MS
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#161

Missouri Tripoli

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Character of samples

The "cream" samples are a light yellow or cream color; the "rose" samples are a dull red. The color in both cases is due to iron oxide. Chemical analyses of two samples follow:

	#26 (cream)	#29 (rose)
SiO_2	98.53	93.78
Al_2O_3	.59	3.36
Fe_2O_3	.22	1.08
MgO	.02	.11
CaO	.03	.08
Na_2O	.03	.07
K_2O	.09	.13
Loss on Ign.	.48	1.59
CO_2	.00	.00
	99.99	100.20

Thermal analyses made and interpreted by R. E. Grim on the 0 by 2 micron fraction of sample 26 show that this fraction is about 60 percent quartz and 40 percent clay mineral material and that the latter is illite. The same fraction for sample 29 was largely clay of the kaolinite type.

Calculations from the above chemical analyses indicate the following approximate mineralogical composition for the samples:

#26 - illite 2 percent, free silica 97½ percent

#29 - kaolinite type clay mineral 8 percent, free silica 90 percent

Character of grains

Microscopic examination of the Missouri tripoli samples revealed that they are of the same general character as the southern Illinois silica, being comprised principally of "cluster" grains. In the "rose" tripoli the grains show a reddish stain or coating due to iron oxide or red ferruginous clay. Grains of a similar nature to the coating are likewise present. Some of the grains in the "cream" tripoli exhibit slight yellow stains. As in the southern Illinois silica there are a few coarse quartz grains present; X-ray examination (Bradley) reveals that basic particle size characteristics are likewise similar. Thermal curves indicate that quartz is the predominant silica mineral.

Specific gravity

True specific gravity, average two samples, is 2.646. No determinations of bulk specific gravity, weight per cu. ft. and porosity of the tripoli were made.

Particle size

See Tables 1, 2, 3, and 4.

Specific surface

See Table 5.

Oil absorption

See Table 6.

Bulking

No determinations of bulking, saturation of oil absorption samples at the end of the oil absorption test, or microscopic examinations at the end of the test were made on Missouri tripoli.

Abrasiveness

See Tables 7, 8, 9, and 10.

Comparison of Missouri tripoli and southern Illinois silica samples tested

Chemical composition. The "cream" tripoli is about of the same chemical composition as the silica. The Fe_2O_3 content is higher, however, in the sample analyzed being 0.22 percent as compared to 0.0 to 0.07 percent in four samples of silica. Al_2O_3 is lower being 0.22 percent in the tripoli as compared to .36 to .95 in four silica samples. The higher Fe_2O_3 content of the tripoli probably accounts for its yellow color.

The "rose" tripoli is much lower in silica and higher in Fe_2O_3 and Al_2O_3 than the silica, in a large measure the result of its greater clay content.

Character of grains. The tripoli is composed of cluster grains of generally similar nature to those of the silica. Like the silica the basic particle size, as shown by X-ray, is 1 to 5 microns.

Specific gravity. The true specific gravity of the tripoli and silica are identical for practical purposes.

Particle size. The tripoli samples are generally coarser than the silica samples. Figure 1 shows curves for the five tripoli samples tested, for the finest and coarsest silica samples and for two silica samples of intermediate size characteristics. The arithmetic mean diameter, first

MISSOURI TRIPOLI

Five samples of Missouri tripoli produced by Barnsdale Tripoli Corporation, Seneca, Missouri, were purchased from Tamms Silica Co. of Chicago. The samples were 100-pound bags representing five commercial grades as follows:

