MATERIAL SPECIFICATION FOR AGGREGATES - GENERAL

TABLE OF CONTENTS

1001.01 SCOPE

1001.02 REFERENCES

1001.03 DEFINITIONS

1001.04 DESIGN AND SUBMISSION REQUIREMENTS

1001.05 MATERIALS

1001.06 EQUIPMENT - Not Used

1001.07 PRODUCTION

1001.08 QUALITY ASSURANCE

1001.01 SCOPE

This specification covers the source, processing, and testing requirements for aggregates and provides for the use of reclaimed asphalt pavement and reclaimed concrete material.

1001.02 REFERENCES

Ontario Ministry of Transportation Publications

MTO Laboratory Testing Manual:
LS-602 Sieve Analysis of Aggregates
LS-609 Petrographic Analysis of Coarse Aggregate
LS-616 Petrographic Analysis of Fine Aggregate

Assessment of Potential for Acid Rock Drainage in Highway Construction, Materials Engineering and Research (MERO) Report (Unpublished), Smith, S.J., Rogers, C.A and Senior, S.A., March 2007 (See Note 1)

Note 1: Some of the applicable sections within this report may be obtained upon request from the Head of the Soils and Aggregates Section, Materials Engineering and Research Office, MTO, at the following address:

Room 220,
145 Sir William Hearst Avenue,
Toronto, Ontario
M3M-0B6
Telephone: 416-235-3734

Canadian General Standards Board

8.1-88 Sieves, Testing, Woven Wire, Inch Series

ASTM International

D 5744 Standard Test Method for Laboratory Weathering of Solid Materials Using a Humidity Cell from SAI Global
E 11 - 09e1 Woven Wire Test Sieve Cloth and Test Sieves

Others

ADTI-WP2 Leaching Column Method for Overburden Analysis and Prediction of Weather Rates, Hornberger, Roger J., et al., 2004.

DRAFT Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Minesites in British Columbia, British Columbia Ministry of Employment and Investment, Energy and Minerals Division; Smithers, BC; Price, W.A., April 1997

Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Toxicity Characteristic Leaching Procedure, Method 1311; United States Environmental Protection Agency, Publication SW-846, July 1992

1001.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Aggregate means natural mineral materials such as sand, gravel, and crushed bedrock. Reclaimed materials may substitute for aggregates when allowed by the appropriate specification.

Boulder means a detached rock mass with a diameter greater than 200 mm.

Clay means a fine-grained soil with particles smaller than 2 µm that exhibit plasticity over a range of water contents.

Coarse Aggregate means that portion of aggregate material retained on the 4.75 mm sieve when tested according to LS-602.

Cobble means a rounded or semi-rounded rock fragment with an average dimension between 75 mm and 200 mm.

Crushed Material means aggregate particles having at least one well-defined face resulting from fracture. Particles with smooth faces and rounded edges or with only small chips removed are not considered crushed.

Deleterious Material means materials that include, but not limited to, the following: wood, clay brick, clay tile, plastic, gypsum, gypsum plaster, wallboard, roots, and all other organic matter.

Fine Aggregate means that portion of aggregate passing the 4.75 mm sieve when tested according to LS-602.

Flat and Elongated Particles means aggregate particles whose greatest mean dimension in the longitudinal axis compared to the least mean dimension in a plane perpendicular to the longitudinal axis exceeds a ratio of 4:1.

Granular means any processed or natural aggregate material with less than 35% by mass passing the 75 µm sieve.

Gravel means rounded, water-worn rock fragments retained on the 4.75 mm sieve and passing through the 75 mm sieve.

Iron Blast-Furnace Slag means the material resulting from solidification of molten blast-furnace slag under atmospheric conditions. Subsequent cooling may be accelerated by application of water to the solidified surface.

Manufactured Sand means sand produced by the crushing and further processing, i.e., washing, grading, classifying of quarried rock, boulders, cobbles, or gravel from which the natural fine aggregate has been removed. Natural sand may be added to optimize properties.

