The Association of Modified Asphalt Producers

SBS Polymer Supply Outlook

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Introduction

There is a current shortage of styrene-butadiene polymers for the asphalt industry. The shortage involves a variety of polymers, including linear and radial SBS polymers, and diblock SB polymers. These will all be abbreviated below as 'SBS'.

AMAP has, with the help of De Witt and Company, investigated this issue and has written this paper in an effort to explain the current SBS polymer supply shortage and to provide some outlook for future supply. The intent of this paper is to help the HMA industry understand the situation and to cope with it.

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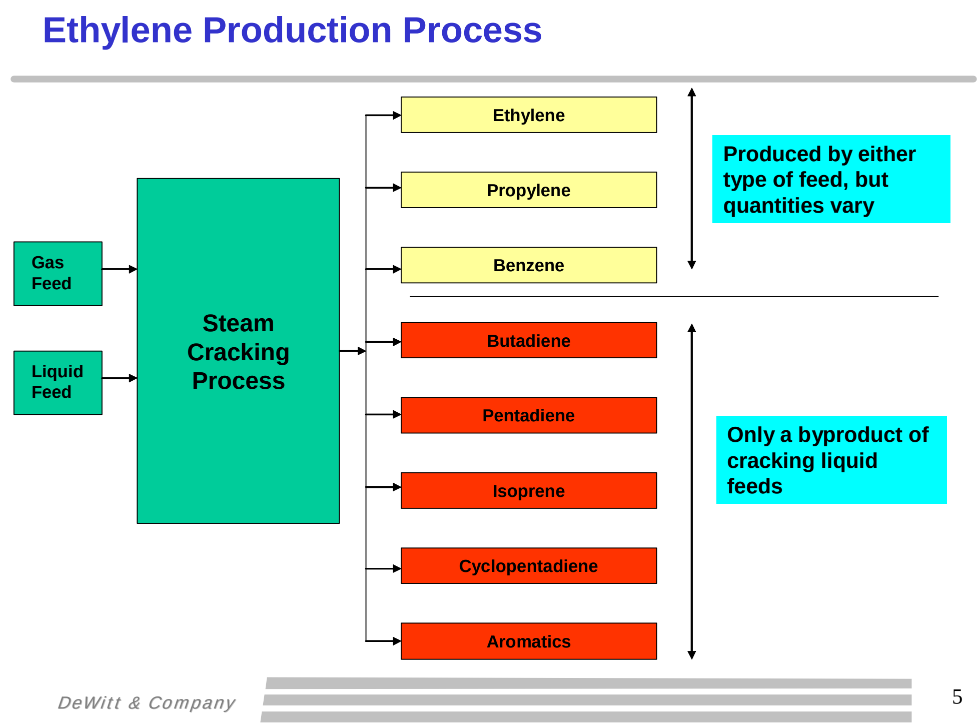
Background

In order to understand the problem with SBS polymer shortages, it is critical that we first understand the supply chain. The proximate reason for shortage of SBS polymer is shortage of butadiene. Butadiene is not produced on purpose, but is a by-product of the production of ethylene. Many chemicals, including styrene and butadiene – the two basic building blocks for SBS polymers – are obtained as by-products from ethylene production.

Ethylene is made via a steam cracking process, and it is one of the many products resulting from the process. Operators of these "crackers" can either feed a gas such as ethane, butane and propane or can feed a liquid petroleum product such as gas oil or naphtha into the process as the raw material. As the chart below shows, ethylene, propylene and benzene can be produced from either gas or liquid feed. However, butadiene and the other chemicals appearing in the flow diagram beneath the butadiene are produced *only* as a byproduct of cracking liquid feeds.



Cracker operators use economic models to determine the feed slate. Gas feeds, especially ethane, have been less costly than liquid feeds in early 2008. The cost to produce a pound of ethylene in May 2008 using ethane feed was $.50 compared to a cost of $.70 per pound when feeding naphtha. As a result, cracker operators are running more gas feeds and producing lees butadiene. The cracking slate moved 10% towards lighter products in the 1st quarter of 2008 and has been projected to continue this move in the second quarter. Incentives to continue to move to lighter products continue to be great, and processors are working to put more gas into the cracking slate on a crash basis. Lighter feed slates result in less butadiene production. Butadiene production in 2008 is projected to be approximately 70-75% of 2007 production.

