SOILS & AGGREGATE TESTING/TECHNOLOGY

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SOILS & AGGREGATE

TEST METHODS AND TECHNOLOGY
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Durability test of aggregate to measure resistance to abrasion and weathering

Equipment

Stainless steel charges & canisters
Magnet

Micro-Deval abrasion machines equipped with laser and revolution counter
Changes to standardized gradations for bituminous & concrete aggregate.

- Gradations A and B (no revisions)

Addition of gradations for intermediate & fine aggregate.

- Gradations C and D

- Gradation A – 120 minutes rotation
- Gradation B – 105 minutes rotation
- Gradation C – 95 minutes rotation
- Gradation D – 15 minutes rotation

Soaking time changed to 1 hour +/- 1 minute
Proposed Gradation C vs Tex-461-A Bituminous Gradation

27 Samples from different quarries

$R^2 = 0.9896$
- Revisions will accommodate materials with different gradations
- Gradation C for intermediate aggregate used in HMA, D/F blends, and pea gravels
- Gradation D for fine aggregate as required in 2014 specs for Item 421
- Quick QC tool for anyone to run with a two-day turnaround time
- Test results from split samples are repeatable between labs
Aggregate Image Measurement System (AIMS)

Analyzes aggregate characteristics using digital imaging technology

Image based particle analysis capturing 3D shape data

Aggregate sizes
$\frac{1}{2}''$, $\frac{3}{8}''$, $\frac{1}{4}''$, and #4
Aggregate Image Measurement System (AIMS)

Aggregate Characteristics

- Angularity – sharpness of corners of aggregate particles
- Shape – round or flat
- Texture – smoothness or roughness of aggregate particle surface
Aggregate Image Measurement System (AIMS)

Advantages

- Removes operator influence & subjectivity
- Improves productivity and precision

Challenges

- Measure degree of wear and loss in texture
- Field validation may be needed
- Correlation to flat & elongated and crushed face count lab tests
Portable unit manufactured by StellarNet Inc.

Bench top unit manufactured by Perkin Elmer
Battery operated, can be used in the field or lab

- Halogen light source
- Green wave spectrometer
- Fiber optic cable
- Power regulator
- Battery (not shown)
Ultraviolet-Visible Spectroscopy

- Uses light energy and absorbance to measure organic content
- Capable of detecting harmful organic matter, humic acid

Tex-408-A, Organic Impurities

- Uses a color comparator to determine organic content
- Subjective & not always effective
Sample preparation includes use of three different solutions to extract organic matter

- 1 blank standard
- 3 known standards of approximately 0.5, 1.0, and 1.5% organic matter tested
- 3 replicates for each sample tested

Cuvette – Used for testing
Advantages

- Able to detect harmful organic matter
- Humic acid contents greater than 1% has shown to retard pozzolanic reaction for long-term strength gain

Challenges

- Requires training, time, and experience to become proficient
- Involved sample preparation procedure
- Sophisticated testing equipment
Veris 3150 Soil Mapping System

Sulfate-Induced Soil Heave
Veris 3150 Soil Mapping System

- Disk harrower used extensively in agriculture
- Measures Electrical Conductivity (EC)
- Equipped with electrodes to make contact with the soil
- Capable of measuring EC from depths of 2 to 4 feet.
EC is a measurement of how much electrical current soil can conduct.

Salinity is the biggest contributor to soil conductivity, which is used to detect sulfates in the soil.

EC is related to the soil texture/clay content, moisture content, and dissolved salts, etc.

EC greater than 100 may contain problematic sulfate levels, areas should be sampled and tested in the lab.
Soil EC and GPS data are recorded and used for creating maps using ArcGIS software.
Veris 3150 Soil Mapping System

Unit is relatively light in weight and can be towed with a pick-up truck or tractor.

Recommended use with a pick-up truck

- Safe and comfortable for travel
- Provides storage space for equipment & accessories
Soil mapping system may be used during any stage of construction

- Safe passable terrain
- No excessive moisture
- Moisture content approximately 10% for reliable & accurate results
Veris 3150 Soil Mapping System

Disks are embedded into soil approximately 1” to 2”

Cost of unit is approximately $30,000
Veris 3150 Soil Mapping System

Advantages

- Screening tool to determine where potential sulfates exist
- Rapid, economical, and covers large areas
- Measures EC at shallow (2’) and deep (4’) depths
- Sampling & testing using EC is more likely to detect areas of high sulfates than random sampling

Challenges

- Needs soil moisture for electrical conductivity
- Does not directly measure sulfate
Tex-124-E Potential Vertical Rise (PVR) - Revised

- Nomograph curves replaced with an Excel template
- Template computes final PVR values using input parameters
- PVR calculations will be easier and more accurate
- Excel template originally developed in the Fort Worth District and has been verified by six districts that use Tex-124-E for their geotechnical soil surveys.
# Tex-124-E Potential Vertical Rise (PVR) - Revised

## PVR Data BH

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**Note:** PVR calculations are based on future pavement grade being the same as present grade. Bold numbers are interpolated and extrapolated values.

## DEPTH (ft) VS PVR (in) using Excel

![Graph](image-url)
Collaboration between Finnish National Road Administration and Texas Transportation Institute (TTI)

Evaluates moisture susceptibility of flexible base materials

Non-destructive test measuring the dielectric constant in laboratory

Dielectric constant is an indicator of the ability for moisture to migrate through materials by capillary effect.
Tex-XXX-E, Tube Suction Test (Draft - New)

- Moisture susceptibility based on dielectric constant of compacted specimens after 10 day capillary soak in laboratory
- Criteria for good, marginal, and poor
- Ratio of unconfined compressive strength before & after 10 day soak
- Moisture content of specimens after 10-day soak, may indicate what may be attained in the field
Dielectric Meter

Four readings equally spaced around perimeter with fifth reading in the center

- Highest & lowest readings discarded
Advantages

- Straightforward test requiring minimal training to measure moisture susceptibility of flexible base materials
- Capable to differentiate between good, marginal, and poor materials
- Measure effect of different types of stabilizers
- Measure effect of different contents of stabilizers
- Forensic investigations

Challenges

- Length of time to complete test may be more than 14 days from day of receiving material
- Test procedures in place to evaluate Lime & Cement
- Receive requests to evaluate liquid stabilizers and additives
- Compares material properties with untreated material to determine benefits
- Includes unconfined compressive strength and swell testing
Thank You