FLORIDA AGGREGATES IN CONSTRUCTION

THEIR CHARACTERISTICS AND PERFORMANCE

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Appendix A

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PETROGRAPHIC STUDIES OF COARSE AGGREGATES
FOR
FLORIDA CONCRETE AND PRODUCTS ASSOCIATION, INC.

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SUMMARY AND DISCUSSION

The nine aggregates are massive-textured and fossiliferous limestones. Several stratigraphic rock types are represented. In general, the limestones are hard, firm and dense, and on the surfaces of the as-received material frequently are crusher fines.

Hydrochloric acid insoluble residues consist of quartz and chert. The acid-insoluble residues are from 0.67 percent to 21.35 percent.

The 24-hour water absorptions are from 3.77 percent to 5.16 percent. Specific gravities are from 2.35 to 2.44. All of the above values are acceptable for concrete aggregates.

The aggregates contain less than 0.007 percent acid-soluble chloride except for one that had a value of 0.011 percent. These chloride values are extremely low and negligible, particularly with respect to corrosion of steel.

There is nothing detrimental regarding the aggregates, providing that good aggregate handling and processing is exercised in their use.

TCE personnel have broad experience with aggregates, cements, admixtures, and concretes throughout the State of Florida. This experience includes concretes from constructions of the 1930's through the present. Excellent concrete can be made using the Florida aggregates, providing they conform to ASTM C33, "Concrete Aggregates", or other equally acceptable specifications, and when used in appropriately designed mixes. This current petrographic study of Florida aggregates confirms the past experiences.

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INTRODUCTION

Reported herein are results of studies of aggregates from nine various locations in Florida. The studies were made at the request of Thomas A. Monahan, CAE, Florida Concrete and Products Association, Inc., Orlando, Florida. The specimens were received from a number of Florida aggregate suppliers and were analyzed at the request of the Florida Concrete and Products Association as part of an independent study of the quality of Florida aggregates.

The aggregates were analyzed using methods of ASTM C295, "Petrographic Examination of Aggregates for Concrete", and ASTM C127, "Test Method For Specific Gravity and Absorption of Coarse Aggregate". Acid-insoluble residues and acid-soluble chloride contents were determined by chemical methods.

STUDIES

Specimens - Samples from nine locations in Florida were received. Specimen identifications are given in Table 1.

Petrographic Studies - The specimens were quartered until a representative sample adequate for the studies was obtained.

Specimen No. 1 is a crushed limestone having a maximum nominal top size of 1 inch. Particles are angular to subrounded and on surfaces are powdery fines of calcite. Many particles have very irregular surfaces. The limestone is light buff and consists mainly of massive-textured calcite. Many fossil shell fragments are frequent. Lining vugs in some particles are colorless prismatic calcite crystals. In many particles are detrital rounded grains of quartz as impurities. Most limestone particles are moderately porous, hard and firm. A few particles have a high porosity. Scattered areas within the limestone are stained tan by iron compounds.

Specimen No. 2 is a crushed limestone having a maximum nominal top size of 1 inch. Particles are mainly buff in color, angular to subrounded, and massive-textured to coarsely crystalline. Particles are variable in their characteristics and range from hard, firm and dense to moderately soft and moderately friable. Several tan particles contain abundant detrital quartz inclusions. Some brownish gray particles are massive-textured, hard, firm and dense and contain vugs lined with rhombohedral or scalenohedral calcite crystals. Off-white to light pale particles are abundant. On surfaces usually are calcite fines. Particles are moderately vuggy and contain abundant fossil shell fragments.

Specimen No. 3 is a crushed limestone having a maximum nominal top size of 1 inch. Particles are angular to subrounded, light buff to gray, and massive-textured to coarsely crystallized. They vary from hard, firm and dense, to soft, porous and moderately friable. Vuggy particles are frequent and contain abundant fossil shell fragments. Vug surfaces are commonly coated with a layer of drusy calcite crystals. Thin coatings of tan clay or hydrated iron oxides are present on some fossils. In occasional dense, massive-textured particles are fragments of quartz and feldspars.

A trace component consists of crystalline calcite having a banded texture.

Several particles are patchy and contain rounded buff areas within gray areas.

Specimen No. 4 is a crushed limestone having a maximum nominal size of 1 inch. Particles are angular to irregular in shape, hard, and firm and dense to vuggy. Particles are buff, light tan or gray, frequently fossiliferous, and on particle surfaces are calcite fines. An occasional particle is stained tan by iron compounds. The vuggy limestone frequently contains vugs lined with clear, colorless, calcite crystals.

Many vug surfaces are pseudomorphous after dissolved fossils, and frequently are lined with drusy calcite. Particles consisting of loosely cemented shell fossils are very vuggy and frequent. Rounded detrital, colorless quartz grains are present as impurities in several particles, and the particles have a granular texture.

Specimen No. 5 is crushed limestone having a maximum nominal top size of 1 inch. Particles are angular to subrounded, hard, firm and dense and on surfaces are calcite fines. Particles are light buff and consist of fine grained massive-textured calcite. Shell fossil fragments are abundant. On fossil surfaces frequently are colorless drusy calcite crystals. Areas of coarse calcite are also present. Several particles are stained tan by iron compounds. Occasional particles are very vuggy and consist of loosely consolidated fossils that have been replaced by drusy calcite.

Chert is a trace component and is tan in color, hard, firm and dense. It consists of cryptocrystalline quartz with microscopically typical salt and pepper texture.

