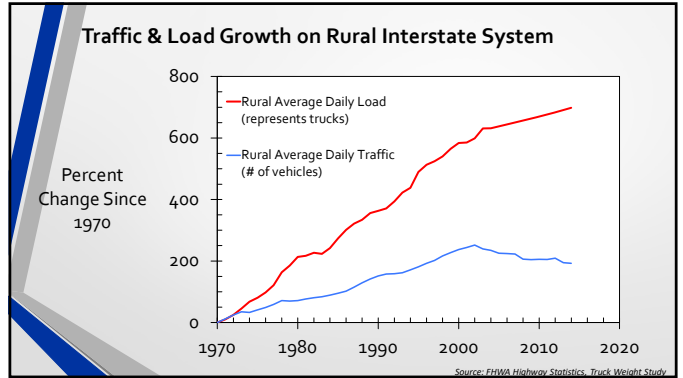


Presentation to
Aggregate Committee

November 19, 2024

Phillip Blankenship, PE



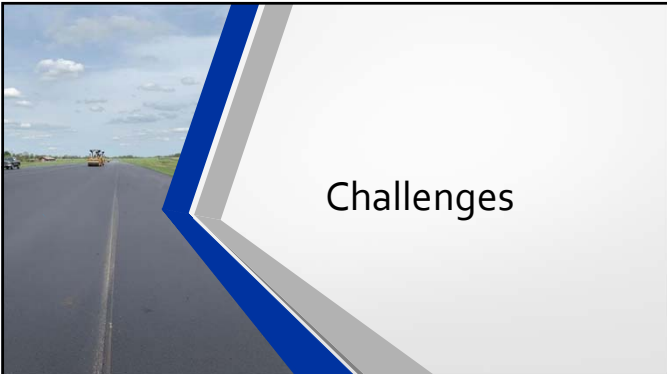
- ### Topics for Today
- Challenges
 - Initiatives
 - Modern Testing
 - Newer Mixes
 - Gradation Review
 - BMD Review
 - Friction – the 3rd Leg of BMD
 - Notes from Erv Dukatz

Sustainability

- Push to evaluate sustainable options
- Happening at a time we are trying to fix our mixes



Challenges



Scarcity of New Aggregate Sources








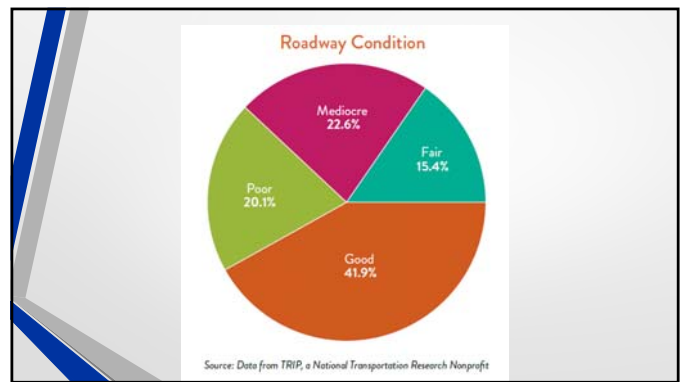
Condition

- "D" rating of our highway system
- 43% of the system is now in poor or mediocre condition costing drivers an estimated \$1000 annually
- While traffic fatalities have been on the decline, over **36,000 people are still dying** on the nation's roads every year
 - Number of pedestrian fatalities is on the rise
- At least **27 states have de-paved** roads.



