
What's in Your Binder? And What Happened Last Summer With This Shortage?

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Producers**



I was also asked to mention...

- **What would effect availability of AC next year?**
 - Hopefully nothing will effect supply next year.
 - The world economy will not shock the financial markets—we have been shocked already
 - If anything effects availability, it would be
 - OPEC dramatically lowering production
 - Extended war or terror activities
 - Low fuel prices
- **How does addition of cokers effect asphalt supply?**
 - We will talk about that
- **What do different crudes mean to asphalt supply?**
 - We will talk about that also



What's in your binder?

- **Depends on:**
 - PG Grade
 - Crude source
 - Anti-strip additives
 - Supplier
 - Haulers/truckers
 - Modifier (if modified)
 - Cross linking agents



What's in your binder?

– PG Grade

- Crude source
- Anti-strip additives
- Supplier
 - Haulers/truckers
- Modifier (if modified)
 - Cross linking agents

- Generally speaking, PG grades with a performance temperature “window” of 86 degrees Celsius or less, will be a neat asphalt.
- Some “robust” asphalt binders such as PG 70-22 can still be neat.
- To obtain the higher performance temperature windows, the supplier will modify the neat asphalt in some way



Crude Source and Asphaltenes

- **All Crudes Are Not Equal-**
- **One difference is % of asphaltenes**
 - In the past, neat AC's high in asphaltenes were considered best for paving. However, when producing modified binders, a high asphaltene content of 30% or more is less desirable due to less compatibility between the neat asphalt and Styrene/Butadiene modifiers
 - In Illinois, you are getting asphalts supplied to your refiner from Canada, Mexico, US and South America
 - Your refiner knows the nature and chemistry of each of its sources and produces asphalt to the state specs



Crude Sources, continued

- **The source of the crude and how it effects the binder is important but....**
 - Refineries are built to run certain type crudes
 - Refineries operate principally to manufacture fuels, not asphalt
 - It makes sense that the oil companies are going to try to refine the crude oil offering more fuel without regard to asphalt byproducts
 - Most refineries receive their crude from pipelines from many different oil fields, but know the nature and chemistry of each crude source
- **The asphalt supplier must produce a binder that is within the state specifications**



Cokers from Richard Holmgreen, ConocoPhillips

- **Cokers reduce the amount of asphalt that will be made**
- **The economy will dictate asphalt production**
 - Price of fuels
 - Healthy profits in fuels will cause refineries to run at efficiencies that may “overrun” a coker and that will add asphalt to the market
 - Low profits cause refineries to slow production—less asphalt but demand unchanged
 - Some companies that utilize cokers at the refinery also continue to manufacture asphalt
- **Having said all that, “Our industry is as uncertain as I have ever seen it in my 40 plus years.”**



What's in your binder?

- PG Grade
- **Anti-strip additives**
- Crude source
- Supplier
 - Haulers/truckers
- Modifier (if modified)
 - Cross linking agents

▪ **Anti-strip agents**

are surfactants capable of modifying the interfacial aggregate to bitumen

They must satisfy three requirements

- To improve adhesion
- To be heat stable
- Must not change the performance of the binder (change PG grade)



Anti-Strip Agents

- **From Institute of Scientific Technology, French Study**
 - For polymer-modified asphalt mixtures, increasing the dosage of liquid anti-strip additives did not improve resistance to moisture susceptibility. On the basis of the investigation, lower dosages of liquid anti-strip additives are recommended for polymer-modified asphalts than would be required for straight asphalts



Supplier

- PG Grade
 - Crude source
 - Anti-strip additives
 - **Supplier**
 - Haulers/truckers
 - Modifier (if modified)
 - Cross linking agents
- **Supplier must produce to the specifications and**
 - Will choose its own modifier
 - Have rheology lab and pass various agency specifications
 - Have adequate and proper storage
 - Provide proper heat to finished products
 - Have proper screens and filters in piping



Haulers/truckers

- **Tanker transport trucks moving binder from refinery/supplier to plant must be monitored**
 - To check what material was in the tanker prior to loading the binder
 - ACs on top of emulsions—temperature and water
 - Cutbacks leaving residue on side of tanker
 - To insure there is no material left in the tanker from last load
 - A 5,000 gallon load of PG 82-22 on top of 2-3 inches of left over PG 64-22 from last load will probably put the entire load out of spec.



