SBS Supply Outlook

Rocky Mountain Pavement Preservation Partnership
October 29, 2008

Presented by: The Association of Modified Asphalt Producers
Why is SBS Currently 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?

- 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

Steam Cracking Process

- Ethylene
- Propylene
- Benzene
  - Butadiene
  - Pentadiene
  - Isoprene
  - Cyclopentadiene
  - Aromatics

Produced by both Gas and Liquid Feed

Only a by-product of cracking Liquid Feeds

Gas Feed

Liquid Feed
Choosing Feeds to Produce Ethylene

- Each producer runs an economic model
- Feed availability and costs for the producer at their location
  - Yield of each feed – varies considerably
  - Demand for each product
  - Alternatives to buy versus make that product
- Ethylene and propylene are the prime products
  - Evaluate netback of all products
  - Liquid feeds generally produce 15:1 ethylene to butadiene
  - Economic impact of butadiene is not large
  - Based on the conditions producers set a feed slate for the “Cracker”
  - Butadiene shortage is not a primary consideration for feed slate
- Liquids are always in the slate due to the facilities being built to be liquid crackers
- Crackers modified in the 80’s to be flexible
- Flexibility depends on producer, but varies from ~10% to ~50%
- Producing 3-5 million pounds a day a few pennies makes a big difference
What’s Changed

- Structural change - natural gas producers installed facilities to separate ethane
  - Ethane higher value than natural gas
- Ethane prices didn’t increase with the crude oil run-up
- Economic incentive to run more ethane feed
DeWitt estimates that the 1Q cracking slate went 10% lighter vs 2007 starting in February

2Q2008 slate has moved even lighter; possibly another 10-20%

Incentives so great that teams of engineers are working on putting more gas into the cracking slate on a crash basis
Ethylene Cash Costs, c/lb

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- Var Cost
- Fixed Cost
- M&A, Distr
- C2 Prc
Supply Issues Today

- Naphtha (liquid) cracking economics have improved, while ethane (gas) gotten worse.
- Ethylene producers have chosen to crack less ethane and more propane and butane for now – replaced gas with gas.
- Propane makes sense as it has a higher yield of propylene, which is short.
- Slowing economy raises the spector of less ethylene production.
- Next month?
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 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
North American Butadiene Consumption

- SBS (For Asphalt) 6%
- Nitrile Butadiene Rubber 3%
- Acrylonitrile Butadiene Styrene 5%
- Adiponitrile 13%
- Other 3%
- Poly Butadiene Rubber 28%
- Poly-chloroprene Rubber 2%
- SBR (crumb form) 28%
- SBR Latex 12%
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.
October 2008

- Spread between gas and liquid feeds now down to $.05
- Demand is shrinking – tire demand is down
  - Asian market price drop of $0.10 - $0.15 per lb
October 2008

- Hurricane 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
  - Result – 100% Bd available to SBS producers for now
  - SBS suppliers may 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

- Non- butadiene polymers
  - Reacted 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
DON’T SHOOT THE MESSENGER
Questions?