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AIRPORT ENGINEERING

ATR-024

A REVIEW AND EVALUATION OF THE MICRO-DEVAL TEST

PROJECT 914222
MATERIALS TESTING REQUIREMENTS
AND PROCEDURES R&D
PHASE II

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1. INTRODUCTION

A review of Public Works and Government Services Canada (PWGSC) Architectural and Engineering Services (A&ES) Air Transportation construction manual ASG-06[1] was carried out in 1995 by a Standards Review Board (SRB). The SRB consisted of members from the private sector and PWGSC, A&ES, Air Transportation. The purpose of the above noted review was to update the manual with current industry practices and developments in technology. Recommendations of the SRB were incorporated in the revised Manual ASG-06[2] (September 1996). Some of the SRB recommendations were not included and it was agreed that further evaluation would be required before their implementation. The National Office of PWGSC, A&ES, Air Transportation, requested assistance from the Atlantic Region Office to evaluate and report on these outstanding recommendations.

2. SCOPE OF WORK

The scope of work included the following three items:

- Review and evaluation of the Micro-Deval test.
- Investigation of the Modified Rice Test Method as put forward by the Canadian Asphalt Mix Exchange Program (CAMEP), compared to the test method for Maximum Specific Gravity of Bituminous Paving Mixtures (ASTM D2041-95). A report has been prepared and is submitted under separate cover.
- Evaluation of the test method ASTM D1557 and ASTM D4718 compared to "Laboratory Density Determination" as defined in section 2.4.1 of ASG - 06[2]. A report has been prepared and is submitted under separate cover.

This report summarizes the literature search and review of the test methods and approaches taken by other Agencies including several Provincial Departments of Transportation in determining the quality of construction aggregates with specific emphasis on the Micro-Deval Test Procedure.

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[1] ASG-06, September 1994. Pavement Construction Materials and Testing, Canadian Standards and Recommended Practices Airport Engineering, PWGSC, A&ES, Air Transportation.

[2] ASG-06, September 1996. Pavement Construction Materials and Testing, Canadian Standards and Recommended Practices Airport Engineering, PWGSC, A&ES, Air Transportation.

3. PWGSC TEST PROCEDURES

Historically PWGSC Air Transportation has evaluated the inherent properties of construction aggregates such as resistance to abrasion and fragmentation, durability and freeze-thaw resistance by assessing the results obtained from three laboratory test procedures: Los Angeles Abrasion and Impact (ASTM C131)[3], Magnesium Sulfate Soundness (ASTM C88)[4] and Water Absorption (ASTM C127)[5]. Standard PWGSC testing requirements for Granular Base, Subbase, Hot Mix Asphalt Concrete (HMAC) and Portland Cement Concrete (PCC) aggregates are provided in Appendices B, C and F of Manual ASG-06[2]. Table 1 summarizes the above noted requirements:

Table 1
PWGSC Aggregate Requirements
for Resistance to Abrasion and Fragmentation,
Durability and Freeze-Thaw

Aggregate Type		Los Angeles ASTM C131[3] (% max)	Magnesium Soundness Loss ASTM C88[4] (% max)	Absorption ASTM C127[5] (% max)
Base		45	NA	NA
Subbase		50	NA	NA
HMAC				
Lower course-	Coarse	30	12	2
	Fine	NA	16	NA
Surface course	Coarse	25	12	2
	Fine	NA	16	NA
PCC *	Coarse	35**	12 ***	NA
	Fine	NA	16 ***	NA

* Coarse and Fine Aggregates to CSA-A23.1[6] ** CSA-A23.2-16A[7]
*** CSA-A23.2-9A[8]

[3] ASTM C131-89. Standard Test Method for Resistance to Degradation of Small Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
[4] ASTM C88-90. Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
[5] ASTM C127-93. Standard Test Method for Specific Gravity and Absorption of Coarse Aggregate.
[6] CSA-A23.1-94. Concrete Materials and Methods of Concrete Construction.
[7] CSA-A23.2-16A. Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
[8] CSA-A23.2-9A. Soundness of Aggregate by Use of Magnesium Sulfate.