Mine By-Product Rock means rock which is removed during an ore mining process and has not been subjected to any sort of chemical processing.

Natural Sand means naturally formed sand found in unconsolidated deposits.

Nickel Slag means the non-metallic product resulting from the production of nickel.

Quarried Rock means the material that has been or is being removed from an open excavation made in a solid mass of rock, which was integral with the parent mass prior to removal.

Reclaimed Asphalt Pavement (RAP) means the processed hot mix asphalt material that is recovered by partial or full depth removal.

Reclaimed Concrete Material (RCM) means removed or processed hardened Portland cement concrete.

Sand means fine aggregate passing the 4.75 mm sieve and retained on a 75 µm sieve resulting from natural disintegration of rock or from crushing.

Screened Sand means natural sand obtained from gravel deposits that is screened only.

Screenings means the fine aggregate produced by the crushing of quarried rock, boulders, cobbles, or gravel.

1001.04 DESIGN AND SUBMISSION REQUIREMENTS

1001.04.01 Submission Requirements

The Contract Administrator shall be advised in writing of each intended aggregate source, prior to its use in the Work.

The Contractor shall provide all test results, either individual or mean values, which demonstrate conformance of the material with the requirements of the appropriate specification.

Test results shall be made available at the Contract Administrator's request.

1001.04.02 Report for Aggregates Produced from Mine By-Product Rock

If an aggregate produced from mine by-product rock is being proposed for use, then, at least 20 Business Days prior to its intended use, a written report, henceforth referred to as the Mine By-Product Rock Aggregate Assessment Report (MRAAR), signed by an Engineer or a licensed Professional Geoscientist (P.Geo.), shall be submitted to the Contract Administrator.

Prior to beginning the Work, the Engineer or licensed Professional Geoscientist (P.Geo.), described above, shall submit sufficient relevant qualifications and past project experience in Acid Base Accounting, NAG testing, metal leachate testing, physical property and any other related testing and analysis, acceptable to the Owner.

The report shall include, but not be limited to, the following:

a) Petrographic test results according to LS-609, Part A and LS-616, Part A carried out by a licensed Professional Geoscientist (P.Geo.). When sulphur minerals or non-iron bearing sulphides are found, sulphur mineral speciation and associated reactivity shall be determined using X-Ray Diffraction and/or Scanning Electron Microscopy.

b) An Acid Rock Drainage (ARD) investigation, carried out by a licensed Professional Geoscientist (P.Geo.) including, but not limited to, the following:

    i. Acid Base Accounting and Net Acid-Generating (NAG) tests. If either the neutralization potential ratio or the NAG tests indicate that the tested material is respectively not shown to be "Non-Acid Generating" or "Non-Acid Forming" according to the "DRAFT Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Minesites in British Columbia", then kinetic testing shall also be carried out using either humidity cells according to ASTM D5744 or columns according to ADTI-WP2 Leaching Column Method for Overburden Analysis and Prediction of Weather Rates.
    ii. pH testing and any other chemical analyses considered necessary by the licensed Professional Geoscientist (P.Geo.).
    iii. An assessment of all the test results and an identification of any potential impacts of the use of acid-generating materials on surface and groundwater, any proximate aquatic ecosystems as well as any other environmentally sensitive areas. When potential impacts are found, recommendations to eliminate or reduce those impacts to acceptable levels including an acceptable monitoring plan shall be included in the assessment.

c) Metal leachate testing using Shake Flash Extraction, as described in "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Toxicity Characteristic Leaching Procedure" or any other method acceptable to the Owner;

d) An assessment of the suitability of the aggregate for its intended use, by assuring that the aggregate:

    i. meets all applicable safety regulations, guidelines and procedures;
    ii. meets all applicable environmental regulations, guidelines and procedures and will not cause any adverse environmental effects;
    iii. meets all current physical and production property requirements required for that aggregate;
    iv. does not cause undue discolouration of the pavement or structure in which the aggregates will be used; and

v. otherwise provides long term field performance at least as well as any other aggregates that are currently acceptable for the same application.

e) Specified minimum sampling & testing rates, the location where the samples shall be taken and the recommended tests to be carried out, as well as any special recommendations outlining the handling and placement of aggregates produced from mine by-product rock during construction to ensure that all of the requirements specified in the Contract Documents will continue to be met during the Contract.