What's in your binder?

- PG Grade
 - Anti-strip additives
 - Crude source
 - Supplier
 - Haulers/truckers
 - **Modifier (if modified)**
 - **Cross linking agents**
- Generally speaking, most modified asphalt binders are modified with a styrene-butadiene type rubber
 - Cross-linking agents
 - But this category of modifier is not the only modifier that can be used
 - This past summer, there was a serious shortage of SBS modifiers—and it could happen again
 - Here is what you need to know about the shortages



Why was SBS in Short Supply?

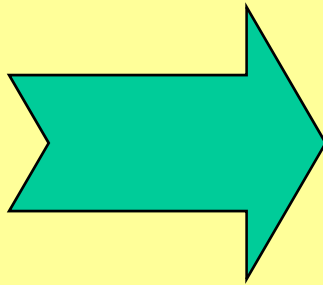


- **Styrene-Butadiene-Styrene (SBS) polymer capacity is not short**
- **Shortage of raw materials**
- **Ethylene production is the problem**



Why is Ethylene Production the Problem?

Ethylene



- **By-products of Ethylene Production**

- Styrene
- Propylene
- **Butadiene**
- Isoprene
- Pentadiene
- Cyclopentadienes
- Aromatic Resin Formers
- Isobutylene
- Amylenes
- Hydrogen
- Benzene



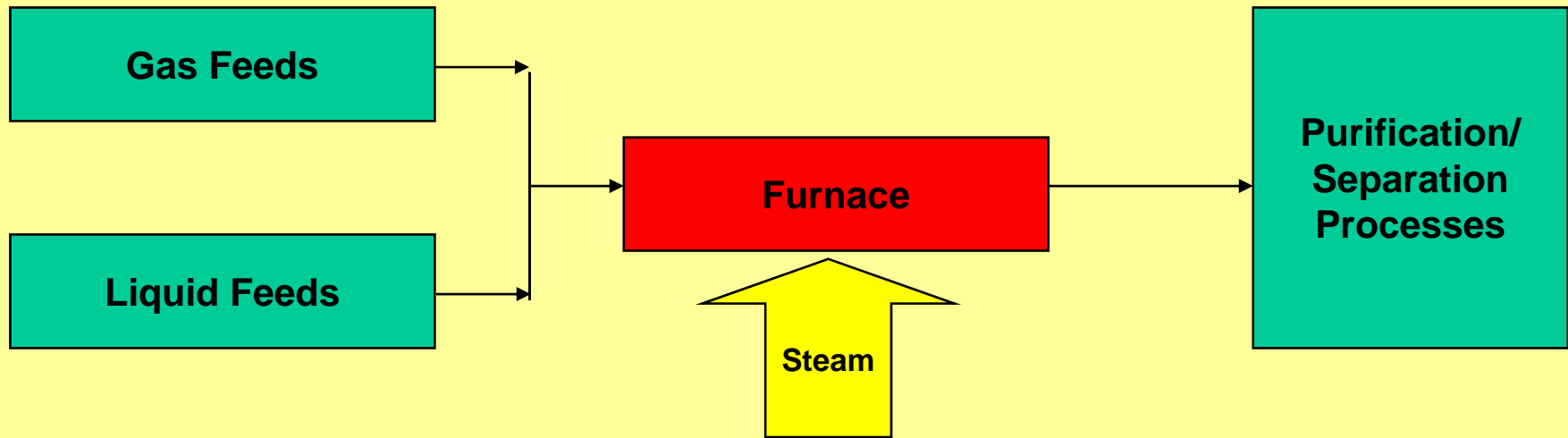
Ethylene & Butadiene Market Comparison



- **Ethylene Market**
 - 120 million tons per year
 - Primary use – packaging materials
 - Plastic wrap
 - Trash bags
 - Milk jugs
- **Butadiene Market**
 - 14 million tons per year
 - Primary use – tires (70%)
 - Multiple other automotive and durable good uses
 - SBS polymer for asphalt (6%)