Facts

- 4 million miles of public roadways in the United States
- Our nation's highways and roads move 72%, or nearly \$17 trillion, of the nation's goods
- Vehicle miles traveled reaching more than 3.2 trillion in 2019, an 18% increase from 2000
- Every lane-mile of road costs approximately \$24,000 annually in operation and maintenance


Recommendations to Raise the Grade

- Focus resources on preserving a state of **good repair**
- Increase **funding** from all levels of government
- **Develop** state and local level comprehensive transportation asset management **plans**



Targeted Overlay Pavement Solutions (TOPS) – Everyday Counts by FHWA

- **"Design methods (SMA), interlayer technology..."** – FHWA
- For asphalt overlays
 - Several DOTs have adopted SMA due to increased service life and performance
 - Other DOTs found highly modified asphalt in thin overlays is more resistant to reflective cracking increasing pavement life by 2 to 4x
- Learn more: www.fhwa.dot.gov/innovation/everydaycounts/edc_6/targeted_overlay_pavement.cfm

Asphalt Materials
 Tim Aschenbrener
 FHWA Office of Preconstruction, Construction, and Pavements
 (720) 963-3247
Timothy.Aschenbrener@dot.gov

Concrete Materials
 Sam Tyson
 FHWA Office of Preconstruction, Construction, and Pavements
 (202) 366-1326
Sam.Tyson@dot.gov



Innovation

- Timely, preventive maintenance of our roads with better materials extends the life of pavement and costs less than reconstructing pavements after they reach failure
- Create smart pavements with sensors to provide real-time feedback with low user impact
- Additionally, the use of next generation materials and decentralized traffic lights to promote traffic flow
- See FHWA: <https://www.fhwa.dot.gov/innovation/everydaycounts/edc-4.cfm>




Targeted Overlay Pavement Solutions (TOPS) – Everyday Counts by FHWA

- *"Approximately half of all infrastructure dollars are invested in pavements, and more than half of that investment is in overlays. By enhancing overlay performance, State and local highway agencies can maximize this investment and help ensure safer, longer-lasting roadways for the traveling public."* – FHWA

Asphalt Materials
 Tim Aschenbrener
 FHWA Office of Preconstruction, Construction, and Pavements
 (720) 963-3247
Timothy.Aschenbrener@dot.gov

Concrete Materials
 Sam Tyson
 FHWA Office of Preconstruction, Construction, and Pavements
 (202) 366-1326
Sam.Tyson@dot.gov

Environmental Product Declaration (EPD)

<https://www.fhwa.dot.gov/pavement/sustainability/hif21025.pdf>

- What is EPD?
 - "Nutritional label for our mixes"
- Environmental Product Declarations (EPDs) are developed by the producers of construction materials as tools that communicate the environmental impacts of material production



Environmental Product Declaration (EDP)

<https://www.fhwa.dot.gov/pavement/sustainability/hif21025.pdf>

- Focus on meeting carbon neutral 2050 mandate
 - Reduce CO₂ levels
- Product Category Rules (PCR) and Life Cycle Assessment (LCA) inputs
- 3 scopes
 - Cradle to Gate
 - Cradle to Site
 - Cradle to Grave



IDEAL-CT and HWT




Modern Testing

Quick Pavement Modulus for Structural Design





BATT – 6,000 sf facility



Friction Testing



BATT Services



Asphalt Material Testing	Consulting Services & Forensic Analysis	Product Development	Training
<ul style="list-style-type: none"> Accredited Lab Binder Hot Mix Asphalt Aggregate 	<ul style="list-style-type: none"> Engineering Pavement Design Expert Witness Pavement Distresses 	<ul style="list-style-type: none"> Lab to Pavement Commercialization Trial Applications Formulation 	<ul style="list-style-type: none"> Mix Design Asphalt 101 Materials Testing Custom-Design Training

New(er) Mixtures and Materials



Extract/Recover Safely


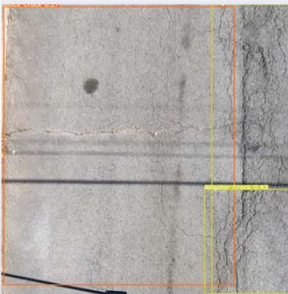


New Mixtures


- BMD – enough said**
 - Contractor (and agency) can see the potential outcome of materials combinations
- High RAP**
 - Not just high RAP...engineered with BMD
- Asphalt interlayer - RCRI**
 - US has had in place since 2000
 - Included in FHWA Every Day Count & TOP's program
- Thin lift surfaces**
 - Similar to interlayer (#4 mix), but lower AC and more open