All PWGSC A&ES Air Transportation Regional Material Specialists have confirmed to the writer that, generally, aggregates satisfying the Los Angeles Abrasion, Magnesium Sulfate Soundness and Water Absorption test requirements as listed in Table 1 have performed satisfactorily in the field except for a few exceptions.

Mr. Abbas Alli Khan, Ontario Region Materials Specialist (416-512-5777), did not recall of any projects where aggregates, meeting test requirements as listed in Table 1, did not perform well in the field. The Micro-Deval test is not being utilized as a test parameter on PWGSC Air Transportation Ontario Region projects.

Mr. Adrian P. Joseph, Pacific Region Materials Specialist (604-623-6259), also did not recall of any projects where aggregates, meeting test requirement as listed in Table 1, did not perform well in the field. He however did identify the existence of aggregates located in British Columbia which are historically known to prematurely deteriorate when used in HMAC. These poor aggregates are usually not proposed by contractors. Mr. Joseph does not have historical laboratory data for these poor aggregate sources due to the fact that they are not utilized for projects where quality control testing is carried out. The Micro-Deval test is not being utilized as a test parameter on PWGSC Air Transportation Pacific Region projects.

Mr. Surinder Singh, Western Region Materials Specialist (204-983-7704), also confirmed that the existing aggregate testing requirements are generally adequate to assess the suitability of aggregates for their intended use. He did identify some questionable sources in Saskatchewan, however he could not provide any historical laboratory test results to compare with field performance again due to the fact that these poor sources are not utilized on projects where quality control testing is carried out. The Micro-Deval test is not being utilized as a test parameter on PWGSC Air Transportation Western Region projects

Mr. Jacques Dumeignil, Quebec Region Materials Specialist (514-633-3935), also stated that the existing aggregate testing requirements are generally adequate to assess the suitability and long term performance of construction aggregates. One exception was a recent premature HMAC pavement failure at the Quebec City Airport. Poor aggregate (Schist) has been identified as one possible cause of the distress i.e. pop outs, raveling and loss of binder. In this case the Soundness test results were marginal. Mr. Dumeignil, who was not involved in the quality control /assurance during the source acceptance or construction phase, indicated that in this case where the Soundness test results were marginal, a Petrographic Number (PN) or a test such as the Micro-Deval test could have provided a better indicator for such a poor aggregate source. Mr. Dumeignil has confirmed that he will modify his future specifications in the Quebec City area by specifying a maximum limit on the PN and include the recently adopted Ministry of Transportation of Quebec (MTQ) Micro-Deval[9] testing requirements.

[9] Determination du Coefficient D'usure par Attrition a L'aide de L'appareil Micro-Deval, Gros Granulats, NQ 2560-070, Bureau de Normalisation du Quebec.

In the Atlantic region, PWGSC Air Transportation does not specify the Micro-Deval test to assess the suitability of construction aggregates. The existing aggregate testing requirements as listed in Table 1 are generally adequate to assess the suitability and long term performance of construction aggregates. However premature stripping of the asphalt binder from the aggregate surface in some of the HMAC pavements is a distress that does not necessarily show up in the aggregate test requirements listed in Table 1. The Marshall Immersion Test as described in Appendix L of ASG-06[2] is intended to complement the test requirements by measuring the effect on Marshall Stability resulting from the action of water however the test does not accurately duplicate the long term field performance. Concerns pertaining to alkali-aggregate reactivity in PCC have been addressed in the revised Appendix F of ASG-06[2] by referring to appendix B "Alkali-Aggregate Reaction" of CSA-A23.1[6].

4. OTHER AGENCIES

4.1 Saskatchewan Highways and Transportation (SHT)

Contact: Randy Smith, (306-787-4935).

SHT does not specify the Micro-Deval test to assess construction aggregates.

4.2 Manitoba Department of Transportation (MDOT)

Contact: Doreen Burdey, (204-945-1371).

MDOT does not specify the Micro-Deval test to assess construction aggregates.

