Establishing a Baseline of Knowledge (thru 2005) by Reviewing AI IS-220, “Polyphosphoric Acid Modification of Asphalt”

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Outline of IS – 220
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• Introduction
• AI’s Position
• What is PPA
• Review of History and Literature
• PPA Modification in Asphalt
• FAQs
• Recommended Practices and Testing
Purpose: Clarify issues regarding PPA modification and to help agencies make informed decisions

Not a promotional piece

Developed through AI’s Technical Advisory Committee and Affiliate Committee by member reps
AI’s Position on Modification and PPA

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• Test modified binder after all additions
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• Answer: purified phosphoric acid, which is an orthophosphoric acid and not recommended for asphalt modification
What is PPA?

- NOT purified phosphoric acid or orthophosphoric acid
- Is a liquid mineral polymer
What is PPA?

• Used industrially for it’s dehydrating and catalytic properties

• Major Applications
  – Surfactant production
  – Water treatment
  – Pharmaceutical synthesis
  – Pigment production
  – Flame proofing
  – Metal finishing
  – Asphalt modification
What is PPA?

- Major Differences Between PPA and Orthophosphoric Acid
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    • Different CAS numbers (unique chemical identifier)
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  - PPA has greater density and higher viscosity
  - PPA has no free water while Ortho Acid has 15% water
    - Total miscibility (mixing ability) with asphalt
    - Significantly lower corrosivity for steel and stainless steel
• Seven Patents found on PPA Modification of Asphalt
  – 1973
    • Chemically modified asphalt
  – 1999 - 2002 (Five Patents)
    • Polymer modified asphalt
  – 2004
    • Crumb rubber modified asphalt
Review of History and Literature (through July, 2005)

- Eight published papers between 2001 and 2005 synopsized in IS-220
- Presentations during same timeframe are also summarized
- Conclusions that follow are based on these
PPA Modification in Asphalt

• PPA can be effective and economical tool for chemical modification, used alone or in conjunction with a polymer
• PPA can improve high-temp PG grade, and with some asphalt sources may slightly improve low-temp PG grade
• Does not oxidize asphalt or lower m-value
• Two main chemical reactions
  – Phosphate ester formation (irreversible reaction)
  – Acid-basic neutralization (partially reversible)
PPA Modification in Asphalt

- When used with polymer, PPA provides flexibility in reaching specified DSR and ER criteria while limiting viscosity increase @ 275°F
- For acidic aggregates such as granite, PPA can enhance moisture resistance of mix to where an anti-strip may not be necessary
- When an antistrip additive is used, a neutralization reaction may occur (depends of nature of asphalt, aggregate and antistrip). If so, then a partial loss of binder stiffness will result without loss of adhesion properties
Q: Does PPA work equally well in all asphalts?
A: No. Interactions dependent on asphalt chemistry. Formulator responsibility.
Frequently Asked Questions

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Q: Are there antistrips that will interfere with PPA modification?
A: Yes. Under certain conditions, PPA may react with certain antistrips leading to partial decrease of high-temp PG improvement from PPA modification. Antistrip function is not inhibited. Correct formulation necessary.
Q: Is there a type of antistrip that can be used with PPA modified binder that will not inhibit gains from PPA?
A: Yes. Phosphate esters don’t react with PPA. They are effective antistrips in both neat and PPA modified binders.
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Q: Are there storage or corrosive issues with PPA binders?
A: No. PPA totally miscible in asphalt and should not separate. Also, no difference in corrosivity between neat asphalts versus those with 1-2% PPA. Raw PPA is corrosive however.
Recommended Practices by Manufacturers

- Asphalt manufacturers using PPA must do so responsibly:
  - Careful formulation to ensure appropriate dosage based on type of asphalt
  - Ensure compatibility with antistrip additives
  - Good communication with contractor regarding potential use of amine-based antistrip
  - PPA as a raw material is corrosive, so follow MSDS info.
Recommended Testing by Agencies

• Specifiers and agencies can help ensure responsible use of PPA by conducting:
  – PG Plus binder test (i.e. ER) to ensure presence of polymer when one is required
  – DSR testing to check for compatibility of PPA with amine-based antistrips before and after antistrip is added.
  – Mix performance tests to evaluate moisture susceptibility (T-283, wheel tracking under water) with all additives included.
Final Thought

• In the next day and a half, it will be interesting to observe:
  – How far we have come in the last 4 years in furthering our knowledge of PPA modification of asphalt
  – How many of the issues and questions on this topic that existed 4 years ago are still present today
Current AI Members, April 2009
Questions?

Reminder: I’m not a chemist