BATT Vision

Pavement Condition (PCI) Monitoring

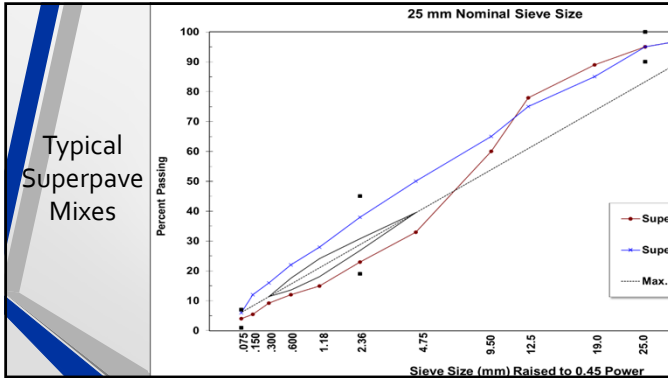
Gradation Choices



Slide 25

ZM0 See what you think of this [@Phillip Blankenship]

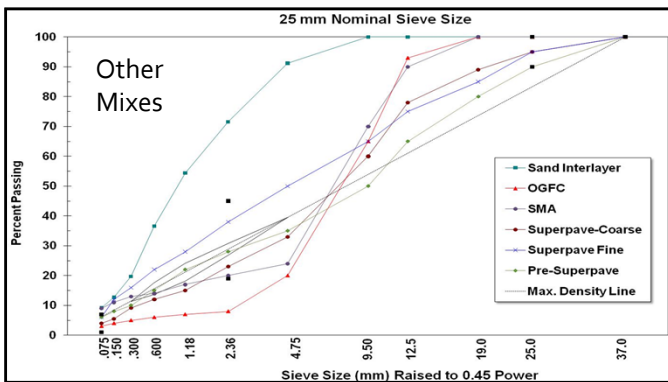
Zack McKay, 2023-02-03T14:59:29.318



What is Balanced Mix Design

“Asphalt mix **design** using **performance** tests on appropriately **conditioned specimens** that address multiple modes of **distress** taking into consideration **mix aging, traffic, climate and location** within the pavement structure.”

Buchanan, S., Balanced Mix Design (BMD) for Asphalt Mixtures, 2016 34

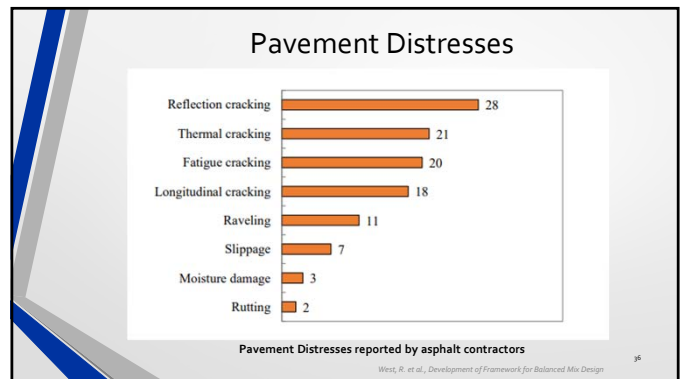


Need for BMD

- BMD is a **balance** between durability (cracking) and stability (rutting)
- Cracking** most prevalent issue on asphalt pavements
- Dry mixtures** result in durability issues
- There is a need to understand the **performance** through performance-related testing