4.3 Nova Scotia Department of Transportation and Communications (NSDOT)

Contact: Paul Reynolds, Technical Services Specialist (902-860-2999).

HMAC aggregate test requirements (NSDOT Standard Specification Book, April 1996) for aggregates include Los Angeles Abrasion and Impact[3] , Sodium Sulfate Soundness[4], Petrographic Number (PN), Water Absorption[5] and a stripping test (AASHTO T-283). Research is presently being carried out on the implementation of Micro-Deval testing on HMAC aggregates. Granular base aggregate testing is now limited to the Micro-Deval and Water Absorption test. The Los Angeles Abrasion and Sodium Sulfate Soundness requirements for granular base aggregates have been eliminated from the standards. PCC aggregates have to conform to the requirements of CSA-A23.1[6].

An interdepartmental study[10] recommended the implementation of a requirement for Micro-Deval testing[11] at a maximum percent loss of 25% for granular base coarse aggregates. The study further concluded that the Micro-Deval test has good repeatability and is able to identify poor performing aggregates such as shales. The cost of conducting the test would be roughly equivalent to the Los Angeles Abrasion and Impact test. Recommendations also included the elimination of the Soundness test due to poor repeatability and lengthy turn around time.

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[10] Paul Reynolds, Granular Specifications Evaluation and Recommendations, NSDOT, 1994.

[11] Method of Test for the Resistance of Coarse Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus, LS-618, 1993, Ministry of Transportation, Ontario, Laboratory Manual

4.4 Ministry of Transportation of Ontario (MTO)

Contact: Stephen A. Senior, Senior Aggregate Engineer (416-235-3743).

MTO presently use the Micro-Deval test method LS-619[12] to assess fine aggregates in PCC and HMAC. They also use the Micro-Deval test method LS-618[11] to assess coarse aggregates in PCC, HMAC , Granular Base and Subbase. The Micro-Deval test requirements adopted or likely to be adopted by MTO are listed in Table 2.

Table 2
MTO MICRO-DEVAL REQUIREMENTS

	Fine Aggregate LS-619[12] Max. % Loss	Coarse Aggregate LS-618[11] Max. % Loss
PCC	20	15
HMAC Surface	20	15
Lower	25	20
GRANULAR Base		25*
Subbase		30*

* The Micro-Deval test has replaced both the PN and Los Angeles Abrasion tests

4.5 Ministry of Transport of Quebec (MTQ)

Contact: Guy Tremblay (418-644-0181).

MTQ has introduced the Micro-Deval test in their "Cahier de Clauses Generales" as of December 1995. The test for coarse aggregates is designated NQ 2560-070[9]. The Micro-Deval test for fine aggregates is designated as LC-21-101[13]. MTQ has completely revised its aggregate specifications by separating the aggregates according to their intrinsic characteristics such as resistance to wear and impact. The Micro-Deval test requirements specified by MTQ are listed in Table 3 and Table 4.

[12] Method of Test for the Resistance of Fine Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus, LS-619, 1993, Ministry of Transportation, Ontario, Laboratory Testing Manual.

[13] Determination du Coefficient d'Usure par Attrition a l'Aide de l'Appareil Micro-Deval, Granulats Fins, LC-21-101, Laboratoire Centrale, Ministere des Transports du Quebec

Table 3
MTQ Requirements for
Resistance to Wear of Fine Aggregate

Fine Aggregate	Micro-Deval LC-21-101[13] Max. % Loss
HMAC	30 or 35
PCC	35

Table 4
MTQ Requirements for
Resistance to Wear and Impact of Coarse Aggregate

Aggregate Category *	Micro-Deval (MD) NQ-2560-070[9] Max. % Loss	Los Angeles Abrasion (LA) Max. % Loss	MD + LA Max. % Loss
1	15	35	40
2	20	45	55
3	25	50	70
4	30	50	75
5	35	50	80
6	40	50	85

* Ranging from category 1 for HMAC Surface Course to category 6 for Granular Subbase. Aggregates have to meet simultaneously all three requirements MD, LA, and MD + LA.