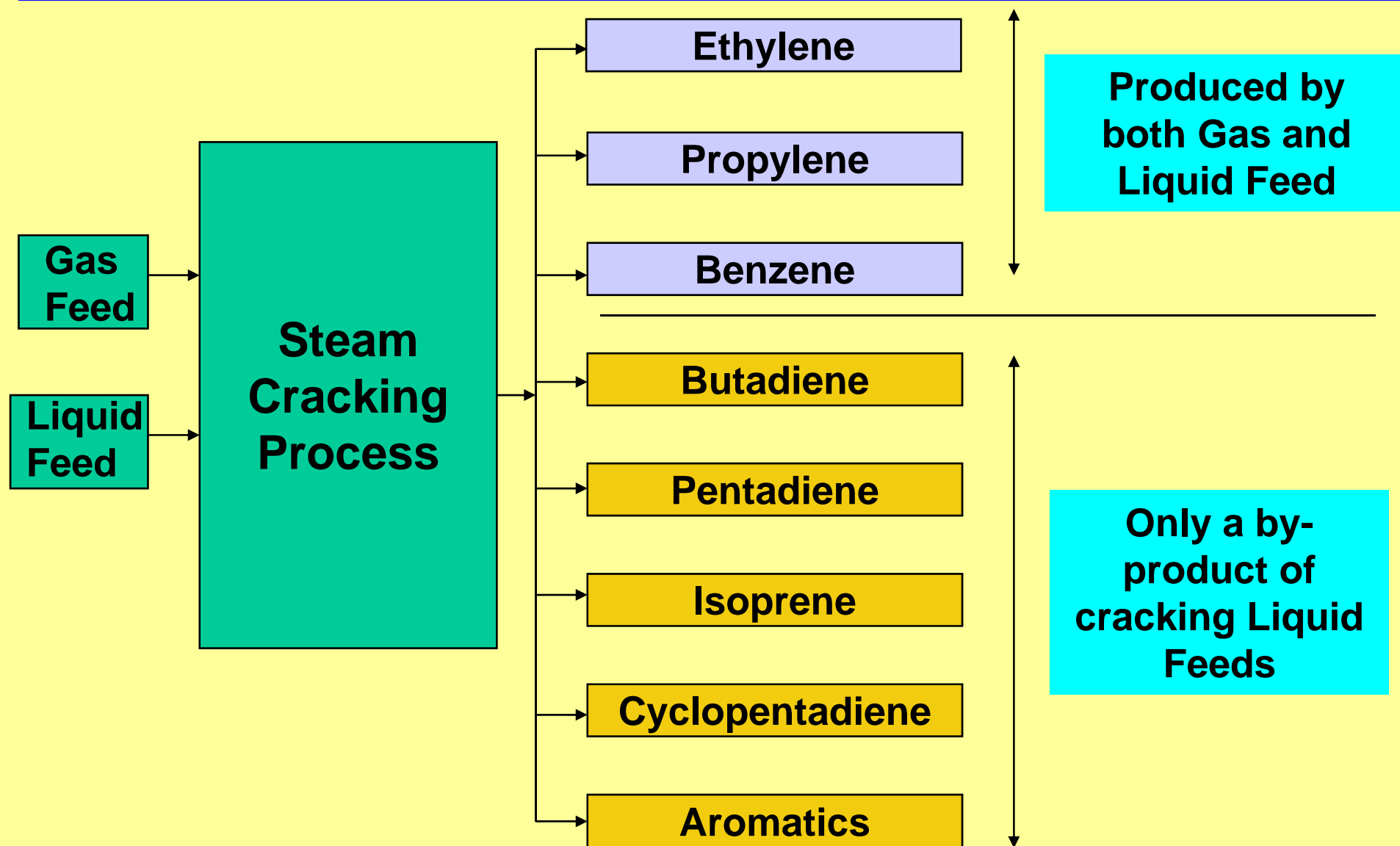
How Is Ethylene Made?



