINES AND GEOLOGY BRANCH

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Introduction.

Early in May, 1942, Mr. R. H. Findlater, Inspecting Officer (Explosives), of the Explosives Directorate, The Inspection Board of the United Kingdom and Canada, 70 Lyon Street, Ottawa, Ontario, submitted three samples of English standard tetryls and asked that grain analyses be carried out

(Introduction, cont'd) -

with a view to determining whether the grain size distribution in various samples could be used as a criterion for evaluating certain properties. The consideration of this problem will comprise Part I of this report.

At the same time, Mr. Findlater submitted two samples of tetryl produced by Defence Industries Limited (Canada) and requested a comparison with the English standards. This request is covered in Part II hereof.

Part I. - The English Standard Tetryls.

Consideration was first given to methods of analysis and preparation of the data for presentation.

Method of Analysis:

Slides of the three samples were prepared by the simple expedient of placing a small portion on a glass slide and dispersing the grains by tapping the slide. This was found to be satisfactory, and there seems to be no necessity for more complicated preparation in a mounting medium with a cover-glass.

A petrographic microscope fitted with a micrometer ocular was employed. The magnification was adjusted so that a single division of the micrometer was equivalent to 6 microns. The best method of illumination at this magnification proved to be transmitted light. This allowed also for the use of polarized light, which was useful in determining whether some of the very small grains were actually tetryl (which is anisotropic) or merely dust particles present on the slide.

The measurement of the grains was carried out using

(Method of Analysis, cont'd) -

the minimum dimension. No difficulty is experienced in measuring and sizing grains which are equidimensional or nearly so. Tetryl, however, departs rather widely from this condition, in that the crystals are hexagonal and characteristically elongated parallel to the axis. It therefore became necessary to either inject a long and laborious series of mathematical calculations, or to assume a single dimension as representing the significant one, and the minimum diameter of the crystals was selected. In presenting the data, instead of a system of ordinal numbers, direct group sizes were arbitrarily taken.

Table I will illustrate the type of data obtained and the method by which the results were extracted.

(Table I follows on next page.)

(Part I, cont'd) -

Table I.

Table To Illustrate the Type of Data Obtained from Measurements of Minimum Dimensions of Grains And The Manner of Extraction of Results. English Standard Tetryl - Medium.

Number of micrometer divisions	Number of grains of this minimum dimension	Range in size, in microns	Mean size, in microns	Functional number	NOMINAL PER CENT	NOMINAL PER CENT CUMULATIVE
90)	-					
80)	-	586-414	500	-	-	-
70)	-					
60)	-					
50)	-	414-293	354	-	-	-
48)	-					
45)	-					
40)	-	293-207	250	35	1.5	100.0
35)	1					
34)	-					
30)	-	207-146	177	50	2.2	98.5
25)	2					
24)	1					
22)	1					
20)	5	146-103	125	218	9.5	96.3
18)	4					
17)	3					
15)	15	103-73	88	406	17.6	86.8
13)	10					
12)	19					
10)	19	73-52	63	496	21.6	69.2
9)	12					
8)	27					
7)	21	52-37	44	363	15.8	47.6
6)	23					
5)	28	37-26	31	278	12.1	31.8
4	44	26-18	22	176	7.6	19.7
3	46	18-13	16	138	6.0	12.1
2	43	13-9	11	86	3.7	6.1
1½	25	9-6.5	8	37	1.6	2.4
1	11	6.5-4.6	5.5	11	0.5	0.8
2/3	7	4.6-3.2	3.9	4	0.2	0.3
½	5	3.2-2.3	2.8	3	0.1	0.1
1/3	-	2.3-1.6	2.0	-	-	-

(Method of Analysis, cont'd) -

It will be noted that the last two columns give "Nominal Per Cent" and "Nominal Per Cent Cumulative". These figures are given as percentages solely for purposes of providing a means of comparing samples, and are not to be interpreted as accurate percentages by weight. Since they are reproducible and represent the character of the grain distribution in the samples, this simplified method of calculation with the elimination of extended computations seems justifiable.

Table II.
Minimum-Dimension Grain Analyses of Three English Standard Tetryls.