#26 - cream, double ground

#27 - cream, air float

#28 - rose, air float

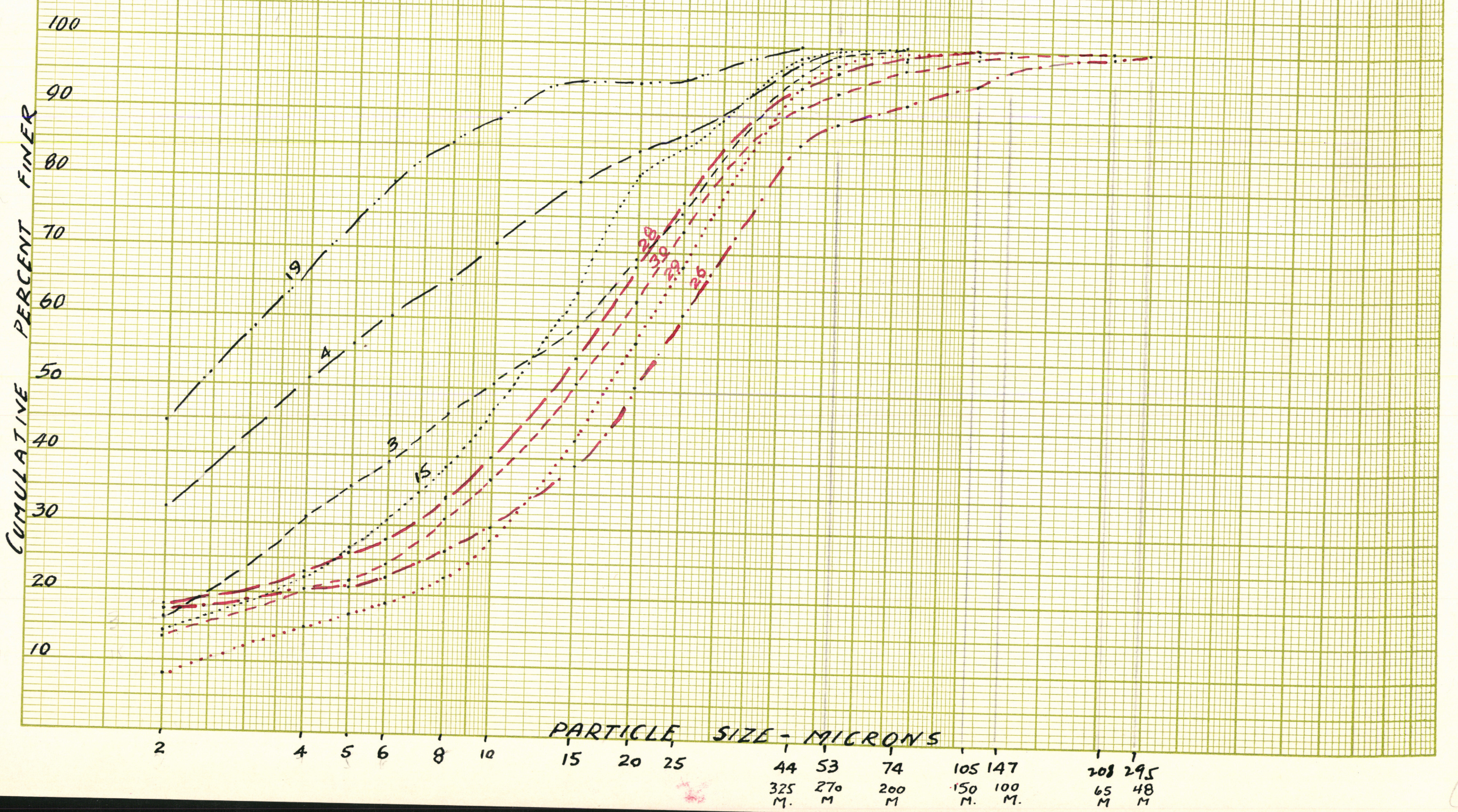
#29 - rose, double ground

#30 - rose, ground

Tests of the above samples were carried out in parallel with those of the northern and southern Illinois silicas and the results are therefore comparable. The tests were made in order to provide a reliable basis for comparing the Missouri and Illinois materials, which compete in some markets, and to afford actual factual information with which to clear away industry sponsored misconceptions regarding the superiority of the tripoli as compared to Illinois silica.

In this report the data are presented in the same sequence as in the reports on the Illinois silicas, mainly in tabular form. No discussion of equipment or special interpretations of data are given as the equipment is the same as that used for the Illinois silicas and the results of tests parallel those of the southern Illinois silica.

FIGURE 1. PARTICLE SIZE, IN CUMULATIVE PERCENT FINER, OF SOUTHERN ILLINOIS SILICA (BLACK) AND MISSOURI TRIPOLI (RED).



quartile and median values of all the tripoli samples are greater than those of the coarsest silica sample and indicate the greater coarseness numerically. The third quartile values of most of the tripoli samples are in the same range as the two coarsest silica samples, Figure 2.

Specific surface. The specific surface, as determined by the Blaine air permeability apparatus, of all the tripoli samples is less than that of any silica sample, Figure 3. Three silica samples have a specific surface about 100 percent greater than most of the tripoli samples.

The average specific surface of two tripoli samples and a silica sample is about the same in the 0 by 5 micron fractions. In view of the fact that the basic particle size of both the tripoli and silica is about the same, that is 1 to 5 microns, the coincidence of the specific surface of the 0/5 micron fractions is understandable. In the coarser fractions the average specific surface of the two tripoli samples exceeds that of the silica sample as follows:- 5 x 10 - 6 percent, 10 x 20 - 15 percent, 20 x 30 - 25 percent, 30 x 44 - 38 percent, and 44 x 53 - 29 percent.

The reason for this higher specific surface is not specifically known. It may be due to a greater angularity of the particles or a greater rugosity of the surface of the particles. These matters were not exhaustively studied but limited investigation suggests that silica and tripoli do not differ markedly in these characteristics. A greater porosity of the tripoli grains may well be the explanation. The smaller specific surface of the 44 by 53 micron fraction, as compared to the 30 x 44 micron fraction, may well be due to the presence of a considerable number of non-porous quartz sand grains or ferruginous clay pellets in the coarser fraction.