4.6 Prince Edward Island Department of Transportation and Public Works (PEIDOT)

Contact: Ron Chinery (902-368-4740).

PEIDOT does not specify the Micro-Deval test to assess construction aggregates. They have carried out some comparison laboratory testing however they have not yet completed their assessment. HMAC aggregate test requirements (General Provisions and Contract Specifications for Highway Construction and Maintenance, April 1996), include Los Angeles Abrasion and Impact[3], Magnesium Sulfate Soundness[4], Water Absorption[5] and PN tests. Granular Base testing includes Los Angeles Abrasion, Magnesium Sulfate Soundness and PN. PCC aggregates have to conform to the requirements of CSA-A23.1[6].

4.7 New Brunswick Department of Transportation (NBDOT)

Contact: Andy Leger (506-453-2619)

NBDOT does not presently specify the Micro-Deval test to assess its construction aggregates. HMAC coarse aggregate testing requirements (NBDOT General Specifications, January 1995) include PN, Los Angeles Abrasion and Impact[3] and Sodium Sulfate Soundness[4] tests. HMAC fine aggregates are assessed by the Sodium Sulfate Soundness test. PCC aggregate testing requirements include Sodium Sulfate Soundness and Los Angeles Abrasion and Impact tests. NBDOT has conducted experimental laboratory testing with the Micro-Deval apparatus on New-Brunswick aggregates. Preliminary results indicate that the Micro-Deval test combined with an Unconfined Freeze-Thaw[14] test looks very promising in predicting long term coarse aggregate field performance. NBDOT confirms that the Micro-Deval test is repeatable and reproducible. Table 5 shows the Micro-Deval testing requirements which were to be incorporated in selected 1996 construction projects.

Table 5
NBDOT Proposed Requirements
For Micro-Deval

Coarse Aggregate		Micro-Deval LS-618[11] Max. % Loss
Granular	Base	25
HMAC	Surface	14
	Lower	18

4.8 Newfoundland and Labrador Department of Works, Services and Transportation (NDOT)

Contact: Keith S. Foster (709-729-2441)

NDOT does specify the Micro-Deval test to assess fine aggregates for HMAC. Test method CSA A23.2-23A[15] is specified with a max. loss of 20 %. Division 3 of their Specifications Book, April 1995, states " If equipment for test method CSA A23.2-23A[13] is not available, the Magnesium Sulfate Soundness test, as detailed in ASTM C88, is acceptable, providing a limit of 15% loss is not exceeded ". HMAC coarse aggregate testing requirements include Los Angeles Abrasion and Impact[3] Magnesium Sulfate

[14] Unconfined Freeze-Thaw Test for Coarse Aggregate, LS-614, MTO, Laboratory Testing Manual.

[15] Method of Test for the Resistance of Fine Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus, CSA-A23.2-23A, 1994.

Soundness[4], PN, Water Absorption[5] and Unconfined Freeze-Thaw[16]test. PCC aggregates have to meet the requirements of CSA-A23.1[6] with a maximum PN of 135. Granular Base testing includes Los Angeles Abrasion and PN.

5. DISCUSSION

5.1 Aggregate Performance

For aggregates to perform well in the field they generally must meet a number of requirements relating to mechanical performance, weather resistance, chemical stability, gradation, shape/ surface texture and deleterious substances. This report will discuss requirements relating to mechanical performance and weather resistance and determine if currently specified PWGSC test methods adequately predict long term field performance and should PWGSC adopt the Micro-Deval test.

5.2 Mechanical Stresses

Mechanical stresses leading to fragmentation, abrasion and polishing can occur during the handling and transportation of aggregates. Placement and compaction will also lead to the phenomena of fragmentation as well as wear by abrasion. In concrete for example, aggregates receive the greatest stress (wear by abrasion) during the mixing operation. In both PCC and HMAC pavement surfaces the action of aircraft and vehicular traffic including snow clearing and sweeping equipment, causes fragmentation by fatigue and impact of the surface particles.

