

Industrial Materials Conference

What is needed in terms of information, resources and training in order to increase the use of Industrial materials in the highway environment



Recycled Materials

- Air Cooled Blast Furnace Slag
- Concrete Riprap
- Fly Ash
- Foundry Sand
- Glass
- Ground Granulated Blast Furnace Slag
- Lime Kiln Dust
- New Waste Roofing Shingles
- Reclaimed Asphalt Shingles
- Reclaimed Asphalt Pavement
- Recycled Concrete
- Silica Fume
- Steel Slag



Coal Combustion Products

Coal Ash

Fly Ash – coal ash with 70% or less passing the No. 200 sieve

Bottom Ash – coal ash with 20% or less passing the No. 200 sieve and 10% or less retained on the No. 10 sieve



Coal Combustion Products Coal Ash – Embankment Construction

- 7 projects since 1994
- 471,200 tons of coal ash



Round Table Intro - What is Needed?

Coal Combustion Products

Fly Ash – Concrete

- Minimum cement/fly ash ratio = 3.2
- Only between April 1 and October 15 of same year
- Not allowed when blended cements are used
- Minimum cement increased to 500 lb/yd³ when portland-pozzolan cements used



Coal Combustion

Wet Bottom Boiler Slag

Sieve Size	% Passing
12.5 mm	100
9.5 mm	95.0 – 100.0
4.75 mm	90.0 – 100.0
1.18 mm	30.0 – 60.0
75 µm	6.0 – 12.0



Foundry Sand

- Approved List
- IDEM waste classification certification for Type III or IV residual sands
- Restrictions
 - Type III not within 100 ft of a stream, river, lake, reservoir wetland, or other protected environmental resource area
 - Type II or IV not within 150 ft of a well, spring, or other ground source of potable water
 - Not placed adjacent to metallic pipes or other metal structures
 - Not used as encasement material
 - Not used in MSE wall applications



Slag

- Steel Slag
- Air-Cooled Blast Furnace Slag
- Granulated Blast Furnace Slag
- FY 12 – 200,000 tons



Round Table Intro - What is Needed?

Certified Aggregate Producer Program



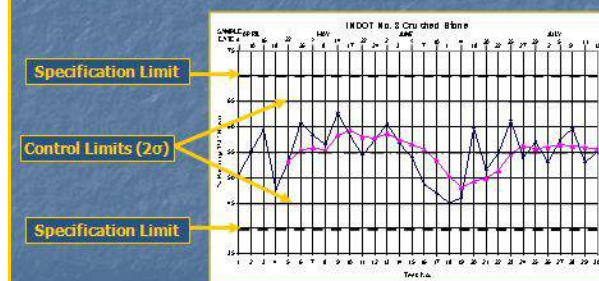
- Required for aggregates except snow and ice abrasives & for precast concrete items



Required Tests



Control Charts



Steel Furnace Slag

- 7 Certified Steel Slag Sources
- Required for HMA surface mixtures with ESAL $\geq 10,000,000$
- Issues
 - Specific Gravity
 - Expansion of Material



Round Table Intro - What is Needed?

Steel Furnace Slag

- Specific Gravity - 3.4
 - Payment is by weight
 - Quantity is adjusted and lay rate adjusted for HMA
 - SMA
 - Specific gravity required at 1 test/2000 tons
 - Target bulk specific gravity established
 - Subsequent tests shall be within 0.050 of target
 - Moving average of 4 consecutive tests within 0.040 of target



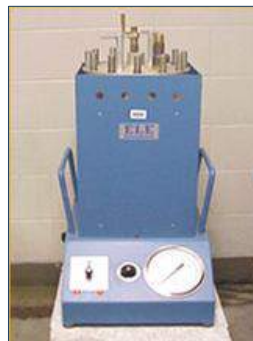
Steel Furnace Slag

- Expansion
 - Calcium oxide and magnesium oxide when hydrated will expand
 - Restricted to aggregate shoulders, HMA surface or SMA surface mixtures, dumped riprap, and snow and ice abrasives