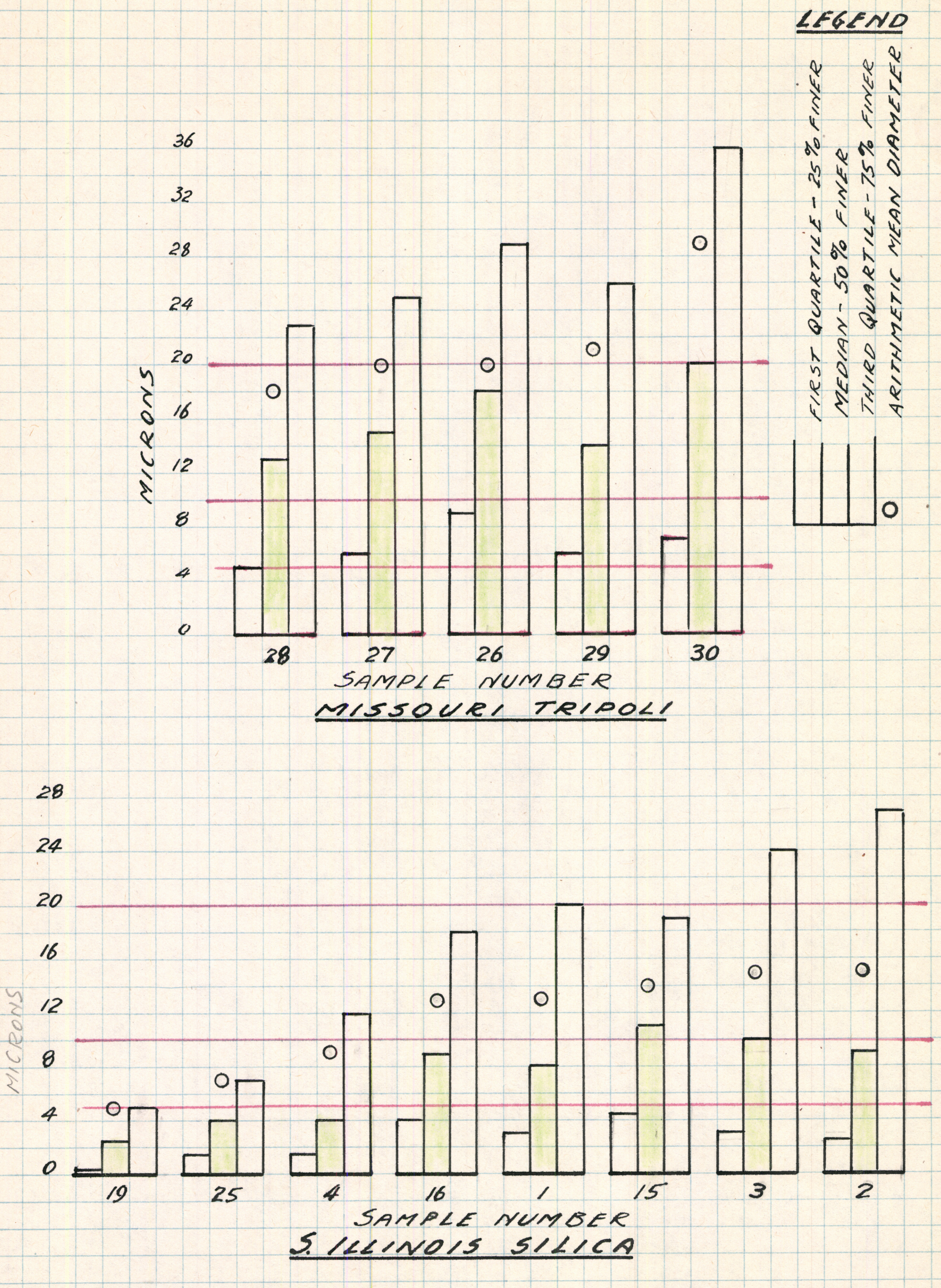
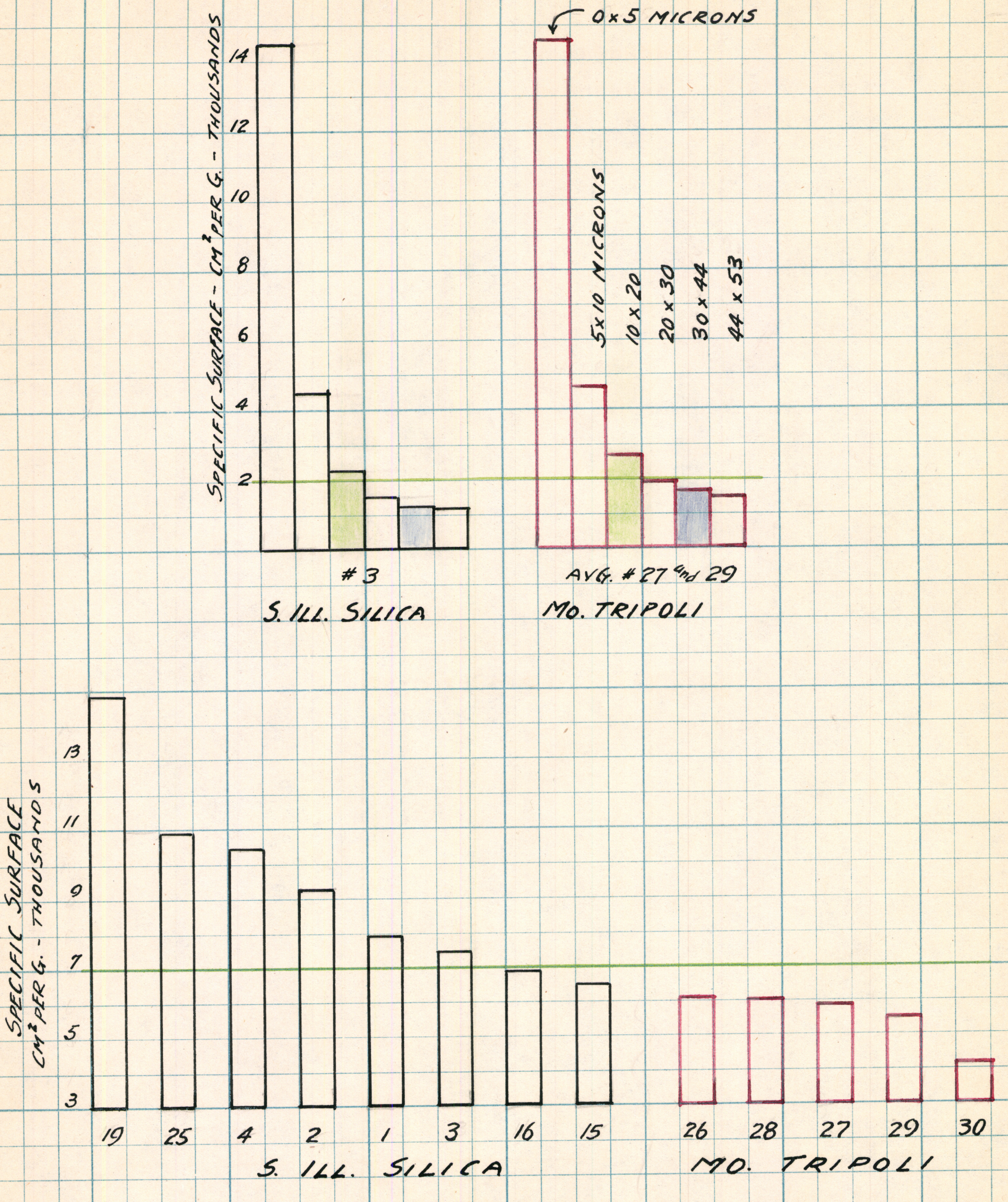


FIGURE 2. QUARTILES, MEDIANS AND ARITHMETIC MEAN DIAMETERS.