The widely used acceptance test for measuring the resistance to mechanical breakdown of coarse aggregates in North America is the Los Angeles Abrasion and Impact test[3]. It has been commonly used since the early 1930's and can be found in most all Provincial and State agency specifications. It is considered that the Los Angeles test is more a measure of impact resistance than abrasion[17]. In recognition of this, the name was changed by ASTM in the 1980's to include the term "Impact".

A recent study of Ontario aggregates has found that the Los Angeles test is a good predictor of the susceptibility of coarse aggregates to mechanical breakdown (in a dry state) but little else[17]. The resistance to fragmentation is also adequately determined by a petrographic examination (PN)[18]. The Los Angeles test is useful in identifying brittle materials which tend to degrade under impact but does not adequately measure interparticle friction that is generated by cyclical loading. Another weakness inherent to the test is the ability of argillaceous, schist or shaley particles to absorb and resist the

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16 Method of Test for Resistance of Unconfined Coarse Aggregate to Freezing and Thawing, CSA-A23.2-24A.

17 C.A.Rodgers and S.A.Senior, Predicting Aggregate Performance Using the Micro-Deval Abrasion Test, 3rd Annual Symposium for the C.F.A.R., U.of T., 1995

18 Marc-Andre Berube, Aggregate Performance and Importance of Composition, Laval University, Geology Engineering Department, 1994

impact of the steel balls , however the same particles would readily degrade if tested in a wet condition[10]. The Los Angeles test fails to identify materials that are prone to degradation in a wet condition[19].

5.3 Durability

Exposure to varying climatic conditions such as wetting-drying and freeze-thaw cycles has a major influence on the durability of aggregates for foundation materials, PCC and HMAC. Deicing salts and Urea also contribute to aggregate deterioration and have a marked accelerating effect on damage caused by freeze-thawing. Durability and resistance to weathering of construction aggregates are normally evaluated in North America by the Sulfate Soundness and Water Absorption tests however the Sulfate Soundness test suffers from disadvantages: lengthy and time consuming, poor multi-laboratory precision, poor repeatability and inadequate correlation with field performance[10,17,20, 21]. The crystallization of soluble salts in the aggregate pores is used to simulate ice crystallization in the Sulfate Soundness test, a model that may have been acceptable when the test was developed in 1828[21] when there were no means to freeze water in the lab, however equipment and procedures are now available to accurately recreate freeze-thaw conditions in the lab[22]. Freeze-thaw test procedures, now available for coarse aggregates include MTO LS-614[14] and CSA-A23.2-24A[16]. CSA-A23.1[6] indicates that the Magnesium Sulfate Soundness test requirements for coarse PCC aggregates can be waived provided the coarse aggregate does not exceed a maximum loss of 6% of the Unconfined Freeze-Thaw CSA test method[16]. The Magnesium Sulfate Soundness test has also been used for many years throughout North America for evaluating the physical suitability of fine aggregates. As stated previously the Sulfate Soundness test unfortunately has poor multi-laboratory precision which is confirmed by the fact that ASTM C-88 does not give precision data for the fine aggregate test.

5.4 Micro-Deval

Although the four standard acceptance test procedures: Soundness loss, Los Angeles Abrasion and Impact, Water Absorption and Petrographic Number can distinguish between an excellent and a poor aggregate, they are not as good in predicting field performance where marginal aggregates are concerned. The Micro-Deval test is presently being specified by provincial agencies such as MTQ, MTO and NSDOT to supplement and even replace the above noted standard acceptance tests. Several other provincial

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[19] P.Gilbert, Normes de Controle Qualitatif des Granulats pour la Construction Routiere, Etude Bibliographique, Projet 78F-164 A, 1981

[20] S.A.Senior, C.A.Rogers, Laboratory Tests for Predicting Coarse Aggregate Performance In Ontario, Transportation Research Record No.1301, Engineering Materials Office, MTO, 1991.

[21] C.A.Rogers, Micro-Deval Test for Evaluating the Quality of Fine Aggregate for Concrete and Asphalt, Transportation Research Record , No 1301, MTO, 1991.

