

Improving Transportation Products with Coal Combustion Products



FHWA/IRC Webinar
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American Coal Ash Association 


American Coal Ash Association

- Founded in 1968
- Mission: Encourage the beneficial use of coal combustion products in ways that are protective of the environment, technically appropriate, commercially competitive, and supportive of a more sustainable society.

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Coal Combustion Products

- Also known as coal combustion residuals, coal combustion byproducts, coal combustion wastes, et al
- Byproduct of combusting coal for power generation
- Second largest waste stream in the US; in 2012 110 million tons generated

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Major CCP Types

- Fly ash – raw feed in cement manufacture; supplementary cementitious material; base material
- Bottom ash – base material
- Synthetic gypsum – cement manufacture
- Boiler slag – not used in transportation

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Base Materials – Fly Ash

- Fly ash commonly used to strengthen or stabilize base materials
- Class F fly ash must be blended with portland cement or lime to initiate pozzolanic activity
- Class C fly ash has a higher CaO content and is self-cementing



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Base Materials – Bottom Ash

- Coarser than fly ash
- Can be used by itself or combined with an activator – Class C fly ash, portland cement, or lime
- Used in base construction, embankments, structural fills



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- Controlled low strength materials
- “Flowable fills”
- Fly ash (Class C and Class F)
- Non specification materials ok
- Flexibility in design
- Used mostly in special applications



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Considerations

- Design and sustainability objectives
- Available materials – non-specification fly ashes are acceptable
- Logistics
- Contractor capability/experience
- Schedule
- Environmental



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Dual layer pavements

- Not a new concept – widely used in Europe
- Bottom layer contains lower grade materials
- Upper layer contains “premium” grade materials and/or higher strength materials



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Recycled materials below

- Base layer may contain high volumes of recycled materials including fly ash and recycled aggregates
- Contractor can elect to pave in a conventional manner or use roller compacted concrete techniques
- Base may be topped with concrete or asphalt



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Advantages

- Use of high quality, more costly materials where the most stress occurs
- QC/QA focus is on the wearing course
- A more sustainable design approach – less virgin material used, lower carbon foot print, less waste to landfills



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High Performance Concretes

- What does “high performance” mean?
- Compressive/flexural strength?
- Reduced permeability?
- Reduced shrinkage?
- Reduced cracking?
- Reduced curling?
- ASR mitigation?



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SCMs are Vital

- Fly ash, slag cement, silica fume, metakaolin, natural pozzolans are necessary to achieve high performance
- Availability varies
- More fly ash is available than all the others combined
- Ternary mixes offer even more benefits



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Public Enemy #1 - ASR

- Class F fly ash best option for mitigation
- Class C fly ash works too – if you use enough
- Other options expensive – import aggregates?
- Objective – lower alkali level in concrete matrix or eliminate reactivity



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Strength and Permeability

- Fly ash contributes to long-term compressive and flexural strength development
- Fly ash reduces permeability
- Ternary mixes offer even greater improvements



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Shrinkage and Cracking

- Supplementing portland cement with fly ash will slow volume change resulting in less shrinkage and cracking.
- Both Class C and Class F fly ashes will provide this benefit.
- Ternary mixes offer even more improvement.



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Some Benefits of HPC

- SCMs used to optimize portland cement performance not simply to replace
- Improved performance life
- Less maintenance
- Reduced GHG from cement production by using fly ash in portland cement mixes: 1 ton for 1 ton.



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The future for fly ash

- Coal-fired power generation is not going away
- Plant closures have been anticipated
- Natural gas is gaining
- Utilities must keep balance in their portfolio



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More on the future

- The number of sources will be reduced
- **Some markets will have fewer choices**
- Logistics will cause price increases
- **The characteristics of some ashes will change due to EPA regulations**
- Ash specifications may be more performance based



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Finally...

- **Beneficiation** technologies are moving forward quickly
- **Reclaiming** ash from wet and dry disposal is a hot topic
- **Research** has verified the value



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