35

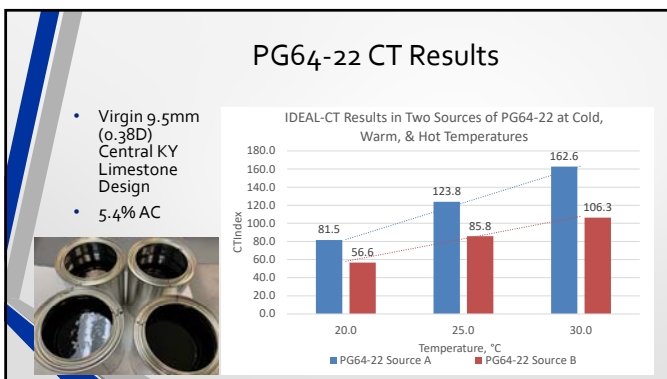
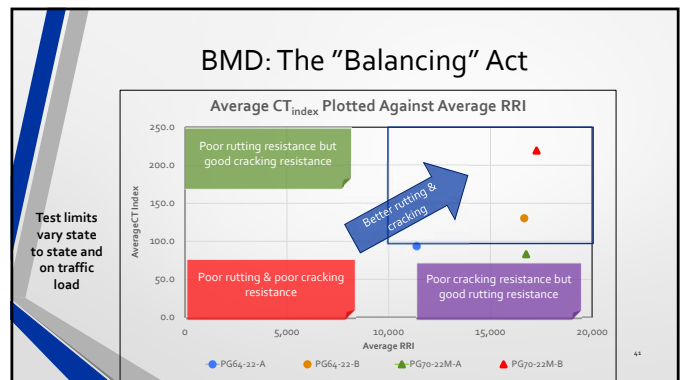
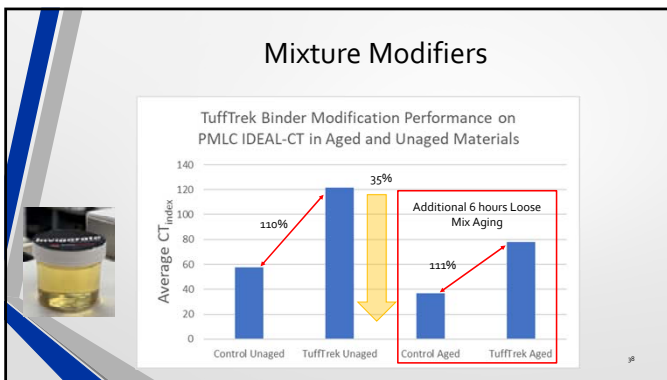
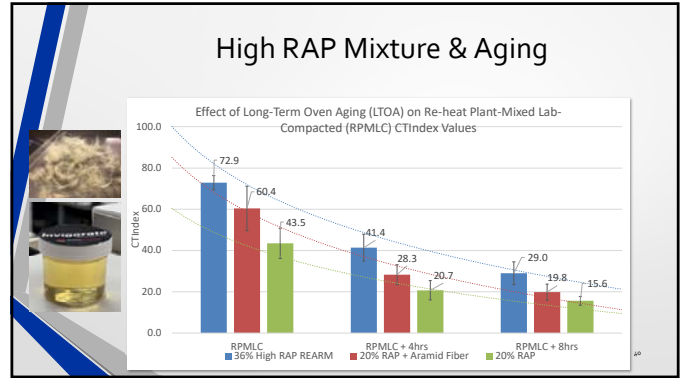
Balanced Mix Design Review



Dry / Non-Durable Mixes


Characteristics

- Dry and usually are low in %AC
- Will block crack
- Longitudinal joints will deteriorate faster
- Allow for water intrusion
- May ravel



