



OFFICE MEMORANDUM

DATE: March 27, 1984

TO: L. T. Oehler
Engineer of Research

FROM: R. W. Muethel

SUBJECT: Petrographic Analysis of Dense-Graded Gravel Aggregate: Butkovich #2 Pit No. 49-74 (Testing Laboratory Sample No. 83A-10084). Research Project 83 TI-916. Research Report No. R-1240

In June 1983 a sample of dense-graded gravel aggregate was received by the Department's Testing Laboratory Section. Information accompanying the sample stated that the material was obtained from the Butkovich #2 Pit No. 49-74, location NW of NW, Sec. 18, T43N, R10W, Mackinac County, by G. H. Gallup.

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.

Rock Class	Condition of Particles	Percent of Sample
Igneous	hard to soft, fresh to highly weathered, and non-porous to finely porous	5.3
Metamorphic	hard, fresh to weathered, and non-porous to porous	1.0
Sedimentary	hard to soft, fresh to highly weathered, and non-porous to finely porous	93.7

Approximately 57 percent of the sample was found to be composed of material having absorption values greater than 2.0 percent.

Detailed tabulations of petrographic composition, specific gravity, and absorption are included in Tables 1 and 2.

Detailed Petrography

Petrographic examination was conducted in general conformance with ASTM C295, "Petrographic Examination of Aggregates for Concrete." Representative portions—300 particles—of the noted sieve fractions were identified megascopically along with

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acid testing and a scratch test for hardness, and microscopically with a stereomicroscope. Specific gravity and absorption determinations were performed in general accordance with ASTM C127, "Specific Gravity and Absorption of Coarse Aggregate." Determinations included all material of the rock types analyzed. The following pages contain the rock type descriptions.

TESTING AND RESEARCH DIVISION

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Attachments

cc: M. L. O'Toole
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TABLE 1
 PETROGRAPHIC COMPOSITION
 (Testing Laboratory Sample No. 83A-10084)

Rock Type	Sieve Fraction Analyzed				Computed Sample Composition
	1 to 3/4-in.	3/4 to 1/2-in.	1/2 to 3/8-in.	3/8 to No. 4	
Igneous					
Granite	4.0	4.0	4.0	3.4	3.9
Diorite	0.7	0.0	0.3	0.3	0.3
Gabbro	1.3	0.0	0.3	1.3	0.7
Felsite	0.0	1.0	0.3	0.3	0.4
Metamorphic					
Quartzite	0.0	1.0	0.3	0.7	0.5
Metasediments	0.0	0.3	1.0	0.3	0.4
Schist	0.0	0.0	0.3	0.0	0.1
Sedimentary					
Limestone	37.0	31.0	35.4	33.0	34.1
Argillaceous limestone	2.0	1.3	6.4	4.0	3.4
Dolomitic limestone	3.3	5.0	1.4	2.3	3.0
Dolomite	44.0	50.0	40.0	47.3	45.4
Argillaceous dolomite	6.7	5.4	8.0	4.0	6.0
Sandstone	0.3	0.0	1.0	1.0	0.6
Siltstone	0.0	0.3	0.3	0.7	0.3
Chert	0.7	0.7	1.0	1.3	0.9
Totals, percent	100.0	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. 83A-10084)

Rock Type	Specific Gravity			Absorption, percent	Composition, percent by weight
	Bulk, dry	Bulk, ssd	Apparent		
Igneous					
Granite	2.62	2.64	2.67	0.75	4.3
Diorite	2.84	2.84	2.87	0.43	0.5
Gabbro	2.89	2.92	2.98	1.09	1.0
Felsite	2.66	2.69	2.73	1.09	0.5
Metamorphic					
Quartzite	2.63	2.65	2.68	0.73	0.3
Metasediments	2.68	2.68	2.70	0.30	0.2
Schist	*	*	*	*	TR
Sedimentary					
Limestone	2.61	2.64	2.69	1.19	35.8
Argillaceous limestone	2.50	2.57	2.70	2.89	2.3
Dolomitic limestone	2.52	2.60	2.74	3.14	3.5
Dolomite	2.55	2.63	2.76	2.85	44.3
Argillaceous dolomite	2.33	2.47	2.71	5.93	6.1
Sandstone	2.51	2.56	2.64	1.92	0.3
Siltstone	*	*	*	*	0.1
Chert	2.35	2.45	2.61	4.25	0.8
Total Sample	2.56	2.62	2.72	2.34	100.0

NOTE: Values are computed from determinations made on all sample material contained in the categories noted. Asterisks indicate insufficient material in sample for determination.