Mean minimum size, microns	English Standard Coarse NOMINAL PER CENT		English Standard Medium NOMINAL PER CENT		English Standard Fine NOMINAL PER CENT	
	Distributed	Cumulative	Distributed	Cumulative	Distributed	Cumulative
500	1.9	100.0	--	--	--	--
354	3.0	98.1	--	--	--	--
250	16.1	95.1	1.5	100.0	--	--
177	22.3	79.0	2.2	98.5	--	--
125	14.5	56.7	9.6	96.3	3.8	100.0
88	10.6	42.2	17.6	86.8	14.1	96.2
63	8.3	31.6	21.6	69.2	20.1	82.1
44	6.8	23.3	15.8	47.6	19.4	62.0
31	6.3	16.5	12.1	31.8	17.4	42.6
22	4.3	10.2	7.6	19.7	11.6	25.2
16	3.1	5.9	6.0	12.1	6.5	13.6
11@	1.5	2.8	3.7	6.1	4.4	7.1
8@	0.9	1.3	1.6	2.4	1.3	2.7
5.5@@	0.3	0.4	0.5	0.8	0.8	1.4
3.9@@	0.1	0.1	0.2	0.3	0.3	0.6
2.8@@	Trace	Trace	0.1	0.1	0.2	0.3
2.0@@	--	--	--	--	0.1	0.1

@ The grains in these sizes are largely fragments of crystals which are irregular in shape.

@@ The grains in these sizes are practically wholly fragments of crystals which are irregular in shape and do not show good crystal boundaries.

(Figures 1, 2, and 3, concluding Part I, are photomicrographs, at approximately X50 magnification, of the three English samples.)

Figure 1.

PHOTOMICROGRAPH OF ENGLISH STANDARD TETRYL - COARSE.
(Approximately X50 magnification).

Figure 2.

PHOTOMICROGRAPH OF ENGLISH STANDARD TETRYL - MEDIUM.
(Approximately X50 magnification).

Figure 3.

PHOTOMICROGRAPH OF ENGLISH
STANDARD TETRYL - FINE.

(Approximately X50 magnification).

Part II. - Canadian (Defence Industries Limited) Tetryls.

Analyses:

The grain analyses of the two Defence Industries Limited samples (designated respectively Batch R.C.C.D. No. 6 and Batch R.C.C.D. No. 22) were carried out and computed in the same manner as were those of the English standards.

Table III gives the grain analyses of these samples.

Table III.

Minimum-Dimension Grain Analyses of Two Samples of Tetryl from Defence Industries Limited.

Mean minimum size, microns	Batch R.C.C.D. No. 6 NOMINAL PER CENT Distributed	Batch R.C.C.D. No. 6 NOMINAL PER CENT Cumulative	Batch R.C.C.D. No. 22 NOMINAL PER CENT Distributed	Batch R.C.C.D. No. 22 NOMINAL PER CENT Cumulative
250	--	--	2.5	100.0
177	--	--	4.0	97.5
125	3.7	100.0	8.8	93.5
88	8.4	96.3	8.9	84.7
63	14.8	87.9	9.7	75.8
44	16.7	73.1	12.3	66.1
31	16.1	56.4	11.2	53.8
22	12.5	40.3	9.0	42.6
16	11.1	27.8	8.9	33.6
11⊕	9.9	16.7	8.7	24.7
8⊕	4.3	6.8	6.2	16.0
5.5⊕⊕	1.4	2.5	4.6	9.8
3.9⊕⊕	0.6	1.1	2.5	5.2
28 ⊕⊕	0.4	0.5	1.9	2.7
2.0	0.1	0.1	0.8	0.8

⊕ Largely fragmentary. ⊕⊕ Wholly fragmentary.

(Figures 4 and 5, following, are photomicrographs, at approximately X50 magnification, of the two Defence Industries Limited tetryls.)

(Part II, cont'd)-

Figure 4.

Photomicrograph of Defence Industries Limited tetryl, Batch R.C.C.D. No. 6. (Approx. X50 magnification).

Figure 5.

Photomicrograph of Defence Industries Limited tetryl, Batch R.C.C.D. No. 22. (Approx. X50 magnification).

(Part II, concluded) -

GRAIN SIZE CURVES:

The cumulative percentages resulting from the grain analyses of the five samples of tetryls were plotted against grain size. These curves are shown in Figure 6 and illustrate the fundamental characteristics of the samples with regard to the grain size distribution.

It will be noted that Batch R.C.C.D. No. 22 contains more of the very fine material and also more coarse material than does Batch R.C.C.D. No. 6. The latter is more uniform, and does not contain the larger sizes; in fact, the curve of this sample falls entirely below that of the "English standard--fine."

Figure 6.

NOMINAL CUMULATIVE PER CENT.

Curves showing the character of the samples of tetryl.

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