



# OFFICE MEMORANDUM

DATE: February 14, 1980

TO: L. T. Oehler  
Engineer of Research

FROM: R. W. Muethel

SUBJECT: Petrographic Analysis of Coarse Aggregate: County Road Comm. No. 3,  
Pit No. 17-62 (Testing Laboratory Sample No. 79 A-2280).  
Research Report No. R-1136

On December 13, 1979, a sample of crushed gravel sprinkle treatment aggregate was received by the Department's Testing Laboratory Section. Information accompanying the sample stated that the material was obtained from a stockpile at the County Road Comm. No. 3, Pit No. 17-62, location northwest of northwest Section 25, T47N, R1W, Chippewa County. The material was submitted to the laboratory to be tested for information. Petrographic analysis of a portion of the sample was requested by G. H. Gallup.

## Summary

Rock Class	Condition of Particles	Percent of Sample
Igneous	Hard, fresh, and non-porous	46
Metamorphic	Hard to moderately hard, fresh, and non-porous to slightly porous	18
Sedimentary	Hard to moderately hard, fresh, and moderately porous to porous	36

Computed Coefficient of Wet Sliding Friction at 40 mph = 0.54

Detailed tabulations of petrographic composition, specific gravity, absorption, and gradation are included in Tables 1 through 4. Calculations of the computed pavement friction coefficient are included in Table 5.

## Detailed Petrography

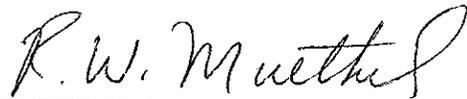
Petrographic examination was conducted in general conformance with ASTM C 295, "Petrographic Examination of Aggregates for Concrete." Representative portions—300 particles—of each sieve fraction of the sample were identified megascopically,

along with acid testing and a scratch test for hardness, and microscopically with a stereomicroscope. Specific gravity determinations were performed in general accordance with ASTM C 127, "Specific Gravity and Absorption of Coarse Aggregate." Determinations included all material analyzed.

Computed Coefficient of Wet Sliding Friction

The computed coefficient of wet sliding friction was calculated from polishing values obtained for the individual rock types tested on the MDOT wear track as part of Research Project 71 C-13, and field correlation tests of the wear track skid tester vs. the MDOT GM skid trailer unit, conducted under Research Project 75 TI-320. The wear track polishing values represent the interaction of a smooth tread skid tire with a test surface of exposed 3/8-in. to No. 4 sized aggregate approximating an open-graded pavement. The computed pavement friction coefficient is weighted to a gradation of the sample conducted by the Structural Materials Testing Unit of the Testing Laboratory Section.

TESTING AND RESEARCH DIVISION



Geologist, Petrography and Hydrology  
Group

RWM:bf

TABLE 1  
 PETROGRAPHIC COMPOSITION  
 Testing Laboratory Sample No. 79 A-2280

Rock Type	Sieve Fraction Analyzed			Computed Sample Composition
	3/4 to 1/2-in.	1/2 to 3/8-in.	3/8 to No. 4	
Granite	26.0	28.3	31.0	28.4
Diorite	3.0	3.0	5.0	3.7
Gabbro	12.0	9.3	10.3	10.5
Basalt	3.7	3.7	2.3	3.2
Felsite	0.3	--	0.7	0.3
Quartzite	12.0	15.7	16.0	14.6
Metasediments	3.7	3.7	3.0	3.5
Sandstone	39.3	36.3	31.7	35.8
Totals, percent	100.0	100.0	100.0	100.0

NOTE: Computed sample composition is based upon counts of 300 particles contained in each of the sieve fractions noted.

TABLE 2  
 SPECIFIC GRAVITY AND ABSORPTION DATA  
 Testing Laboratory Sample No. 79 A-2280

Rock Type	Specific Gravity			Absorption, percent	Composition, percent by weight
	Bulk, dry	Bulk, ssd	Appar-ent		
Granite	2.64	2.66	2.69	0.61	28.2
Diorite	2.80	2.81	2.81	0.01	3.9
Gabbro	2.98	2.99	3.00	0.29	12.1
Basalt	2.86	2.87	2.88	0.26	3.6
Felsite	2.64	2.66	2.69	0.82	0.4
Quartzite	2.54	2.57	2.62	1.14	13.1
Metasediments	2.70	2.71	2.73	0.30	3.4
Sandstone	2.44	2.49	2.59	2.39	35.3
Total Sample	2.60	2.63	2.68	1.22	100.0

NOTE: Values are computed from determinations made on all sample material contained in the categories noted.

TABLE 3  
GRADATION  
Testing Laboratory Sample No. 79 A-2280

Sieve Size	Sample Gradation <sup>1</sup> Weight Retained, grams	Weighted Sample Gradation <sup>2</sup>	
		Weight Retained, grams	Percent
3/4-in.	--	--	--
1/2-in.	1285	1285	38.33
3/8-in.	1030	1030	30.73
No. 4	1037	1037	30.94
No. 8	89	--	--
P No. 8	190	--	--
Total	3631	3352	100.00

<sup>1</sup> Conducted by Structural Materials Testing Unit, Testing Laboratory Section.