The sampling, testing and analyses required for parts a) to d) of the MRAAR shall be based on a minimum of 3 or 8 samples for up to 10,000 or 100,000 tonnes respectively, of crushed mine by-product rock that is intended for use on the Contract. All samples used for testing and assessment purposes required for parts a) to d) shall be obtained from stockpiles of at least 1000 tonnes of the crushed mine by-product rock which is intended for use in the Work. The details regarding the sampling and testing carried during construction shall be as specified in the MRAAR, according to part e) listed above.

In any case, the sampling & testing rates and the types of tests specified above in parts a) to d) for the preparation of the MRAAR and in part e) to be conducted during construction, shall only be considered minimums and the actual amount of sampling, testing and types of tests carried out anytime during the Contract will depend on the variability of the source, the Contractor's ability to control that variability as well as any other relevant recommendations that the MRAAR provides.

In addition to the sampling and testing already described and as specified elsewhere in the Contract Documents, the Owner may require additional sampling and testing during construction. Such sampling and testing shall be carried out at no additional cost to the Owner. If, however, the Owner deems that sufficient testing is being done to adequately monitor changes within the aggregate source during construction, according to the recommendations given in the MRAAR, then the Owner shall be responsible for the costs of that additional testing.

All testing carried out for the preparation of the MRAAR as well as during construction shall be conducted by laboratories that are acceptable to the Owner.

Within 15 Business Days after submission of the MRAAR, the Contractor shall be notified as to whether the mine by-product rock is acceptable for use.

In addition to the MRAAR and within 20 Business Days of using aggregate produced from mine by-product rock, an Aggregate Management Plan shall also be submitted to the Contract Administrator detailing how the Contractor intends to ensure that the aggregates that are produced will continue to remain acceptable during aggregate production for the contract.

1001.05 MATERIALS

1001.05.01 Aggregates

1001.05.01.01 General

Aggregates shall be composed of hard, durable fragments that are clean and free of clay coatings and other deleterious material.

1001.05.01.02 Fine Aggregates

Fine aggregates shall be according to the appropriate specifications and, unless otherwise provided therein, shall be one or a blend of the following:

a) Natural sand.

b) Manufactured sand.

c) Screenings produced during crushing.

d) Iron blast furnace slag or nickel slag.

e) Reclaimed asphalt pavement.

f) Reclaimed concrete material.

1001.05.01.03 Coarse Aggregates

Coarse aggregates shall be according to the appropriate specifications and, unless otherwise provided therein, shall be one or a blend of the following:

a) Crushed particles of consistent quality throughout produced from bedrock formations or boulders.

b) Uncrushed material of consistent quality produced from gravel formations.

c) Iron blast furnace slag or nickel slag.

d) Reclaimed asphalt pavement.

e) Reclaimed concrete material.

1001.07 PRODUCTION

1001.07.01 Stripping of Aggregate Source

Prior to excavating materials for aggregate production, the area to be worked shall be cleared of shrubs and trees, grubbed of roots, and stripped of all unsuitable surface materials and weathered zones. The area open ahead of the quarrying or excavating operation shall be of sufficient size to prevent contamination of the aggregate source working face.

1001.07.02 Processing

1001.07.02.01 General

When necessary to conform to the type of materials specified, aggregates shall be screened, crushed, washed, classified, or otherwise processed with suitable equipment to meet specification requirements.

Washed materials or materials excavated from underwater shall be stored for at least a 24 hours or longer period to allow all free water to drain and for the materials to attain uniform water content.

1001.07.02.02 Washing

When specified in the Contract Documents, aggregates shall be washed in washing plants, or otherwise processed to meet specification requirements. Truck or mixer washing and other similar methods shall not be permitted.