[22] D.Boothe, Development of an Unconfined Freeze-Thaw Test for Coarse Aggregates, Report EM-87, MTO, 1989.

agencies are presently assessing the Micro-Deval test and are anticipating implementation of the test in the near future.

The Micro-Deval test originated as the Deval test in the 1900's[19] and was standardized by ASTM under the designator ASTM D-2 (1908) and D-289 (1928); these standards have since been dropped from ASTM. A wet abrasion test called Micro-Deval was developed in France during the 1960's[23] on which most current standards are based. The purpose of the Micro-Deval test is to measure aggregate resistance to abrasion and wear by attrition in the presence of water.

Generally the Micro-Deval test procedure for coarse aggregates consists of soaking a sample in water and then placing it in a 195 mm diameter steel jar with water and 5 kg of 9.5 mm diameter steel balls. The jar is rotated for two hours and at completion the sample is dried and then passed on a 1.2 mm sieve to determine percent loss. For fine aggregates the test is modified as follows: a 700 g sample of sand is washed on a .075 mm sieve and oven dried. A representative sub sample of 500 g is soaked in water then placed in the steel jar with water and 1250 g of steel balls then rotated for 15 min. The sample is then washed over a .075 mm sieve to determine percent loss.

5.5 Coarse Aggregate

A comparison of the Micro-Deval test with the Magnesium Sulfate Soundness test[21] based on 106 coarse aggregate samples indicates similarity of test results however a greater amount of precision was obtained with the Micro-Deval. It was found[17] based on comparative laboratory testing that the Micro-Deval test was far more effective at separating good from poor granular base aggregates than the Los Angeles test. The reason for the apparent superiority of the Micro-Deval test is that it is a wet abrasion test where as the Los Angeles test is predominantly an impact test carried out on dry aggregates. The Los Angeles test also showed little correlation with field performance when the loss was less than 50. The Micro-Deval has good repeatability and good multi-laboratory precision[10,17,21].

Mr. Guy Tremblay of MTQ states[24] "... this test probably contributes the most relevant information on aggregate quality ... In Quebec, the most competent materials have Micro-Deval numbers under 10. These materials are considered to be aggregates of very high performance, provided they do well in the Los Angeles test, which is generally the case". MTQ is looking into the Unconfined Freeze-Thaw test and the Washington Fracturing test to either supplement or replace the Sulfate Soundness test. The Sulfate Soundness test has not been used to assess limestone aggregates in Quebec since the mid 1980's, mainly because its results are too erratic and do not correlate with field performance.

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23 C.Tourenq, L'essai Micro-Deval, Bulletin Liaison Laboratoire, Routieres, Ponts et Chaussees, Paris, France, No 50, 1971

24 Guy Tremblay, Testing Methods of Aggregates, 1994, Ministry of Transport of Quebec

The most significant finding observed by NSDOT, based on their preliminary investigation[10], is the high degree of degradation suffered by some marginal coarse sedimentary aggregates when subjected to the Micro-Deval and Freeze-Thaw tests. These marginal materials would meet the current provincial standards for Sulfate Soundness and Los Angeles Abrasion tests. The existing provincial Petrographic Number requirement would effectively eliminate the use of these marginal materials in HMAC. Both MTQ and NSDOT have confirmed a major drawback with the Petrographic Number in that the test has a poor reproducibility and is somewhat a subjective evaluation. The Petrographic identification is however helpful in identifying potential reactive aggregates in Portland Cement or soft aggregates which are unsuitable for HMAC. PWGSC does not have a PN requirement for construction aggregates relying solely on test requirements listed in Table 1.

The relation between the Sulfate Soundness, Water Absorption, PN and Unconfined Freeze-Thaw tests on coarse aggregates compared with actual field performance was investigated by MOT and can be summarized as follows: no test procedure by itself is totally reliable for separating good, fair and poor aggregate performance in concrete[21]. The study finds that the Micro-Deval combined with the Freeze-Thaw tests are the most reliable in predicting field performance of PCC coarse aggregates. The Micro-Deval was also found to be more preferable than the Los Angeles and the British based Aggregate Abrasion Value (AAV) tests for assessing wear resistance of coarse aggregates in HMAC.