<sup>2</sup> Sample gradation weighted to sieve fractions examined in petrographic analysis.

TABLE 4  
WEIGHTED PETROGRAPHIC COMPOSITION\*  
Testing Laboratory Sample No. 79 A-2280

Rock Type	Sieve Fraction Analyzed			Weighted Petrographic Composition
	3/4 to 1/2-in.	1/2 to 3/8-in.	3/8 to No. 4	
Granite	9.97	8.70	9.59	28.26
Diorite	1.15	0.92	1.54	3.61
Gabbro	4.60	2.86	3.19	10.65
Basalt	1.42	1.14	0.71	3.27
Felsite	0.11	--	0.22	0.33
Quartzite	4.60	4.82	4.95	14.37
Metasediments	1.42	1.14	0.93	3.49
Sandstone	15.06	11.15	9.81	36.02
Totals, percent	38.33	30.73	30.94	100.00

\* Computed from the petrographic composition in Table 1, and the weighted sample gradation in Table 3.

TABLE 5  
 COMPUTED COEFFICIENT OF WET SLIDING FRICTION  
 Testing Laboratory Sample No. 79 A-2280

Rock Type	Weighted Petrographic Composition percent	MDOT Wear Track Polishing Value at Four Million Wheel Passes	Computed Sample Polishing Value*
Granite	28.26	350	98.91
Diorite	3.61	360	13.00
Gabbro	10.65	350	37.28
Basalt	3.27	310	10.14
Felsite	0.33	320	1.06
Quartzite	14.37	370	53.17
Metasediments	3.49	340	11.87
Sandstone	<u>36.02</u>	490	<u>176.50</u>
Total Sample	100.00		401.93

\* The computed sample polishing value 401.93 is within the MDOT wear track polishing value range from 394 to 402 correlated to a skid trailer coefficient of wet sliding friction of 0.54 at 40 mph.

IGNEOUS ROCKS

Rock Type	Granite	Diorite	Gabbro
Color	mottled pink, white to buff, and dark green to black; and mottled white and dark gray or green to black	mottled buff to white, and dark green to black; and mottled pink and dark green to black	mottled white to gray and dark green to black
Texture	medium to fine grained	medium to fine grained	medium to fine grained
Luster	dull to subvitreous	dull	dull
Hardness	Mohs 6 to 7	Mohs 6 to 7	Mohs 5-1/2 to 6
Porosity	non-porous	non-porous	non-porous
Particle Shape	angular	angular	angular
Particle Surface	fresh, rough, dented to ridged	fresh, rough, dented to ridged	fresh, rough, dented to ridged
Remarks	Apparent grain size range: 2 mm to 0.1 mm. Apparent avg. grain size: 0.5 mm.	Apparent grain size range: 1 mm to 0.1 mm. Apparent avg. grain size: 0.5 mm.	Apparent grain size range: 1 mm to 0.1 mm. Apparent avg. grain size: 0.5 mm.

IGNEOUS ROCKS (Cont.)

Rock Type	Basalt	Felsite
Color	dark gray or green to black	greenish gray; pink; and mottled buff and brown
Texture	fine grained to micro-crystalline	fine grained to micro-crystalline
Luster	dull	dull
Hardness	Mohs 5-1/2 to 6	Mohs 6 to 7
Porosity	non-porous	non-porous
Particle Shape	angular	angular
Particle Surface	fresh, rough, dented to ridged	fresh, rough to moderately smooth, dented to ridged
Remarks	Apparent grain size range: 0.2 mm to <0.1 mm. Apparent avg. grain size: 0.1 mm.	Apparent grain size range: 0.1 mm to <0.1 mm. Apparent avg. grain size: <0.1 mm.

METAMORPHIC ROCKS

Rock Type	Quartzite	Metasediments
Color	white; pink; gray; green; and mottled white, pink, buff, and reddish brown	gray to green; and mottled white, buff, pink, and gray
Texture	fine to very fine grained; and massive	fine grained to micro-crystalline
Luster	dull to vitreous	dull
Hardness	Mohs 7	Mohs 5 to 7
Porosity	non-porous to slightly porous	non-porous
Particle Shape	angular	angular
Particle Surface	fresh, rough, dented to ridged	fresh, rough to moderately smooth, dented to ridged
Remarks	<p>Apparent grain size range: 0.5 mm to &lt;0.1 mm. Apparent avg. grain size: 0.1 mm. Orthoquartzite particles are included in this category due to similar physical characteristics.</p>	<p>Apparent grain size range: 0.5 mm to &lt;0.1 mm. Apparent avg. grain size: &lt;0.1 mm.</p>

SEDIMENTARY ROCKS

Rock Type	Sandstone
Color	buff; white; pink; and mottled buff to white, and pink to reddish brown
Texture	fine to very fine grained
Luster	dull
Hardness	Mohs 6 to 7
Porosity	porous to moderately porous
Particle Shape	angular to subangular
Particle Surface	fresh, rough, dented to ridged
Remarks	Apparent grain size range: 0.5 mm to 0.1 mm. Apparent avg. grain size: 0.3 mm. Some of the particles are partially indurated to ortho-quartzite.