Water used for washing aggregates shall be clean and free from injurious amounts of oil, acid, alkali, organic matter, or other deleterious substances.

1001.07.02.03 Blending

Blending of aggregates including reclaimed materials that meet the physical requirements of the appropriate specification shall be permitted in order to satisfy the gradation requirements for the material to be provided. The blending shall produce a consistent and acceptable product. Except where noted elsewhere in the Contract Documents, blending to improve the physical requirements shall not be permitted, except to increase the percentage of crushed particles or decrease the percentage of flat and elongated particles.

1001.07.03 Handling and Transporting

At all times, aggregates shall be handled and transported in a manner and with equipment that avoids segregation of the material, excess loss of fines, and contamination by any deleterious material.

1001.07.04 Stockpiling

Stockpile sites shall be level, well drained, free of all foreign materials, and of adequate bearing capacity to support the mass of the materials to be placed thereon. Stockpiles shall be either far enough apart or separated by substantial dividers to prevent intermingling.

For all coarse aggregates, except when stockpiled on Portland cement concrete or asphaltic concrete foundations or on an uncontaminated durable surface, a compacted granular pad of material with a maximum particle size no larger than that of the material being stockpiled and not less than 0.3 m in depth shall be provided to prevent contamination of the piled material.

For fine or combined aggregate stockpiles, the foundation shall be as specified above for coarse aggregates or the material may be placed on the ground provided that the bottom 0.3 m of the pile is not incorporated into the Work.

When samples are obtained for acceptance purposes from stockpiles of combined fine and coarse aggregate material for gradation testing, the stockpile shall be constructed in layers not exceeding 1 m in depth, and spilling of material over the edge of the stockpile shall not be permitted. These stockpile construction requirements shall not apply to separate stockpiles of fine and coarse aggregates and shall not apply to stockpiles of combined fine and coarse aggregate when the gradation acceptance samples are obtained after the material has been removed from the stockpile.

1001.08 QUALITY ASSURANCE

1001.08.01 General

Irrespective of compliance or non-compliance with the gradation and physical requirements of the applicable specification, aggregates may be accepted or rejected on the basis of past field performance, as determined by the Owner.

When a change in the character of the material occurs or when the performance of the materials is found to be unsatisfactory, use of those materials shall be discontinued until the Contractor can prove to the satisfaction of the Contract Administrator that the source remains acceptable or can be made acceptable.

1001.08.02 Sampling

1001.08.02.01 General

Quality assurance samples shall be obtained, handled, and stored as specified in the Contract Documents. The Contract Administrator shall be allowed to access all sampling locations and reserves the right to request quality assurance samples at any time.

1001.08.02.02 Mix Design

Samples obtained by the Contractor for the purposes of mix design shall be representative of the materials to be placed in the Work.

1001.08.03 Testing

1001.08.03.01 General

Tests on aggregates shall be as specified in the Contract Documents. The most recent published test method shall be used.

1001.08.03.02 Testing Sieves

Gradation analysis shall be based on the designated sieves shown in Table 1. As indicated, sieves complying with the alternative shown are compatible and may be used interchangeably with the MTO sieve designation shown.

TABLE 1
Laboratory Testing Sieves

MTO Sieve Designation	Alternate Sieve Standards, CAN/CGSB 8.1 and ASTM E 11
150 mm	6 inch
106 mm	4.24 inch
75.0 mm	3 inch
63.0 mm	2-1/2 inch
53.0 mm	2.12 inch
37.5 mm	1-1/2 inch
26.5 mm	1.06 inch
25.0 mm	1 inch
22.4 mm	7/8 inch
19.0 mm	3/4 inch
16.0 mm	5/8 inch
13.2 mm	0.530 inch
12.5 mm	1/2 inch
9.5 mm	3/8 inch
6.7 mm	0.265 inch
4.75 mm	No. 4
2.36 mm	No. 8
1.18 mm	No. 16
600 µm	No. 30
425 µm	No. 40
300 µm	No. 50
150 µm	No. 100
75 µm	No. 200