BMD: Factors on IDEAL-CT, HWT/APA, & Density

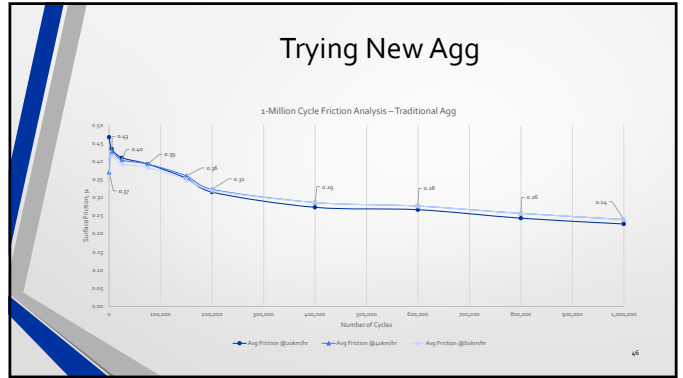

Factor	IDEAL-CT	HWT	Density
Increase %AC (assuming typical PG)	+++	---	+++
Lower PG	++	--	+
Higher PG	--	++	-
Time Under Heat (oven or silo)	---	+++	-
Increase RAP (generally stiffens)	--	++	-
Increase DP (dust-asphalt ratio)	--	++	?
High absorption agg	--	++	--
Recycling Agents – bio oil type (soybean or corn oil)	++	--	+
Warm Mix Asphalt (WMA) Additive	+	- ?	++
Aramid fibers (polymer fiber)	++	++	?
Thicker paving mat	NA	NA	+++



BMD

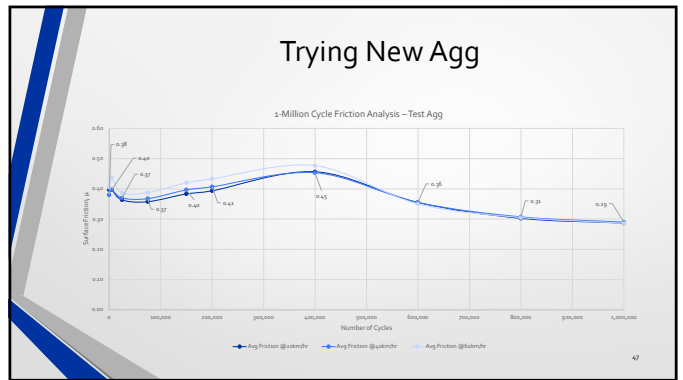
- Some states have already begun to improve mixtures...but this is more than raising the %AC
- HWT and IDEAL-CT requirements are here
 - Per latest Kentucky update, **significant cracking** is appearing in **3 years or less** in asphalt pavement.
 - KY Transportation Cabinet is aiming to improve this to 7 years by
 - Implementing IDEAL-CT (much higher than Tx recommendations)
 - Provide rutting check with HWT
 - Key issue is **repeatability** and **sample preparation**

43




The 3rd Leg of BMD - Friction

44

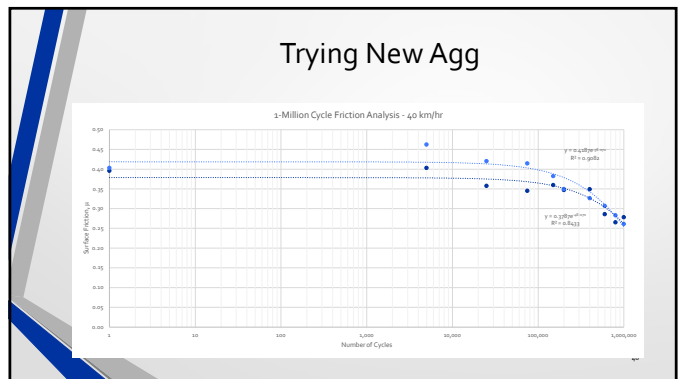



Geology 101 Review: Minerals & Rocks

- Rock (aggregate) is made up of more than one mineral**
- There are three types of rocks
 - Sedimentary** - made up of "sediments" or pieces and formed in layers
 - Sandstone, limestone, coal, shale
 - Igneous** - formed from magma (melted rock)
 - Granite (pieces of quartz), pumice
 - Metamorphic** - rocks that have changed (morphed) into another kind of rock by pressure and heat
 - Limestone to marble, shale to slate, coal to diamond