<u>FIGURE 3.</u> SPECIFIC SURFACE, INCLUDING DATA ON VARIOUS SIZE FRACTIONS.

<u>Oil absorption</u>. The oil absorption of the tripoli samples, Figure 4, exceeds that of the silica samples. The average for the five tripoli samples is 45.1 percent and for the 8 silica samples 27.0 percent, indicating a 67 percent greater oil absorption for the tripoli. Oil absorption of the size fractions of the tripoli sample No. 27 is about the same as that for the average of silica samples 3 and 16 in the 0/5 fraction but is higher in the coarser fractions by the following percents:- 5 x 10 - 19 percent, 10 x 20 - 15 percent, 20 x 30 - 24 percent, 30 x 44 - 35 percent, and 44 x 53 - 37 percent. The causes of the greater oil absorption of the tripoli are probably related to the same phenomena discussed with reference to specific surface in the paragraph above.

<u>Abrasiveness</u>. The abrasiveness of all the tripoli samples exceeded that of any silica sample, Figure 5. The abrasiveness of the 0 x 5, 5 x 10, and 10 x 20 micron size fractions of silica sample 3 is less than that of the equivalent size fractions of tripoli sample 29 by .0013, .0006 and .0065 grams respectively. In the 20 x 30, 30 x 44, and 44 x 53 micron fractions the reverse is true and the silica exceeds the tripoli by .0055, 0211 and .0138 grams respectively.

By measuring the weight loss of the type metal blocks at the end of each successive 2000 revolutions the rate at which samples 3 and 27 produced wear was determined with the results shown in Figure 6. The left hand chart shows that the silica produced greater wear than the tripoli up to 6000 revolutions when the rate of wear was about the same for both materials. Above 6000 revolutions the tripoli produced greater wear than the silica.

The right hand chart of Figure 6, showing the amount of wear during successive 2000 revolutions indicates an abrupt decline in the amount of wear

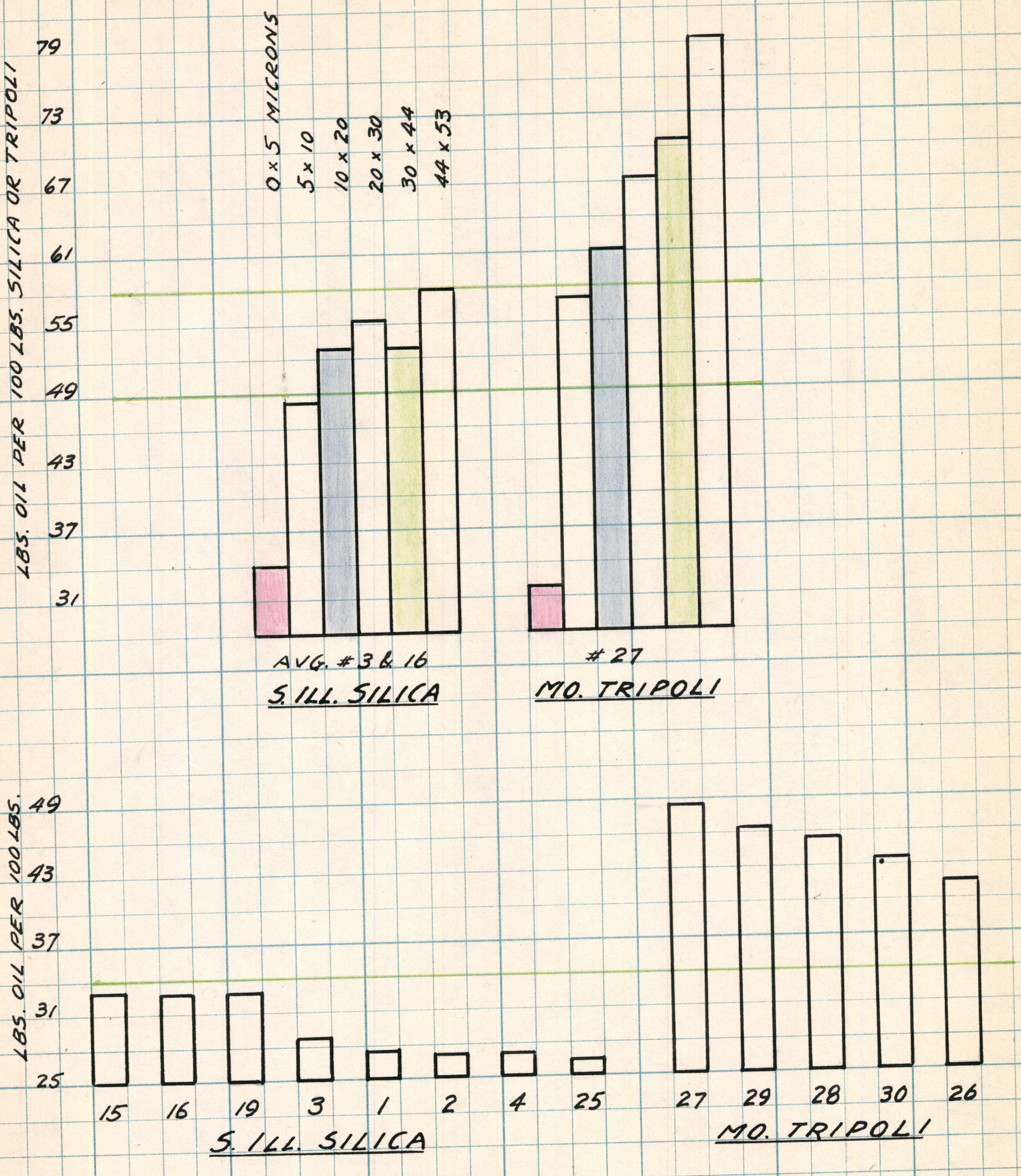
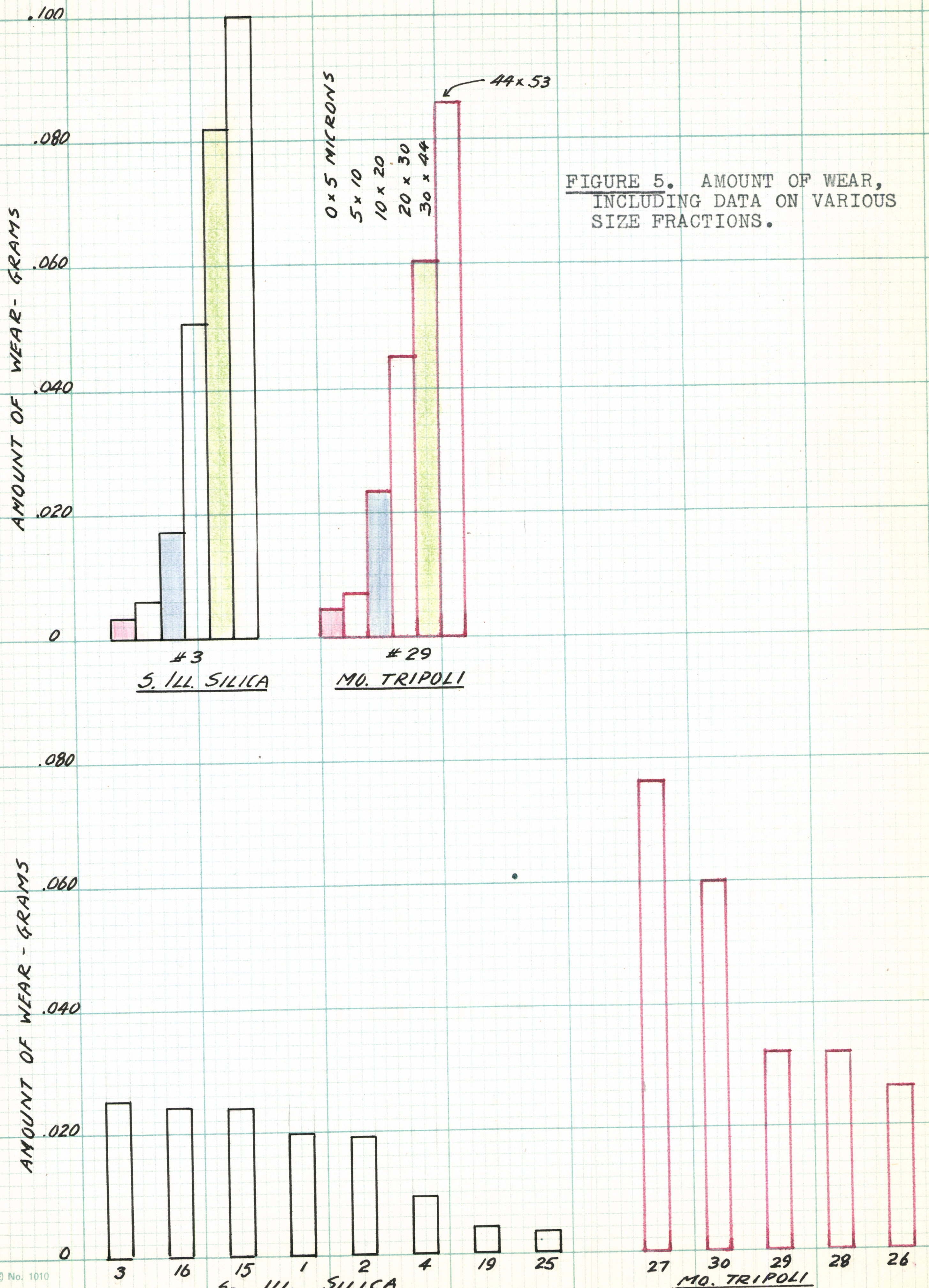