5.6 Fine Aggregate

In 1992 MTO replaced the Magnesium Sulfate Soundness requirement for HMAC fine aggregate with the Micro-Deval requirement as shown in Table 2 due to the wide multi-laboratory variations of the Sulfate Soundness test and in some cases its poor ability to predict field performance. The new Micro-Deval requirements have been successful to date in evaluating fine aggregates for use in HMAC in Ontario.

CSA-A23.1[6] indicates that the Magnesium Sulfate Soundness test requirements for fine concrete aggregate can be waived provided the fine aggregate does not exceed a max. loss of 20 % of the Micro-Deval CSA test method[15] and states: " This test for fine aggregate is rapid, has excellent precision, and has a significant correlation with the more complex and variable $MgSO_4$ soundness test.".

At present most agency specifications for granular base materials have no physical requirements for the fine portion of the aggregate other than a plasticity requirement.

6. CONCLUSIONS

The Los Angeles Abrasion test has poor correlation with field performance of some marginal granular base coarse aggregates and fails to identify materials that are prone to degradation when wet. The Micro-Deval test is able to separate good granular base aggregates from poor ones. It has demonstrated promise as a relative indicator of Granular base coarse aggregate field performance. It is recommended that the Micro-Deval test be initially considered by PWGSC for evaluating mechanical strength properties of granular base coarse aggregates in Airfield Pavement Structures. A requirement of a maximum percent loss of 25% would appear to differentiate between poor and acceptable aggregates. The Los Angeles test should be maintained until sufficient regional comparison test data is accumulated and assessed.

It is recommended that PWGSC continue specifying PCC fine and coarse aggregate requirements as suggested in CSA A23.1[6] allowing for the Micro-Deval alternative testing requirement for fine aggregate.

The Micro-Deval test has a good correlation with the Sulfate Soundness test. It can be completed in a fraction of the time required to conduct a Sulfate Soundness test : two days compared to ten days. The Micro-Deval test has a much better multi-laboratory precision than the Sulfate Soundness test. It is for these reasons that the Micro-Deval test should be considered a valid test in predicting long term field performance for HMAC aggregates. The Micro-Deval test has however not been adopted for assessment of source aggregate properties in the Asphalt Institute Mix Design Manuals MS-2[25]or SP-2[26]. Typical Micro-Deval requirements for quality HMAC aggregates adopted or likely to be adopted by Provincial Agencies are a maximum percent loss of 14% for coarse aggregates and 20% for fine aggregates.

At this time it is suggested that PWGSC consider specifying the Micro-Deval test for HMAC fine and coarse aggregate as a supplemental requirement on a regional basis with local Provincial requirements used as a guideline. Testing requirements listed in Table 1 should be maintained for the present. It should be noted that a number of Provincial Agencies are only specifying the Micro-Deval for the first time in 1996 and others are presently investigating and or rewriting their aggregate specifications.

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[25] Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types MS-2, Sixth Edition.

[26] Superpave Level 1 Mix Design, Asphalt Institute Superpave Series No.2 (SP-2), Aug 1995.

It is recommended that prior to specifying a Micro-Deval test requirement for construction aggregates , PWGSC will have to assess the different test methods such as CSA A23.2-23A[15], LC-21-101[13] or LS-619[12] for fine aggregates and LS-618[11] or NQ 2560-070[9] for coarse aggregates to determine which procedure is preferable.

In conclusion it is recommended that the Micro-Deval test be incorporated in PWGSC testing requirements as a guideline and be used as a supplementary test method particularly in situations where local aggregates are of marginal quality.

Any regional offices that make use of the Micro-Deval test shall inform the National Centre of Expertise (NCOE) in Ottawa to co-ordinate the collection and recording of data and ensure that the experience gained is distributed nationally.