46





Notes from Erv Dukatz

Former Vulcun QC

49

Thoughts from Erv Dukatz

- The **difference in age of aggregate** often results in different physical properties important to the BMD, such as specific gravities, absorption, LA Abrasion and soundness to name a few.
- Another **key aggregate property** to track is the **gradation** of each of the aggregate products used in any asphalt mix design, but even **more important to track in BMDs** from lab to production.
 - When samples don't produce the expected results, determine **which product has changed**, don't assume the gradations used for mix design haven't changed.
 - Blend **changes typically are made on the basis of the component gradations** used in the mix design. The aggregate products being made for the project are usually tested, but the not the aggregate gradations in the working faces of the stockpiles (should be checked daily)....don't assume check

50

Thoughts from Erv Dukatz

The rule:

A rock, is a rock, is a rock
is a rock, is a rock, is a rock,

...except when it's not!

50

Thoughts from Erv Dukatz

- What I have discovered over and over again, especially when using a new process/test procedure, and so forth, is that the **basics are forgotten**
- Check type of aggregate. **Not all limestones have the same properties**, as not all hard rocks are not the same even with the same gradation, and soft rocks perform differently than hard rocks. "Don't assume a rock is rock."
- One final thought, $P_{b, \text{beff}}$ is what holds the mix together. The difference between $P_b - P_{\text{beff}}$ is filler

"What gets measured gets managed." Peter Drucker

53

Thoughts from Erv Dukatz

- My thoughts on aggregate which I think are especially important for BMD start with **never assuming the aggregate you have is the same as the aggregate you worked with on your last mix design**, especially if there is any time between designs.
- The first test is one most often neglected is the color test, has the aggregate changed colors between samples
 - The difference could be as simple as one sample is drier than another, or could be an indication of physical change. Test each sample for physical properties - **Determine the reason**. Limestone can vary much depending on which side of a joint/fault is sampled.

54





BATT
BLANKENSHIP
ASPHALT TECH & TRAINING
Lab-to-Pavement Innovation

Q&A

Phillip Blankenship, PE, MSCE

Blankenship Asphalt Tech and Training

Phil@BlankenshipAsphaltTech.com
www.BlankenshipAsphaltTech.com






www.linkedin.com/company/batt-lab/




www.s.com/BATT_Lab



FINAL THOUGHTS

1. **Sedimentary aggs that produce dust** look poor with 4% voids designs but may be able to improve if we design at lower air voids.
 - Why is this important? With the **extra handcuffs** of trying to meet air voids with dust limitations, The extra handcuffs cause issues for contractors, trying to obtain passing CT and HWT data.

55




FINAL THOUGHTS

2. If we plan to implement performance-based specifications/BMD, specifying agencies need to be **willing to review exceptions on a case-by-case basis**, especially where **performance** criteria are met, and volumetric criteria are not
3. We all must be willing to **accept mixtures that fail our past assumptions** of volumetrics when passing performance criteria
4. Volumetrics has been a very **good teacher** to get us where we are today, but will limit us on our potential to innovate and design, sustainable pavement
 - **Rely on BMD/end-result testing**

56

Notes from Erv Dukatz



- Wonderful KY aggregate. I once told Vulcan Sr. Mgmt the best option was before the state spec'd out all limestones. The problem then was a combination of high sulfate soundness loss that was a characteristic of very soft limestone. Very poor performance on the interstate.
- As for aggregate, my favorite is traprock. First problem with quartz and some granites is stripping and polishing. Some of the best performing SMA mixes I've designed have been with limestone/dolomites. The key is competent aggregates and dust of fracture (no silt) and knowing optimal BMD values for the aggregate source. That said, it is key to know that really great limestone (DCT = >400) will not achieve the same high test result numbers as a really good hard traprock or granite (DCT > 600) in some cracking tests, but will equal or exceed the in-place pavement performance. Then, as mentioned in the previous email, some granites are good and those with physical properties like limestone make really poor aggregates.
- MI and WI have adopted regression to use the volumetric data from a 4% mix design to determine the higher asphalt content needed to achieve 3% production air voids.
- Some crushed gravel works well to clean up the mix, as will some clean silica sand, as long as you keep the mix FAA > 40%.

57