FIGURE 4. OIL ABSORPTION, INCLUDING DATA ON VARIOUS SIZE FRACTIONS.

FIGURE 5. AMOUNT OF WEAR, INCLUDING DATA ON VARIOUS SIZE FRACTIONS.



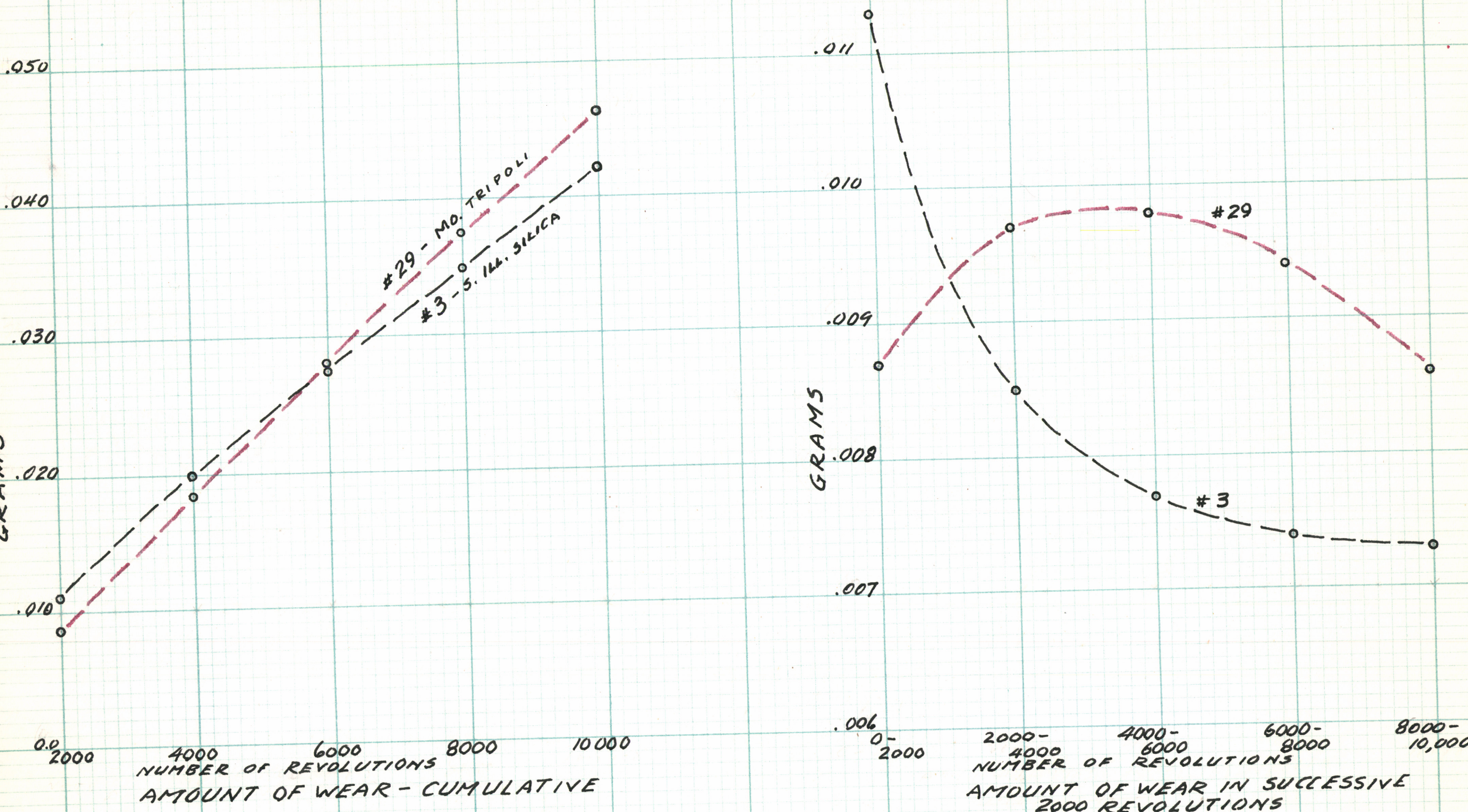


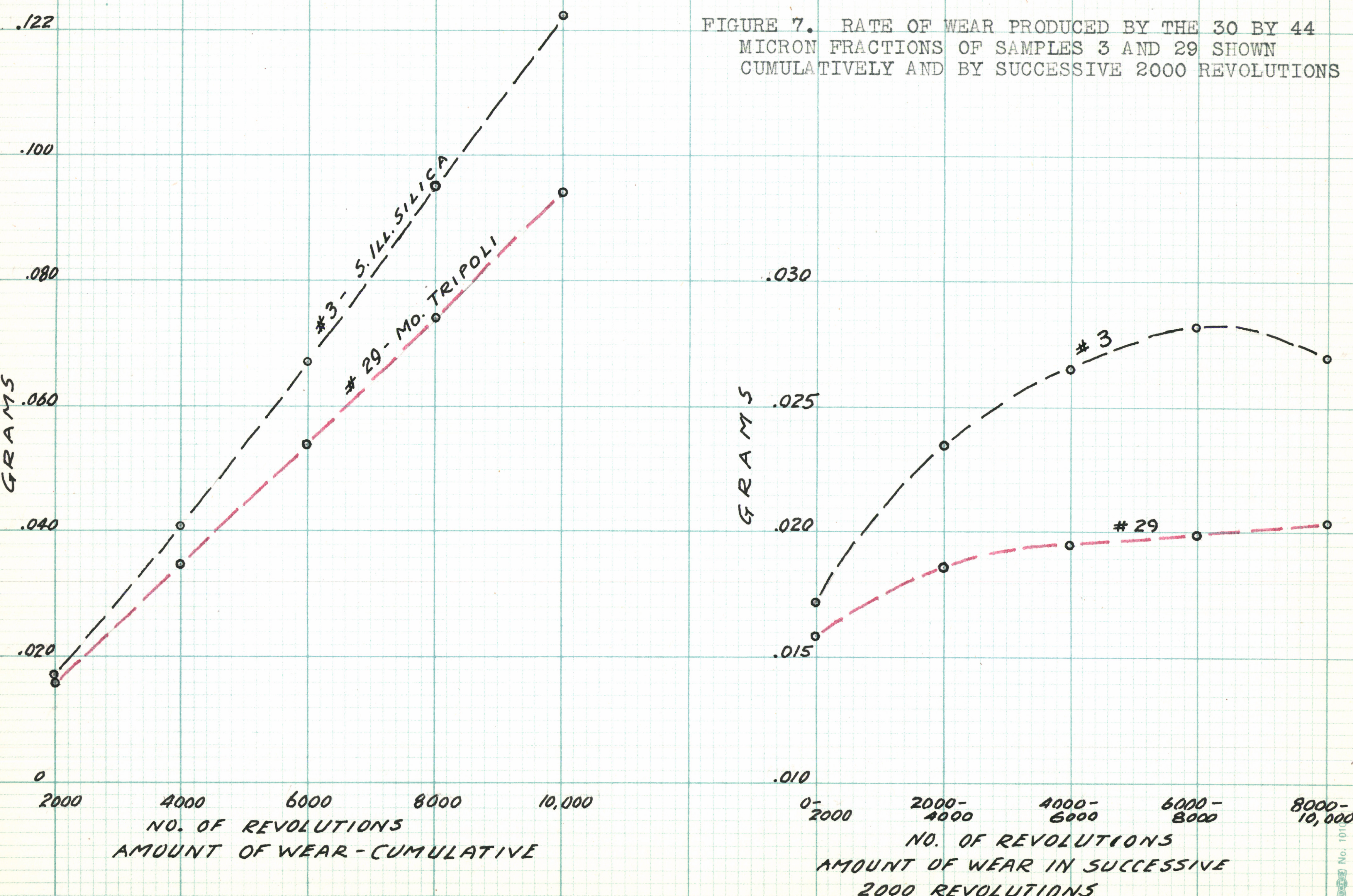
FIGURE 6. RATE OF WEAR, SHOWN CUMULATIVELY AND BY SUCCESSIVE 2000 REVOLUTIONS.

produced by the silica followed by a more gradual decline. In contrast the amount of wear produced by the tripoli increased up to 6000 revolutions and thereafter declined.

