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

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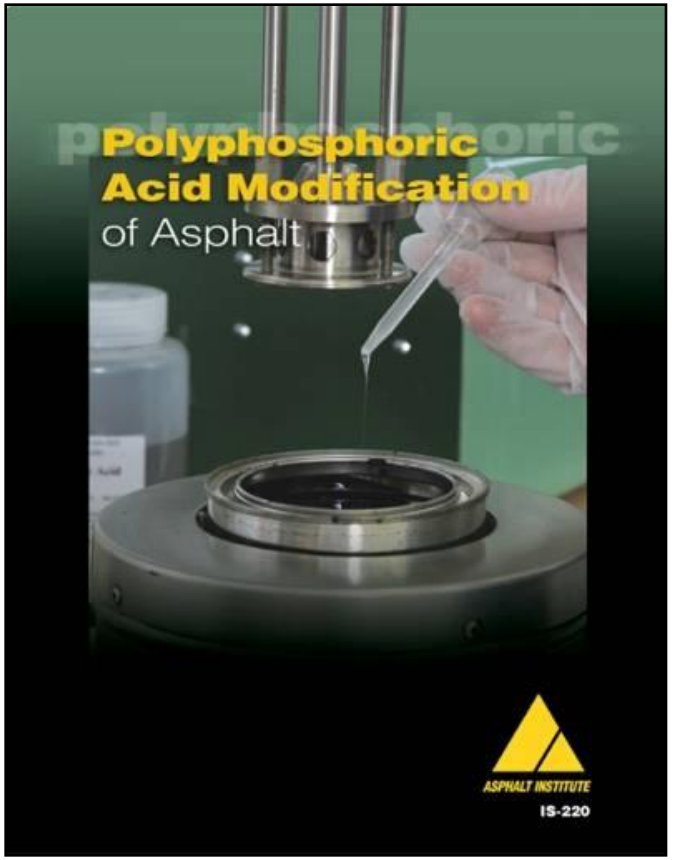
Outline of IS – 220
Published in July 2005

- Introduction
- AI's Position
- What is PPA
- Review of History and Literature
- PPA Modification in Asphalt
- FAQs
- Recommended Practices and Testing



Introduction (in IS – 220)

- 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

asphalt institute

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- Continue developing performance-related specs
- Test modified binder after all additions

Trivia Question?

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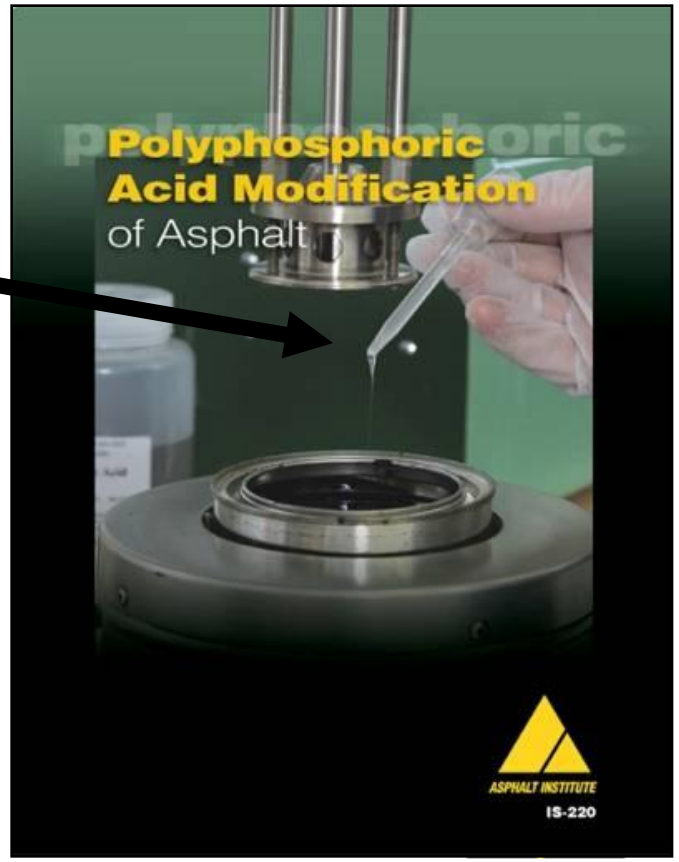
- Another name for PPA besides polyphosphoric acid???
- Answer: purified phosphoric acid, which is an orthophosphoric acid and not recommended for asphalt modification

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

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  - $H_{n+2}P_nO_{3n+1}$ versus H_3PO_4
    - Different CAS numbers (unique chemical identifier)
  - 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

Review of History and Literature
(through July, 2005)

- 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 @ 275ºF
- 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

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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

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Q: Is there a type of antistrip that can be used with PPA modified binder that will not inhibit gains from PPA?

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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

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Questions?

Reminder: I'm not a chemist