- Basic ethylene production technology is called a steam cracking process
 - Process heats feed up to 1700 degrees, then injects steam that cracks the molecules
 - Cracker unit cost \$2 billion
- Choice between gas feeds like ethane, propane and butane and liquid feeds like naphtha and gas oils.
- Output is a mixture of ethylene and other products
- Requires a downstream purification processes to separate products



What's Important to Know About Ethylene Production



Ethylene General Trends

- **Significant ethylene capacity additions in Middle East and Asia**
 - Most of the Middle East is gas cracking
 - Most of Asia is liquid or naphtha cracking
- **Little to no capacity additions in Western World**
- **Naphtha is short globally and expected to be priced higher like gasoline until more refineries are built ~2012**
- **New trend for ethylene units outside of US to be more flexible to be able to run more gas feeds**
 - Historically have been naphtha crackers
- **Expect more flexible cracking; hence, more variable Butadiene supply**



Butadiene (Bd) Supply

- **Globally tight due to lighter cracking and higher demand**
 - 2008 Bd supply estimated at 75-85% of 2007
- **New Bd and ethylene capacity due on-stream in Asia**
- **Expected capacity utilization to be lower than 90% for the foreseeable future**
- **Regional differences**
 - US crude Bd supply tight due to light cracking in first half
 - US has excess purification capacity and buys crude Bd from Europe to fill capacity
 - Europe tight on supply due to somewhat lighter cracking; thus, less crude Bd to export to US
 - New Asian capacity needs to catch-up with demand



What Factors Will Influence Supply?

Positive

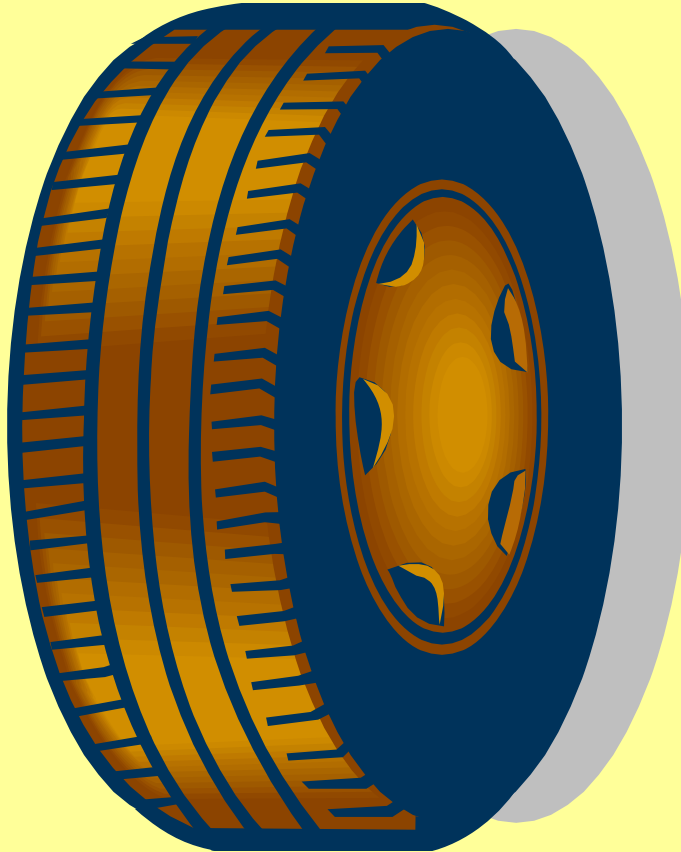
- **New capacity**
- **Bd pricing itself out of some applications**
- **High gas prices:**
 - Less driving mean fewer replacement tires
 - Smaller vehicles/smaller new car tires
- **Slowing economy; less growth**

Negative

- **Higher natural rubber prices driving consumers to synthetic rubbers based on Bd**
- **Lighter cracking**
 - Higher naphtha prices
 - Structural change in US ethane market
- **Low cost gas-based ethylene capacity coming on-stream in Middle East.**