General trends in the ethylene market are as follows:

- The worldwide ethylene market is 120 million tons per year
- The primary use for ethylene is product packaging
- There are scheduled significant ethylene capacity additions in the Middle East. Most of the Middle East is gas cracking (no additional butadiene)
- There are new crackers being built in Asia. Most of the new capacity in Asia is liquid, or naphtha cracking.
- There is scheduled little or no capacity expansion in the West.
- Naphtha is short globally, and expected to carry higher prices until new refinery capacity in Asia and the Middle East comes on stream, around 2012.

- New cracking units are tending towards greater flexibility, i.e., able to handle both gas and liquid feed. This will lead to less predictable butadiene supply.

General trends in the butadiene market are as follows:

- The worldwide butadiene market is 14 million tons per year
- The primary use of butadiene is in tires (70%)
- SB and SBS polymer for asphalt modification accounts for 6% of butadiene usage
- US crude butadiene supply is tight due to light cracking in 1st half of 2008.
- US has excess purification capacity and buys crude butadiene from Europe to fill capacity.
- Europe is tight on supply due to lighter cracking, resulting in less crude butadiene to export to the US.
- Asia has a high demand growth and a light cracking slate.
- New Asian capacity needs to catch up with demand.

Conclusions

A number of factors will influence future butadiene supply. Negative factors influencing future butadiene supply are as follows:

- Lighter cracking will lead to more production flexibility and potentially less butadiene productions.
- Low cost, gas-based ethylene cracking capacity in the Middle East will result in no net additional butadiene availability.
- Higher naphtha prices and structural changes in the US ethane market will lead the industry to lighter cracking and lessened butadiene availability.

Positive factors influencing increased butadiene production are listed as follows:

- New butadiene capacity in Asia will bring some relief.
- Higher butadiene prices will drive butadiene out of some applications, thus easing supply problems.
- High gasoline prices and a slowing economy will reduce demand for new vehicles and new tires. High gasoline prices are also shifting vehicle sales away from trucks and SUVs to smaller, more fuel efficient cars. These small cars will require smaller tires, thus reducing butadiene demand. Car sales in July 2008 are down 20% compared to July 2007. The shift to smaller tires should reduce butadiene demand even more. It will take time for the reduced demand to work its way up the supply chain, but in time it will provide additional butadiene to the asphalt market.

The costs of gas and liquid feeds for crackers are subject to change rapidly as the price of crude oil fluctuates. The cost of ethane rose to a level equal to the cost of naphtha in July 2008, but the cost of propane remains significantly less. It is extremely difficult to predict relative cracker feed costs and, therefore, difficult to predict butadiene supply, but it does not appear that this is a short-term issue that will quickly dissipate. While no one is able to predict what will happen with any reasonable degree of certainty, prudent planners should be working on the basis that availability of SBS polymers will remain tight for the immediate future.

AMAP suggests the following list of modifiers as possible alternatives to SBS polymers during this supply shortage:

- Styrene Butadiene Latex - SBR latex has been used extensively in the paving industry as an elastomeric modifier for asphalt, and although it has similar elemental chemical composition to SBS, it is not currently suffering from such a severe shortage.
- Natural latex
- Reacted Ethylene Terpolymer (Elvaloy)
- Ethyl Vinyl Acetate (EVA) – EVA modified asphalt can be subject to cracking in cold-weather climates. It can be used alone successfully as a modifier in warm climates or it can be blended with SBS to provide reasonable cracking performance in cold weather.
- Ground Tire Rubber (GTR) – the wet process is a recipe specification that adds 20% GTR to asphalt and allows it to melt and swell. However, no cross-linking occurs and the binder is not storage stable. It should also be noted that the rubber particles in this material prevent a meaningful PG grading in the Dynamic Shear Rheometer.
- Hybrid Binders – the SBS supply can be extended by blending SBS with GTR to produce cross-linked storage stable polymer-modified asphalt
- Polyphosphoric Acid (PPA) - PPA has been used successfully as a co-modifier/extender in conjunction with SBS polymer