



# 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: Garfield #2 Pit No. 49-104 (Testing Laboratory Sample No. 83A-10085). Research Project 83 TI-916. Research Report No. R-1240(1)

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 Garfield #2 Pit No. 49-104, location NE of NE, Sec. 29, T43N, R9W, 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 conducted for Research Project 83 TI-916, "Investigation of Freeze-Thaw Durability for Aggregates in Bituminous Mixtures in the Upper Peninsula."

### Summary

Rock Class	Condition of Particles	Percent of Sample
Igneous	hard, fresh to moderately weathered, and non-porous to finely porous	7.6
Metamorphic	hard, fresh to slightly weathered, and non-porous to slightly porous	1.0
Sedimentary	hard to moderately hard, fresh to moderately weathered, and finely porous to porous	91.4

Approximately 46 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—

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300 particles--of the noted sieve fractions were identified megascopically along with 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

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TABLE 1  
 PETROGRAPHIC COMPOSITION  
 (Testing Laboratory Sample No. 83A-10085)

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	4.7	4.0	7.3	4.6	5.2
Diorite	0.3	0.7	0.0	0.0	0.2
Gabbro	2.7	1.0	1.0	1.0	1.4
Basalt	0.7	0.0	0.3	1.0	0.5
Felsite	0.3	0.3	0.0	0.7	0.3
Metamorphic					
Quartzite	0.3	0.3	0.0	1.0	0.4
Metasediments	0.3	0.3	1.0	0.7	0.6
Sedimentary					
Limestone	45.6	41.4	42.0	47.3	44.1
Argillaceous limestone	0.7	0.3	1.0	0.0	0.5
Dolomitic limestone	2.7	3.3	3.3	3.7	3.2
Dolomite	32.0	36.0	38.4	37.0	35.9
Argillaceous dolomite	9.0	8.7	4.3	1.7	5.9
Sandstone	0.0	0.0	0.7	0.0	0.2
Chert	0.7	3.7	0.7	1.3	1.6
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-10085)

Rock Type	Specific Gravity			Absorption, percent	Composition, percent by weight
	Bulk, dry	Bulk, ssd	Apparent		
Igneous					
Granite	2.64	2.66	2.69	0.68	4.5
Diorite	2.71	2.74	2.79	1.17	0.5
Gabbro	2.94	2.96	2.99	0.50	2.3
Basalt	2.91	2.91	2.92	0.06	0.5
Felsite	2.45	2.55	2.73	4.12	0.3
Metamorphic					
Quartzite	2.64	2.65	2.66	0.29	0.3
Metasediments	2.65	2.67	2.70	0.75	0.5
Sedimentary					
Limestone	2.60	2.63	2.68	1.16	44.9
Argillaceous limestone	2.58	2.62	2.68	1.36	0.8
Dolomitic limestone	2.43	2.54	2.72	4.49	2.6
Dolomite	2.54	2.65	2.76	2.38	33.8
Argillaceous dolomite	2.36	2.49	2.70	5.34	7.7
Sandstone	*	*	*	*	0.1
Chert	2.34	2.44	2.60	4.27	1.2
Total Sample	2.58	2.63	2.72	1.99	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; and mottled white and black	mottled white and dark gray to black	mottled gray and dark green to black; and mottled yellowish brown, gray, and black
Texture	coarse to fine grained	medium to fine grained	medium to fine grained
Luster	dull	dull	dull
Hardness	Mohs 6 to 7	Mohs 6 to 7	Mohs 5-1/2 to 6
Porosity	non-porous to slightly porous on weathered surfaces	non-porous to finely porous	non-porous to slightly porous on weathered surfaces
Particle Shape	angular to subrounded	angular	angular to subrounded
Particle Surface	fresh to slightly weathered, rough to moderately smooth, and dented to ridged	fresh, rough, and dented to ridged	fresh to slightly weathered, rough to moderately smooth, and dented or pitted to ridged

IGNEOUS ROCKS

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

METAMORPHIC ROCKS

Rock Type	Quartzite	Metasediments
Color	mottled white and light green to brown	dark gray to green
Luster	dull to vitreous	dull
Hardness	Mohs 7	Mohs 5-1/2 to 7
Porosity	non-porous	non-porous to slightly porous
Particle Shape	angular to subrounded	angular to subrounded
Particle Surface	fresh to slightly weathered, rough to moderately smooth, and dented to ridged	fresh to slightly weathered, rough to smooth, and dented to ridged

SEDIMENTARY ROCKS

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



SEDIMENTARY ROCKS (Cont.)

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

SEDIMENTARY ROCKS (Cont.)

Rock Type	Chert
Color	white; and mottled white and tan to gray
Texture	microcrystalline
Luster	dull to subvitreous
Hardness	Mohs 7
Porosity	finely porous
Particle Shape	angular to subangular
Particle Surface	fresh to moderately weathered, rough to smooth, and dented or pitted to ridged