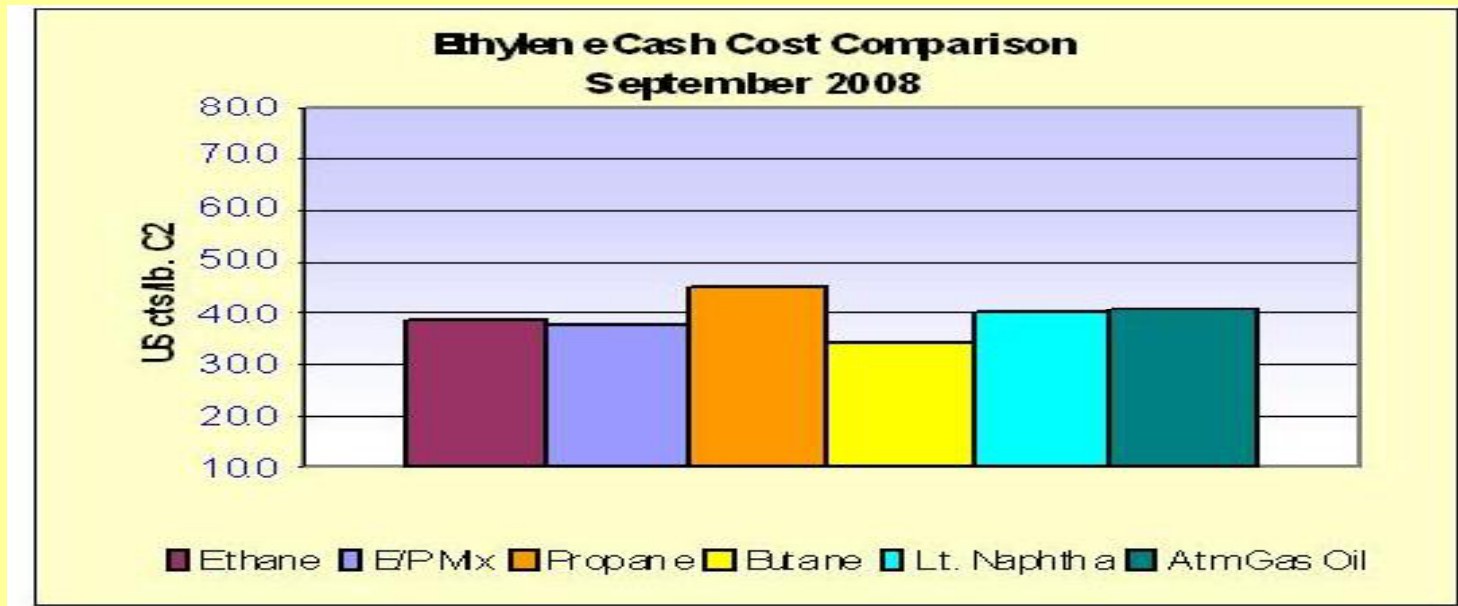
Tire Demand Data



- **New Tire Demand**
 - June vehicle production down 8% and falling
 - Vehicle production skewed towards smaller vehicles
 - Tire demand could be down over 12%
- **Replacement Tires**
 - Higher gas prices are reducing miles driven
 - Expect reduced tire demand over time
 - May take 3-6 months to play out.



Changes in past 3 months



- **Hurricanes Gustav and Ike – temporarily shut down Gulf Coast crackers**
 - Expected Bd price increase of \$0.10 per lb
 - Reduced demand caused spike of only \$0.04 per lb
- **Crackers are back on line, but tire compound plants are not**
- **Tire Demand is way down – Frees up Butadiene supply for SBS**
 - Result – 100% Bd available to SBS producers for now
 - SBS suppliers will be able to build up substantial inventory this winter



Alternatives to SBS Polymer



- **SBS polymer-modified
asphalts are typically cross-
linked systems**
 - **Contractor friendly**
 - Terminal blend supply
 - Do not require agitation
 - Storage stable
 - No major changes to HMA
plant operation
 - No major changes to HMA
laydown and compaction
- **Alternative modification
systems need to exhibit
similar qualities**



Alternatives to SBS Polymer



- **SBR Latex – butadiene based polymer that is not in short supply at this time**
 - Not storage stable
 - Must be blended at HMA plant which means rheology labs at the plant
- **Non- butadiene polymers**
 - Reactive Ethylene Terpolymer (Elvaloy)
 - Ethyl Vinyl Acetate (EVA)
 - Used in warm climates
 - Blended with SBS in cold climates
- **Polyphosphoric Acid (PPA)**
 - An extender, not an alternative
 - Can be blended with SBS to reduce SBS content