Specimen No. 6 consists of crushed limestone having a maximum nominal top size of 1 inch. Particles are angular to subrounded, off-white to buff in color, and on surfaces are powdery calcite fines. Particles are generally hard and firm, and moderately vuggy. Fossil shell fragments are abundant. On vugs and fossil surfaces frequently are calcite crystals. Some particles are rich in casts of calcite after fossils. Several particles contain abundant grains of colorless, transparent quartz as impurities. Some particles consist of loosely cemented fossil shell or shell fragments and are more friable than the more compact limestone.

Some fossiliferous limestones consist of a fine grained, massive-textured groundmass that contains areas of sparry calcite. Occasional surfaces are stained by iron compounds.

Specimen No. 7 is a crushed limestone having a maximum nominal top size of 1 inch. Particles are angular to subrounded, generally hard and firm, and on surfaces are powdery calcite fines. Particles generally are buff in color and an occasional particle is tan. The buff limestone is fine-grained and massive-textured or vuggy with abundant fossil shell fragments and areas of calcitic cement. Occasional particles are mottled black and tan, hard, firm, and dense. A few particles are off-white, soft, porous and friable, and consist of loosely cemented fossils. Vugs in occasional particles of tan limestone are lined with colorless prismatic quartz crystals. Other particles contain abundant sand-sized quartz inclusions.

Chert is a trace component and occurs as very hard, firm and dense, light tan to dark brown particles having a conchoidal texture.

Microscopically, the chert has typical salt and pepper texture and consists of cryptocrystalline quartz.

Specimen No. 8 consists of crushed limestone having a maximum nominal top size of 1 inch. Particles are angular to subrounded and on surfaces are calcite fines. The limestone is generally buff, massive-textured to vuggy, and coarsely crystalline.

It is hard and firm, and, when not vuggy, also dense. An occasional particle contains tubes made by boring organisms. Some particles of otherwise fine-grained massive-textured off-white to light buff particles contain scattered aggregations of sparry calcite or calcite veins. Traces of cherty limestone occur as red-brown to tan, hard, firm and dense particles. Other cherty limestone particles are mottled buff and gray and have a conchoidal texture. Microscopically, they consist of cryptocrystalline quartz and have typical salt and pepper textures.

Specimen No. 9 consists of crushed limestone having a maximum nominal top size of 1 inch. Particles are angular to subrounded, buff to gray, and are generally hard, firm and dense. Color variations occur within single particles.

Buff portions are softer, more porous, and more friable than gray portions, which generally are dense and less porous.

The buff limestone is frequently vuggy; vug surfaces commonly are coated with colorless, transparent, drusy calcite crystals. Particles having a cellular texture, which readily absorb water, are frequent.

An occasional particle consists of sparry calcite and clay bands. Other particles of gray fossiliferous limestone contain veins of calcite.

Tubes made by boring organisms are present in a few particles of buff limestone. Several particles contain traces of pyrite. Occasional iron-stained, tan, massive-textured particles contain detrital quartz grains.

A few off-white particles consist primarily of fossil shells cemented by coarse calcite.

The gray massive-textured particles are hard, firm and dense, and are the most abundant type present.

Acid-insoluble Residue

Acid-insoluble residues were determined chemically. Results are given in Table 2.

Absorptions and specific gravity

Absorptions after 24 hours and specific gravities were determined using the methods of ASTM C127. Results are given in Table 3.

Chloride Studies - Acid-soluble chloride contents were determined by an acid digestion-potentiometric titration method. A representative aggregate portion was pulverized and analyzed. Results are given in Table 4.

Testwell Craig Erlin Associates, Inc.

Melvyn P. Machin
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MM/clm

TABLE 1 - AGGREGATES - SPECIMEN IDENTIFICATIONS

No.	
1	Tarmac FDOT Mine #87-042, #57 Stone, 2 bags, East Side, Belt Sample Miami, Florida.
2	Rinker FDOT Mine #87-090, 2 Bags, Miami, Florida.
3	Florida Rock Ind. FDOT Mine $12-008, #57 Stone, 2 bags, Ft. Myers, Florida.
4	Florida Mining & Materials, Charlotte Co. Rock Division, FDOT Mine #01-305, 3 bags, North Ft. Myers, Florida.
5	Florida Crushed Stone Co., FDOT Mine #08-012, #57 Stone, Gay Quarry, Brooksville, Florida.
6	Tarmac Florida, Inc., FDOT Mine #87-145, #57 Stone, 2 bags, Tarmac Pennusuco Plant.
7	Florida Rock Ind., FDOT Mine #08-004, 2 bags, Brooksville Quarry, Brooksville, Florida.
8	Florida Mining & Materials, FDOT Mine #08-005, 2 bags, Brooksville Rock, Brooksville, Florida.
9	Florida Rock Ind., FDOT Mine #34-106, 2 bags, Gulf Hammock Quarry.

TABLE 2 - ACID-INSOLUBLE RESIDUES OF THE AGGREGATES

Sample No.	Acid-Insoluble Residue (% by weight)
1	11.21
2	13.25
3	5.59
4	21.35
5	4.79
6	17.96
7	3.46
8	1.15
9	0.67

TABLE 3 - ABSORPTIONS AND SPECIFIC GRAVITIES OF THE AGGREGATES (SSD)

Specimen No.	24 hr. Absorption (percent)	Specific Gravity
1	4.59	2.37
2	3.77	2.36
3	4.50	2.36
4	4.71	2.41
5	3.77	2.42
6	4.34	2.35
7	4.54	2.43
8	5.16	2.39
9	4.57	2.44

TABLE 4 - ACID-SOLUBLE CHLORIDE CONTENTS OF THE AGGREGATES

Specimen No.	(Cl^-, % by weight)
1	0.011
2	less than 0.007
3	less than 0.007
4	less than 0.007
5	less than 0.007
6	less than 0.007
7	less than 0.007
8	less than 0.007
9	less than 0.007