Figure 7 shows data on the rate of wear produced ~~to~~ by the 30 by 44 micron fractions of samples 3 and 29. The silica produced wear at a considerably more rapid rate than the tripoli as the left hand chart shows. The right hand chart indicates that the rate at which the silica produced wear increased notably up to 8000 revolutions and thereafter declined. In contrast the rate at which wear was produced by the tripoli increased moderately up to 6000 revolutions but thereafter increased but little.

Figure 8 shows the particle size distribution of samples of the 30 by 44 micron fractions of samples 3 and 29 at the end of 10,000 revolutions. In this test the sequence of revolutions was not interpreted, as was necessary in preceding tests, to make weighings every 2000 revolutions. It was recognized that the mixing of the slurry on the glass plate by the spreaders of the abrasiveness testing machine might cause a certain amount of break down of the silica and tripoli particles and tests were therefore run with the spreaders in position but without the metal blocks in place. Particle size analyses were made of the silica and tripoli at the end of this test and the data used to correct the information resulting from the tests with the metal blocks in place. Data given in Figure 8 have been corrected so that they reflect only the wear thus assignable to the metal blocks. The figure shows that the percent of 30 by 44 micron material remaining at the end of the test was about the same for both the silica and tripoli. However, the erosion of the original silica grains resulted in greater fragmentation of the silica as reflected by the 38 percent of 0 by 10 micron particles produced in contrast to about 28 percent for the

FIGURE 7. RATE OF WEAR PRODUCED BY THE 30 BY 44 MICRON FRACTIONS OF SAMPLES 3 AND 29 SHOWN CUMULATIVELY AND BY SUCCESSIVE 2000 REVOLUTIONS



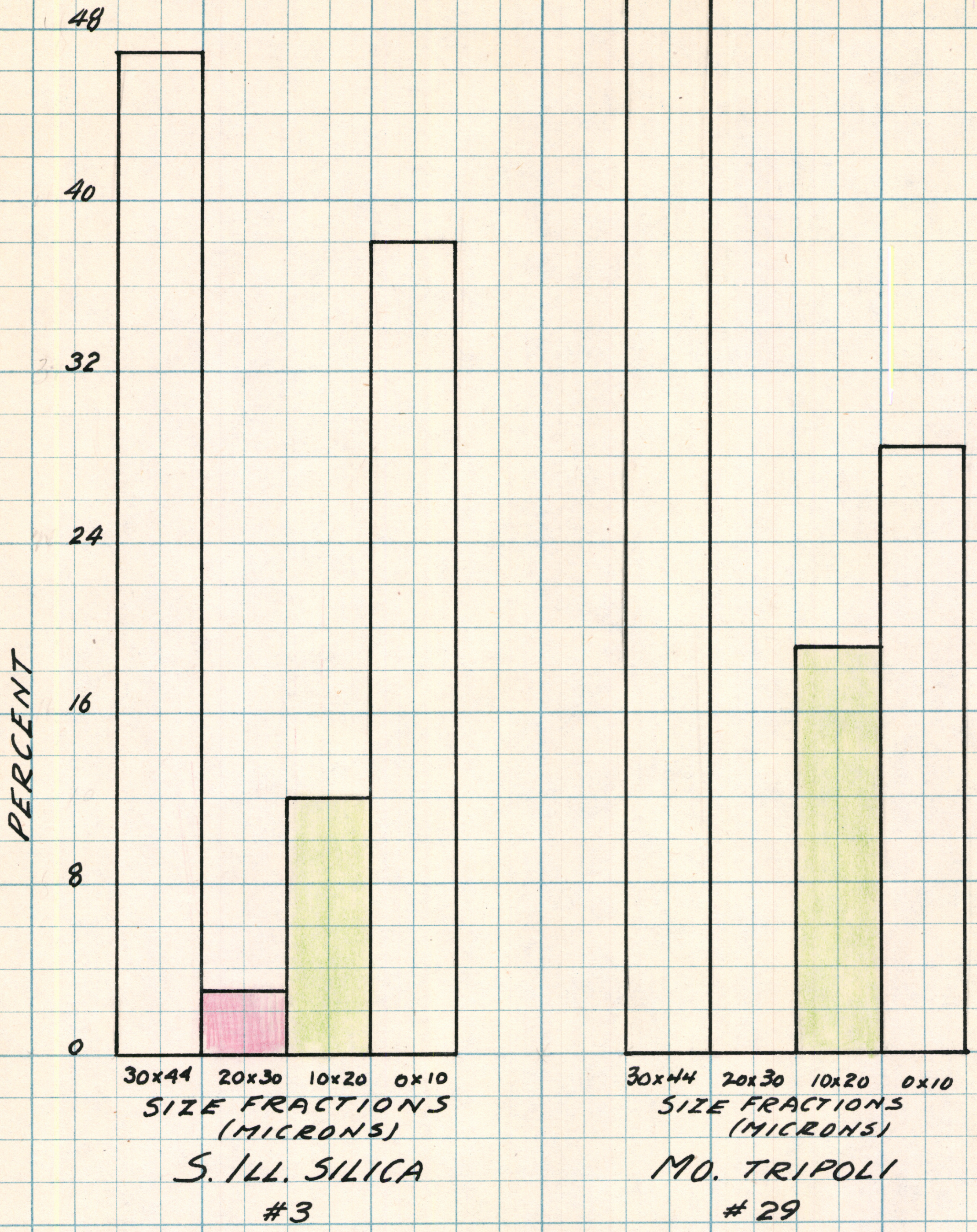


FIGURE 8. PARTICLE SIZE DISTRIBUTION OF 30 BY 44 MICRON FRACTIONS OF SILICA AND TRIPOLI AFTER BEING SUBJECTED TO 10,000 REVOLUTIONS IN THE ABRASIVENESS MACHINE. WEAR PRODUCED BY SPREADERS DISCOUNTED.

tripoli. These differences are largely balanced off in the 10 x 20 micron fraction of which the silica yielded 10 percent as against 19 percent for the tripoli.