Alternatives to SBS Polymer

- **Ground Tire Rubber (GTR) – wet process**
 - 15-20% GTR melted and swelled into asphalt
 - No cross-linking occurs
 - Not storage stable
 - Not a terminal blend process
 - AR binder cannot be PG graded in a meaningful way



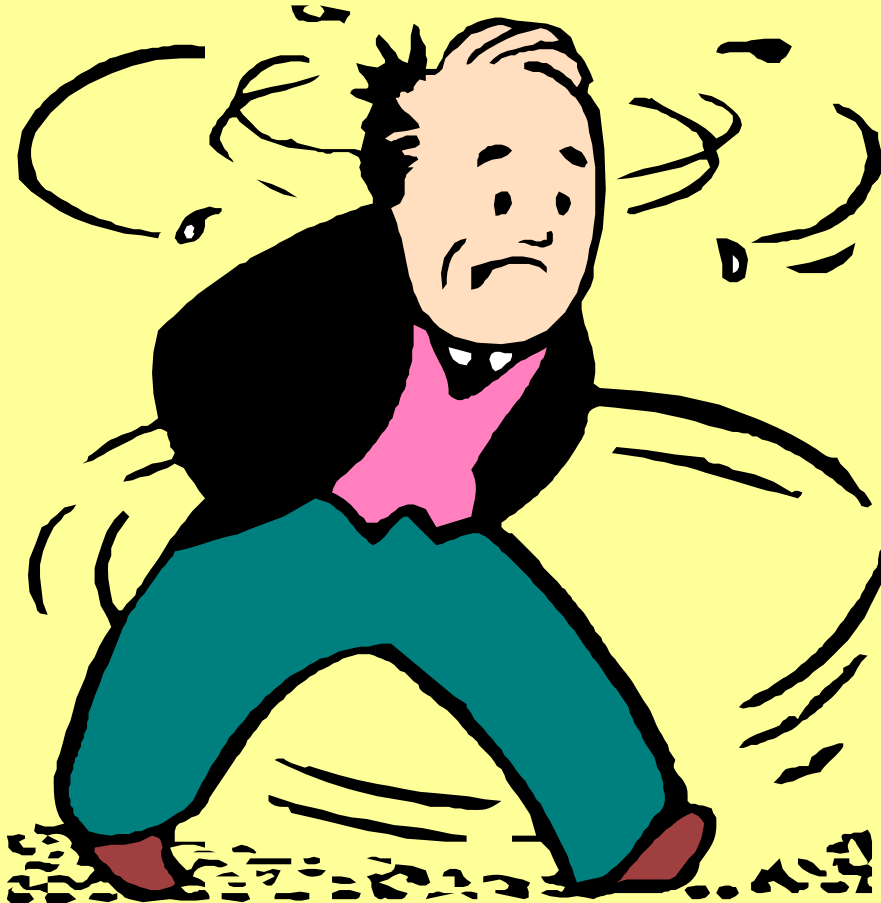
Alternatives to SBS Polymer

- **Hybrid Binders**

- Blend of SBS and GTR
- Cross-linked system
- Storage stable
- Terminal blend system
- Current research sponsored by FL DOT at University of Florida



Alternatives to SBS Polymer



- **‘NOTHING’ is not an option**
 - PG Grading system is based on climate and traffic
 - Using the wrong grade will lead to poor performance
 - We have enough historical data to prove that PMA does improve pavement performance
 - Flexibility and creativity are needed to come up with answers



What's in your binder?

- **Performance!!**



Questions?



AMAP's 10th Annual Conference

- Considered by many to be the most informative meeting about modified binders in the world
- February 9th, 2009—Modified binders and emulsion workshop from 1:00 pm to 6 pm
- February 10th and 11th, General Session with excellent agenda
- Venue: Hilton Sedona Resort and SPA, Sedona, AZ
- For information—website: www.modifiedasphalt.org





DON'T SHOOT THE MESSENGER