Steel Furnace Slag – Deleterious Materials

- Coarse aggregates in HMA Base and Intermediate mixtures
- ITM 219 – Autoclave
- Conducted by Certified Aggregate Producer 1/2000 t
- Deleterious $\leq 4.0\%$
- Stockpiles failing may be tested again after 30 days from test date



Air -Cooled Blast Furnace Slag

- 3 Certified Air-Cooled Blast Furnace Slag Sources
- Required for HMA Surface mixtures with ESAL $\geq 10,000,000$
- Issues
 - Specific Gravity
 - Leachate



Round Table Intro - What is Needed?

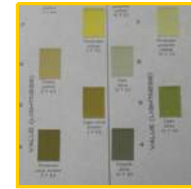
Air - Cooled Blast Furnace Slag

- Coarse Aggregate Specific Gravity - 2.3
 - Payment is by weight
 - Quantity is adjusted and lay rate adjusted for HMA
- Not allowed in SMA



Air -Cooled Blast Furnace Slag

- ITM 212 – calcium sulfide
- pH of 6.0 – 10.5
- Rock color chart – greenish-yellow color
- Test conducted by Certified Aggregate Producer 1/2000 t
- Failing stockpiles may be tested again after 30 days



Granulated Blast Furnace Slag

- Rapid chilling in water of blast - furnace slag
- Proposed for use in HMA
 - Specific Gravity (2.2 → 1.9)
- Allowed as mineral admixture in concrete

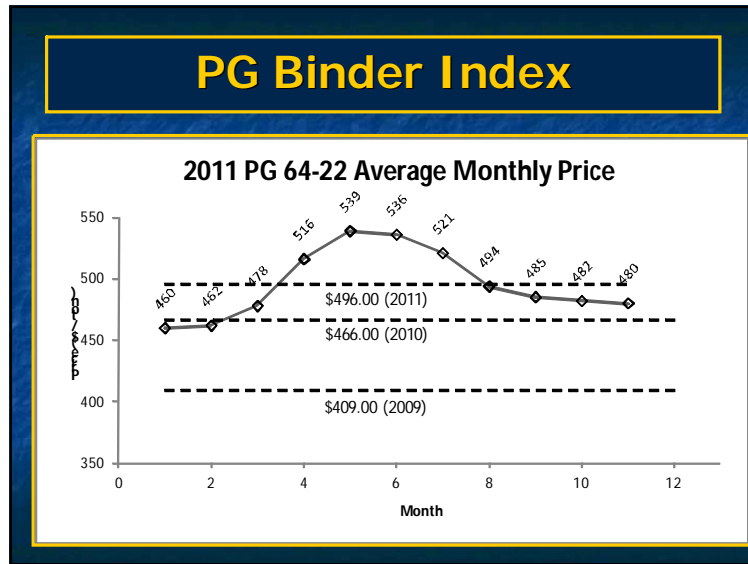


Construction Materials

- Reclaimed Asphalt Pavement (RAP)
- Reclaimed Asphalt Shingles (RAS)
- Recycled Concrete



Round Table Intro - What is Needed?



Reclaimed Asphalt Pavement

- Allowed as binder replacement in all mixtures
- First used in 1980s by plant heat transfer method up to 50%
- Refined after SuperPave

Reclaimed Asphalt Pavement

- Processed into more sizes

Reclaimed Asphalt Pavement

- Plants have more RAP bins

Round Table Intro - What is Needed?

Reclaimed Asphalt Pavement

- HMA surface mixtures – friction resistance
 - Category 3, 4, & 5 --100% passing the 3/8 in. sieve and 95 -100% passing the No.4 sieve



Reclaimed Asphalt Pavement

- FY12
 - 4,100,000 tons of HMA
 - 895,000 tons RAP (22%)



Reclaimed Asphalt Shingles

- Allowed as binder replacement in all mixtures
- First used in 1980s -pre-consumer shingles
- Post consumer shingles introduced in 2010



Reclaimed Asphalt Shingles

- Issues
 - Asbestos - tested
 - Asphalt Grade – limited to 25% by weight of total binder content
 - Aggregate – 100% passing 1/2 in.
 - Deleterious – AASHTO MP 15



Round Table Intro - What is Needed?