Table 1

Percent by size fractions

Size fraction - microns	Sample No. 26	27	28	29	30
0-2	8	7	18	13½	17½
2-4	7	6	5	7	3
4-6	3½	5½	5	4	2
6-8	4	6½	6	6½	4
8-10	5½	7	6	6	3½
10-15	14½	19	14½	14	9
15-20	14½	14½	13½	12	11½
20-25	11	10½	9½	10	10½
25-44	26	17½	17	18½	25
44-53	3½	1½	2	2	3
53-74	2	2	1½	3½	3
74-105	½	2	1½	2	3
105-147	0	½	½	½	2
147-208		½	0	½	2½
208-295		0		0	½
295-417					0

44 microns - 325 mesh
53 " - 270 "
74 " - 200 "
105 " - 150 "

147 microns - 100 mesh
208 " - 65 "
295 " - 48 "

Table 2

Cumulative percent finer

Size, microns	Sample No. 26	27	28	29	30
2	8	7	18	13½	17½
4	15	13	23	20½	20½
5	17	16	26	22	21
6	18½	18½	28	24½	22½
8	22½	25	34	31	26½
10	28	32	40	37	30
15	42½	51	54½	51	39
20	57	65½	68	63	50½
25	68	76	77½	73	61
44	94	93½	94½	91½	86
53	97½	95½	96½	93½	89
74	99	97½	98½	97	92
105	100	99½	99½	99	95
147		99 3/4	100	99½	97
208		100		100	99½
295					100

44 microns - 325 mesh
53 " - 270 "
74 " - 200 "
105 " - 150 "

147 microns - 100 mesh
208 " - 65 "
295 " - 48 "

Table 3

Percent by size fractions

Size fraction (microns)	Sample No. 26	27	28	29	30
0/5	17	16	26	22	21
5/10	11	16	14	15	9
10/20	29	33½	28	26	20½
20/30	22½	23	16½	17	19
30/44	14½	5	10	11½	16½
44/74	5½	4	4	5½	6
+ 74	½	2½	1½	3	8

Table 4

Arithmetic mean diameter, quartiles and medians

Sample No.	Arith. mean dia.-microns	First quartile 25% finer than	Median 50% finer than	Third quartile 75% finer than
		Size in microns and percent finer		
26	20	9	18	29
27	20	8	15	25
28	18	5	13	23
29	21	6	14	26
30	29	7	20	36

Table 5

Specific surface
(Blaine air permeability apparatus)

Sample 26 - 6,030 $cm.^2$ gm.
" 27 - 5,860 "
" 28 - 6,000 "
" 29 - 5,555 "
" 30 - 4,115 "

Size fraction (microns)	Sample 27	Sample 29	average
0/5	14,575	14,335	14,455
5/10	4,845	4,430	4,638
10/20	2,540	2,835	2,688
20/30	2,060	1,880	1,970
30/44	1,700	1,605	1,653
44/74	1,525	1,445	1,485
+ 74	1,200	1,270	1,235

Table 6

Oil absorption

Sample	Oil absorption (lbs. oil per 100 lbs. tripoli)
26	41.4
27	48.3
28	45.6
29	46.4
30	43.7

Sample 27

Size fraction (microns)	Oil absorption
0/5	32.3
5/10	57.0
10/20	61.3
20/30	67.4
30/44	70.8
44/~~74~~ 53	79.3
+ ~~74~~ 53	83.1

Table 7

Abrasiveness

Sample No.	Abrasiveness
26 (cream)	.0263
27 "	.0763
28 (rose)	.0316
29 (rose)	.0318
30 "	.0600

Sample 29

Size fraction (microns)	Abrasiveness
0 by 5	.0047
5 by 10	.0065
10 by 20	.0236
20 by 30	.0452
30 by 44	.0608
44 by 53	.0862

Table 8

Rate of abrasion, Sample 29

No. revolutions	Cumulative amount of wear
2000	.0087
4000	.0184
6000	.0282
8000	.0376
10000	.0462

No revolutions	Amount of wear during each successive 2000 revolutions	Percent of wear as compared with the wear during the first 2000 revolutions
0-2000	.0087	100
2000-4000	.0097	112
4000-6000	.0098	113
6000-8000	.0094	108
8000-10000	.0086	99

Table 9

Rate of abrasion, 30 by 44 micron fraction, Sample 29

No. revolutions	Cumulative amount of wear
2000	.0158
4000	.0344
6000	.0539
8000	.0738
10000	.0942

No. revolutions	Amount of wear during each successive 2000 revolutions	Percent of wear compared with wear during first 2000 revolutions
0-2000	.0158	100
2000-4000	.0186	118
4000-6000	.0195	123
6000-8000	.0199	126
8000-10000	.0204	128

Table 10

Particle size of a sample of 30/44 micron tripoli from Sample 29 after 10,000 revolutions

Size fraction microns	Particle size after 10,000 revolutions with metal blocks in machine and spreader in place	Particle size after 10,000 revolutions with spreader in place but no metal block in machine	Percent of each size fraction attributable to wear by metal block	Particle size after 10,000 revolutions produced by wear attributable to metal block
	Percent	Percent		Percent
30 by 44	30½	78	47½	50
20 by 30	18	18	0	0
10 by 20	19	Trace	19	19
0 by 10	32½	4	28½	28½