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A PETROGRAPHIC INVESTIGATION OF SOIL GRAVEL FROM THE SITE OF THE PROPOSED INTERNATIONAL AIRPORT ST. SCHOLASTIQUE, QUEBEC

by

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ABSTRACT

Gravel removed from a sample of soil from the proposed site of the international airport was examined petrographically to determine if it could be incorporated in soil cement, to be laid as a sub-base material for runways without reacting and endangering the overlying concrete. The study indicated that the gravel should be quite innocuous in that environment; moreover, it could be suitable as concrete aggregate, provided that it meets standard acceptance tests.

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Direction des mines
Rapport d'investigation IR 71-81

UNE INVESTIGATION PETROGRAPHIQUE DU GRAVIER PROVENANT DU SOL DU SITE PROPOSE POUR L'AEROPORT INTERNATIONAL DE ST-SCHOLASTIQUE, QUEBEC

par

James A. Soles*

RÉSUMÉ

Le gravier obtenu d'un échantillon du sol du site proposé pour l'aéroport international a été examiné pétrographiquement pour déterminer s'il pouvait être incorporé dans le sol-ciment devant être utilisé comme matériau de fondation pour les pistes d'envol sans produire aucune réaction ou mettre en danger le béton superposé. L'étude a révélé que le gravier devrait être complètement inoffensif dans cet environnement; de plus, son utilisation comme agrégat à béton pourrait être appropriée, pourvu qu'il satisfasse les spécifications normalisées requises.

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INTRODUCTION

A request for a petrographic analysis of gravel contained in the soil at the site of the proposed Montreal international airport, St. Scholastique, Quebec, was made by Mr. G. H. Argue of the Construction Engineering Branch, Department of Transport. The soil was to be mixed with cement for use as runway sub-base material, and it was necessary to know if the contained gravel particles were deleterious.

PROCEDURES

Approximately three pounds each of coarse (3/4 to 1/4-in.) and fine (<1/4-in.) gravel, obtained previously from a soil sample by screening, was tumbled for ten minutes with water in a small laboratory mill to remove adherent fine soil particles. The cleaned gravel fractions were dried, stained to differentiate minerals in the particles, and a petrographic grain count analysis was made under the stereomicroscope.

Different types of particles in both fractions were assigned 'soundness factors' grading from 1.0 (sound) to 6.0 (deleterious), which relate to the estimated resistance of materials to deteriation by weathering based upon the empirical scale of Bayne and Brownridge[1]. The products of 'factors' and percentages of corresponding material were summed to obtain a quality rating, or 'petrographic number', which indicates the potential durability of aggregate employed as a construction material. A somewhat similar classification system is given by Mielenz[2].

RESULTS

The results of the petrographic investigation are summarized in Table 1.

Coarse Gravel Fraction

Particles in the gravel fraction are almost totally igneous, ranging in composition from diorite to granite. Textures are mostly hypidiomorphic, i.e., subhedral to anhedral crystals are oriented and distributed randomly, although granitic rock particles most often have a gneissic texture. Grain sizes of the constituent minerals vary widely, from 0.5 to 10 mm. Particles are predominantly rounded, but some platy fragments, mostly chips of coarse grained diorite, are present. A few rusty particles stained by iron oxides derived from pyrite were noted, and sedimentary fragments were observed rarely. The surfaces of minerals in pebbles and fragments are fresh, although a thin film, in part organic, may coat some particles.

TABLE 1

Petrographic Analysis of the Coarse and Fine Gravel Samples

Types of Particles	Amount (%) In C. Gravel	Amount (%) In F. Gravel	Total Sample	S.F.	Product %xS.F.
Adherent Soil	2%	4%	6%	-	-
Dark, Dioritic	30	20	25.5	1.1	28.1
Light, Granodioritic	30	18	24.6	1.1	27.1
Pink, Granitic	34	21	28.1	1.2	33.7
Misc. Rusty, Friable	3	2	2.5	4.0	10.0
Quartz	1	10	5.0	1.0	5.0
Potassium Feldspar	1	9	4.5	1.0	4.5
Na-Ca Feldspar (An_{45})	1	13	6.2	1.0	6.2
Garnet	< 1	2	1.4	1.0	1.4
Amphibole, Pyroxene	-	4	1.8	2.0	3.6
Magnetite, Misc.	-	1	0.4	1.0	0.4
			Petrographic Number =		120.0

Fine Gravel Fraction

Rock particles in this fraction are similar in composition, proportions, and lack of alteration to those in the gravel fraction, and mineral fragments are also similar to those in the rock particles. It is therefore probable that the source materials were the same for all particles in the sample.

Petrographic 'Number'

The sum of products of soundness factor and proportions rock type yielded a petrographic number of 120. This index figure is well below the estimated maximum of 140 considered by the Ontario Department of Highways to be a safe value for aggregate used in concrete structures and pavements (1, p. 96). It should be noted that petrographic methods of evaluating potential aggregate are dependable only if correct soundness indices are assigned to different types of particles. Standard C.S.A.[3] acceptance tests must be made to ensure that the aggregate can actually meet the specifications prescribed for a particular use.

DISCUSSION

The petrographic analysis indicates that the gravel derived from the soil sample provided by the Department of Transport should be harmless when incorporated in soil cement because deleterious particles are rare and surficial alteration, which can produce reactive or non-cohesive minerals, is minimal. The gravel may even be suitable as concrete aggregate, but standard acceptance tests would be required to prove that it meets the specifications.

REFERENCES

1. R. L. Bayne and F.C. Brownridge, "Petrographic Analysis for Determining Quality of Coarse Aggregates". Roads and Engineering Construction, 93(11), 90-98 (1955).

2. R. C. Mielenz, "Petrographic Examination". In: "Significance of Tests and Properties of Concrete and Concrete-Making Materials", ASTM Spec. Tech. Pub. No. 169-A, 381-403 (1967).

3. Canadian Standards Association, C.S.A. Standard A23.1, "Concrete Materials and Methods of Concrete Construction" (1967).

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