Recycled Materials								
Maximum Binder Replacement, %								
Mixture Category	Base and Intermediate					Surface		
	Dense Graded			Open Graded		Dense Graded		
	25.0 mm	19.0 mm	12.5 mm	25.0 mm	19.0 mm	12.5 mm	9.5 mm	4.75 mm
1	40.0			25.0		40.0		
2	40.0			25.0		40.0		
3	40.0			25.0		25.0		
4	40.0			25.0		25.0		
5	40.0			25.0		25.0		

Scrap Tires

- Embankments
- HMA
 - Pyrolized Carbon Black
 - Dry Process
 - Wet Process – waste tennis and racquet balls






Scrap Tires - Embankments

- Lightweight fill in embankments over peat, for landslides, and for retaining walls
- 1,342,000 tires since 2001 on 11 projects

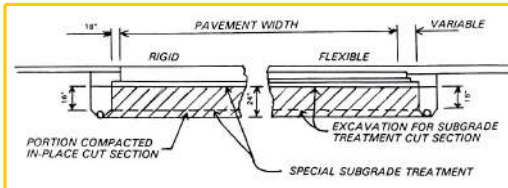





Round Table Intro - What is Needed?

Recycled Concrete Aggregate

- Subgrade Treatment
- Processed on contract to required size through the CAPP



The diagram illustrates a cross-section of a pavement structure. It shows a rigid pavement section on the left and a flexible pavement section on the right. The rigid section has a 18-inch width and a 1.5-inch thickness. The flexible section has a variable width and a 1.5-inch thickness. Below the rigid section, there is a 'PORTION COMPACTED IN-PLACE CUT SECTION'. Below the flexible section, there is an 'EXCAVATION FOR SUBGRADE TREATMENT CUT SECTION' with 'SPECIAL SUBGRADE TREATMENT' indicated below it.






Recycled Concrete Aggregate (RCA)



- Test Sections placed in 2012 containing 30% and 50% RCA






D-Cracking



ASTM C 666

- Introduced in early 1990s
- 350 freeze-thaw cycles – 3 month test
- Maximum beam expansion of .060
- 85 approved sources
- Most recycled concrete placed prior to 1990



Round Table Intro - What is Needed?

Hydraulic Fracture Test

- 7 day test to supplement ASTM C 666
- Allows Contractor to verify AP status quickly and reuse RCA from same contract



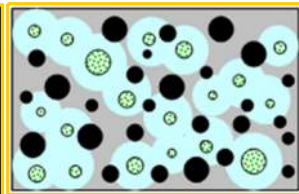
Expanded Shale

- Lightweight Fine Aggregate



Internally Cured Concrete

- Highly saturated lightweight fine aggregate
- Absorbed water provides internal moisture that is slowly released to hydrating cement
- Intended to inhibit shrinkage and early age cracking of bridge deck



Lime Kiln Dust

- Soil stabilization
- Over 4 million yd² of subgrade in lieu of lime in more than 100 projects in 2012



Round Table Intro - What is Needed?

Crushed Glass as Bedding Material

- Bedding material beneath pipes and storm sewers
- Recycled glass beverage and food containers
- Type III or Type IV restricted waste
- No colored bottles because of the mercury



Sieve Size	% Passing
½ in.	85 - 100
No. 4	45-85
No. 10	25-70
No. 40	10-30
No. 200	0-10



Silica Fume

- Product from reducing high-purity quartz with coal in an electric arc furnace in the manufacture of silicon
- Allowed as mineral admixture in concrete
- Only used in high performance concrete



What is Needed?

- Website portals
- Material mapping
- Online training & webcasts
- CEU credits
- How to overcome the "not invented here" syndrome
- Can traditional suppliers become partners?

