1240(2)

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: Ozanich Pit No. 49-97 (Testing Laboratory Sample No. 83A-10128). Research Project 83 TI-916. Research Report No. R-1240(2).

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 Ozanich Pit No. 49-97, location SW of SE Sec. 17, 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 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 slightly weathered, and non-porous to slightly porous	4.8
Metamorphic	hard, fresh to slightly weathered, and non-porous to slightly porous	0.5
Sedimentary	hard to soft, fresh to moderately weathered, and non-porous to porous	94.7

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 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

K. W. Mutthal

Geologist, Petrography and Hydrology Group.

RWM:jba

Attachments

cc: M. L. O'Toole
D. F. Malott
G. H. Gallup
J. W. Burge
M. G. Brown
R. H. Vogler

TABLE 1
PETROGRAPHIC COMPOSITION
(Testing Laboratory Sample No. 83A-10128)

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	3.4	3.7	4.7	6.3	4.5
Diorite	0.0	0.7	0.7	0.7	0.5
Gabbro	0.0	0.7	0.0	0.3	0.2
Basalt	0.3	0.3	0.3	0.7	0.4
Felsite	0.3	0.0	0.3	0.7	0.3
Metamorphic					
Quartzite	0.3	0.0	0.0	0.3	0.2
Metasediments	0.3	0.3	0.7	1.0	0.6
Sedimentary					
Limestone	37.7	37.3	30.3	35.3	35.2
Argillaceous limestone	2.0	1.0	1.0	0.0	1.0
Dolomitic limestone	3.3	4.3	6.3	3.0	4.2
Dolomite	42.7	41.7	48.4	43.7	44.1
Argillaceous dolomite	8.4	7.7	6.0	5.0	6.8
Sandstone	0.0	0.3	1.0	0.7	0.5
Siltstone	0.3	0.0	0.0	0.0	0.1
Shale	0.0	0.0	0.0	0.3	0.1
Chert	1.0	2.0	0.3	2.0	1.3
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-10128)

Rock Type	Specific Gravity			Absorption, percent	Composition, percent by weight
	Bulk, dry	Bulk, ssd	Apparent		
Igneous					
Granite	2.66	2.67	2.68	0.41	3.8
Diorite	2.81	2.82	2.84	0.39	0.2
Gabbro	3.03	3.04	3.07	0.35	0.2
Basalt	2.76	2.83	2.95	2.32	0.4
Felsite	2.60	2.63	2.67	1.05	0.2
Metamorphic					
Quartzite	2.69	2.69	2.70	0.08	0.1
Metasediments	2.70	2.72	2.77	0.93	0.4
Sedimentary					
Limestone	2.63	2.66	2.70	0.95	38.5
Argillaceous limestone	2.43	2.52	2.67	3.67	1.4
Dolomitic limestone	2.51	2.59	2.73	3.14	3.8
Dolomite	2.60	2.66	2.76	2.21	42.6
Argillaceous dolomite	2.38	2.50	2.70	4.98	7.2
Sandstone	2.38	2.45	2.56	3.03	0.1
Siltstone	2.14	2.36	2.74	10.18	0.1
Shale	*	*	*	*	TR
Chert	2.34	2.44	2.61	4.54	1.0
Total sample	2.59	2.64	2.72	1.82	100.0

NOTE: Values are computed from determinations made on all sample material contained in the categories noted. Asterisks indicate no determination due to insufficient material in sample.

IGNEOUS ROCKS

Rock Type	Granite	Diorite	Gabbro
Color	mottled pink, buff to white, and dark gray to black	mottled white and dark gray to black	mottled dark gray and black; and mottled yellowish brown and black
Texture	medium 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 slightly porous on weathered surfaces	non-porous to slightly porous on weathered surfaces
Particle Shape	angular to subrounded	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 moderately smooth, and dented to ridged	fresh to moderately weathered, rough to moderately smooth, and dented to ridged

IGNEOUS ROCKS (Cont.)

Rock Type	Basalt	Felsite
Color	dark gray to black	pink; and mottled pink and reddish brown
Texture	very fine grained to micro-crystalline	very fine grained to micro-crystalline
Luster	dull	dull
Hardness	Mohs 5-1/2 to 6	Mohs 6 to 7
Porosity	non-porous to finely porous on weathered surfaces	non-porous to slightly porous
Particle Shape	angular to subrounded	angular to subangular
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

METAMORPHIC ROCKS

Rock Type	Quartzite	Metasediments
Color	mottled gray and white; and clear	dark gray to greenish gray
Texture	fine grained to massive	very fine grained to micro-crystalline
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 rounded	angular to rounded
Particle Surface	fresh, rough to smooth, and dented to ridged	fresh to slightly weathered, rough to moderately smooth, and dented to ridged

SEDIMENTARY ROCKS

Rock Type	Limestone	Argillaceous limestone	Dolomitic limestone
Color	tan to buff or gray; and mottled buff and gray	tan to buff	tan or buff to gray
Texture	fine grained to micro-crystalline	fine grained to micro-crystalline	fine grained to micro-crystalline
Luster	dull	dull to earthy	dull
Hardness	Mohs 3 to 3-1/2	Mohs 3	Mohs 3-1/2 to 4
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 to ridged	fresh to slightly weathered, rough to smooth, and dented to ridged	fresh to slightly weathered, rough to smooth, and dented to ridged

SEDIMENTARY ROCKS (Cont.)

Rock Type	Dolomite	Argillaceous dolomite	Sandstone
Color	tan to buff or gray; and mottled tan to buff and gray	buff; and gray	white to buff
Texture	fine grained to micro-crystalline	fine grained to micro-crystalline	medium to 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	porous
Particle Shape	angular to rounded	angular to rounded	angular to rounded
Particle Surface	fresh to moderately weathered, rough to smooth, and dented to ridged	fresh to moderately weathered, rough to smooth, and dented to ridged.	fresh to slightly weathered, rough, and dented to ridged

SEDIMENTARY ROCKS (Cont.)

Rock Type	Siltstone	Shale	Chert
Color	tan	brown	white to buff; and mottled white and buff to gray
Texture	very fine grained to micro-crystalline	very fine grained to micro-crystalline	very fine grained to micro-crystalline
Luster	earthy	dull	dull to chalky; and vitreous
Hardness	Mohs 2-1/2 to 3	Mohs 2-1/2	Mohs 7
Porosity	finely porous	finely porous	finely porous to non-porous
Particle Shape	angular	rounded	angular
Particle Surface	slightly weathered, smooth, and dented to ridged	slightly weathered, smooth	fresh to moderately weathered, rough to moderately smooth, and dented to ridged