IGNEOUS ROCKS

Rock Type	Granite	Diorite	Gabbro
Color	mottled buff to white, pink, and dark green to black	mottled white to gray and black	mottled white to gray and dark gray to black; and mottled yellowish brown and black
Texture	medium to fine grained	fine grained	medium to fine grained
Luster	dull	dull	dull
Hardness	Mohs 5-1/2 to 7	Mohs 6 to 7	Mohs 6 to 3
Porosity	non-porous to slightly porous on weathered surfaces	non-porous	non-porous to finely porous
Particle Shape	angular to subrounded	angular	angular to subrounded
Particle Surface	fresh to slightly weathered, rough to moderately smooth, and dented to ridged	fresh to slightly weathered, rough to moderately smooth, and dented to ridged	fresh to deeply weathered, rough to moderately smooth, and dented or pitted to ridged
Remarks			One particle is deeply weathered and limonitic.

IGNEOUS ROCKS (Cont.)

Rock Type	Felsite
Color	pink; and grayish green or reddish brown
Texture	very fine grained to micro-crystalline
Luster	dull
Hardness	Mohs 6 to 7
Porosity	non-porous to slightly porous
Particle Shape	angular to subrounded
Particle Surface	fresh to moderately weathered, rough to smooth, and dented to ridged

METAMORPHIC ROCKS

Rock Type	Quartzite	Metasediments	Schist
Color	white; gray; and buff	dark gray	mottled white and black
Texture	fine to very fine grained	very fine grained to micro-crystalline	medium to fine grained
Luster	dull to vitreous	dull	dull to silky
Hardness	Mohs 7	Mohs 5-1/2 to 7	Mohs 5-1/2 to 7
Porosity	non-porous	non-porous	porous
Particle Shape	angular to rounded	angular to subrounded	angular
Particle Surface	fresh to slightly weathered, rough to smooth, and dented to ridged	fresh to slightly weathered, rough to moderately smooth, and dented to ridged	weathered, rough, and dented to ridged

SEDIMENTARY ROCKS

Rock Type	Limestone	Argillaceous limestone	Dolomitic limestone
Color	buff; tan; and mottled buff to tan and gray	buff; tan; and mottled buff to tan and gray	buff; tan; and mottled buff or tan and gray
Texture	fine grained to microcrystalline	fine grained to microcrystalline	medium grained to microcrystalline
Luster	dull	dull to earthy	dull to earthy
Hardness	Mohs 3	Mohs 2-1/2 to 3	Mohs 2-1/2 to 3-1/2
Porosity	non-porous to finely porous	finely porous	non-porous to finely porous
Particle Shape	angular to rounded	angular to rounded	angular to subrounded
Particle Surface	fresh to slightly weathered, rough to smooth, and dented or pitted to ridged	fresh to moderately weathered, rough to smooth, and dented or pitted to ridged	fresh to moderately weathered, rough to smooth, and dented or pitted to ridged
Remarks			A few particles contain argillaceous exposures.

SEDIMENTARY ROCKS (Cont.)

Rock Type	Dolomite	Argillaceous Dolomite	Sandstone
Color	buff; tan; gray; and mottled buff to tan and gray	buff; tan; and mottled buff or tan and gray	buff to white
Texture	medium grained to micro-crystalline	medium grained to micro-crystalline	medium to fine grained
Luster	dull	dull to earthy	dull
Hardness	Mohs 3-1/2 to 4	Mohs 2-1/2 to 4	Mohs 7
Porosity	non-porous to finely porous	finely porous	finely porous
Particle Shape	angular to rounded	angular to rounded	angular to rounded
Particle Surface	fresh to moderately weathered, rough to smooth, and dented or pitted to ridged	fresh to moderately weathered, rough to smooth, and dented or pitted to ridged	fresh to slightly weathered, rough, and dented to ridged

SEDIMENTARY ROCKS (Cont.)

Rock Type	Siltstone	Chert
Color	buff; and brown	gray; and mottled white to buff and gray
Texture	very fine grained to micro-crystalline	microcrystalline
Luster	dull to earthy	dull to chalky
Hardness	Mohs 2-1/2	Mohs 7
Porosity	finely porous	finely porous
Particle Shape	angular to subrounded	angular to subangular
Particle Surface	fresh to highly weathered, rough to smooth, and dented or pitted to ridged	fresh to highly weathered, rough to smooth, and dented to ridged