Understanding Polyurethane Foam Price Increases
Agenda

- Components of Polyurethane Foam
- Dependence on Oil & Natural Gas
- Background on Step Change
- Impact on PU Foam Raw Materials:
  - Polyols Overview
  - TDI Overview
  - Other Cost Factors Overview
- Renewable Alternatives?
- Working Together
- Summary/Projections
Components of Polyurethane Foam

- **Polyols**
  
The “meat” of the foam formulation. The material that all of the other ingredients bind to form the molecular chain that is the flexible foam.

- **TDI**
  
  Toluene **Di**isocyanate is the material that reacts with the Polyol to form the chemical reaction that “builds” the complex shape that becomes the flexible foam.

- **Other Materials**
  
  Various materials such as water, CO2, flame retardants, catalysts, dyes needed to complete the formulations to meet performance standards.
Components of Polyurethane Foam

Tradition has been that increases and decreases in the price of polyurethane foam only occur when Polyols and/or TDI change.

Important to note that all foam manufacturers evaluate all costs at these times to arrive at new price.
Dependence on Oil & Natural Gas

**Dependence Factors - Why?**

- Key Polyol Raw Materials
- Key TDI Raw Materials
- Byproducts used in Many Minor Materials
- Cost of Energy
- Cost of Transportation
Greenspan Says Oil to Keep Rising on Capacity Limits (Update2)
By David Tweed
May 14 (Bloomberg) -- Former Federal Reserve Chairman Alan Greenspan said oil prices will keep rising as energy companies have invested too little in production and infrastructure to cope with higher demand.
Companies haven’t been reinvesting enough to keep supply growing in line with demand, Greenspan said via satellite to a conference sponsored by Deutsche Bank AG in Singapore, according to an investment strategist who attended the event and who spoke on the condition of anonymity.
Increasing futures-market activity is expanding the aggregate demand for oil because more needs to be held in storage to meet contracts, Greenspan said, according to the person who attended the event.

Shell shuts more Nigerian oil after rebel attack
By Daniel Flynn
LAGOS (Reuters) - Royal Dutch Shell shut down more of its production in Nigeria after a fresh militant attack on Saturday on a flowstation in the restive Niger Delta, where local militants have stepped up a campaign of violence.
The bombing of the Shell facilities in Nigeria’s southern Bayelsa state, the 11th militant attack in just over a month, came a day after a federal court ruled that one of the leaders of the rebel Movement for the Emancipation of the Niger Delta (MEND), Henry Okah, should be tried in secret.

Oil hits record near $127 as Iran mulls output cut
By Matthew Robinson
Reuters
Tuesday, May 13, 2008
NEW YORK (Reuters) - Oil surged to a record peak near $127 on Tuesday after OPEC producer Iran said it was studying a plan to cut output despite signs record-high prices are hurting consumer nations.
U.S. crude settled up $1.87 to $126.80 a barrel, after striking a record $126.98 earlier. London Brent crude rose $1.19 to $124.10 a barrel.
Crude oil and natural gas are driving significant feedstock cost increases globally

- Crude oil prices have risen 2X over the last year to ~$135(USD) per barrel
- Natural gas has risen almost 2X over the last year to ~$13/MMBTU

Key raw materials and feedstocks are at very high levels

- Propylene is at an all-time high of ~$0.77/lb versus a 2007 average of $0.52/lb
- Benzene, toluene, other raw materials, transportation costs, etc. have had a 2X increase since 2007
Background on Increases

Flexible Polyurethane Foam

Crude Oil

Source: CMAI May 2008
Background on Increases

Natural Gas

Source: CMAI May 2008

Flexible Polyurethane Foam
What Does This Mean for All of Us?

- **Chemical Companies Margin levels are not sustainable.**
  - They cannot, at these profit margins, serve their customers over the long term by investing in R&D (new products and processes), building new plants and expanding in new markets
  - They will not be able to help their customers grow

- **As manufacturers, we are all in this together.**
  - We are subject to the same pressures
  - At one end we experience the margin squeeze caused by energy and feedstock cost increases
  - At the other end, retailers use their enormous clout with consumers to put downward pressure on our prices

- Thus, nearly everyone in the middle of the manufacturing value chain is subject to the margin squeeze.

- As a result, we must take action on pricing of many of our products.
Polyols Overview

- How Polyols Are Made
- Key Raw Materials for Polyols
- How Are Polyol Raw Materials Derived?
- Historical Overview of Raw Material Costs
How Polyols Are Made

Propylene and propylene oxide are key raw materials and cost inputs to the production of Polyols.

Crude Oil → Nat Gas → Propylene

Catalyst

Propylene Oxide

Ethylene Oxide

Initiator

 Reactor(s) → Polyols

Product Storage → Transportation

Crude Oil → Nat Gas → Ethylene

OTHER RAW MATERIALS:
- Glycerine
- Sugars
- Glycols
- Amines
- Catalysts

Antioxidants

Flexible Polyurethane Foam
How Are Polyols Raw Materials Derived?

Crude Oil
- Refinery
  - Liquid Petroleum Gas (LPG), Naptha, Gas Oil
- Gasoline
- Natural Gas
- Gas Separation Unit
- Methane, Ethane (Fuel Gas)

Flexible Polyurethane Foam

Crude C4
  - Pygas/Reformate
    - Heavy Aromatics, C5/C6
  - Pygas/Reformate
    - Benzene
      - MDI
    - Toluene
      - TDI

Conversion Unit
- Propylene Oxide
  - Other Propylene Technologies:
    - Propane Dehydro
    - Metathesis

Other Derivatives

Refinery FCC Unit, Steam Cracker, Reformer
- Butane, Lt Naptha, Propane, Ethane
- Butadeine, Mixed Butylene
- Liquid Petroleum Gas (LPG), Naptha, Gas Oil
- Heavy Aromatics, C5/C6
- Benzene
- Toluene
- Propylene
- Other Propylene
- Technologies:
  - Propylene Dehydro
  - Metathesis
A majority of NAA propylene is produced by refineries. Price is driven by its alternate value in gasoline and distillates.

New crackers are mostly built for an ethane feedstock that yields minimal propylene (only 2% yield).

CONCLUSION: The floor price of propylene will be driven by gasoline.

Source: CMAI 2006
Polyol Overview: Key Raw Materials

All polyol producers compete with other users for propylene and propylene oxide and therefore must provide acceptable returns to the envelope to secure product.
Historical Overview: Polyol Raw Material Costs

**Flexible Polyurethane Foam**

**Propylene**

- '04-'06
  - $0.41 (US)

- '02-'03
  - $0.21 (US)

- June 1
  - ~$0.77 (US)

Source: CMAI May 2008
- Propylene and propylene oxide have not been the only contributors to the significant increases in polyol costs.
- Initiators, antioxidants, catalysts, etc. have also increased sharply in cost.
TDI Overview

- How TDI is Made
- Key Raw Materials for TDI
- How Are Raw Materials Derived?
- Historical Overview of Raw Material Costs
How TDI is Made

Toluene is a key raw material and cost input to the production of TDI.

- Toluene
- Nitric Acid
- Hydrogen
- Natural Gas
- Oil

Carbon Monoxide
Chlorine

Phosgene Production

TDI Reaction

TDI Finishing

Flexible Polyurethane Foam

Transportation

TDI
How Are TDI’s Raw Materials Derived?

Crude Oil

Refinery

Gasoline & Distillates

10%

Liquid Petroleum Gas (LPG), Naptha, Gas Oil

Crude C4

Butadeine, Mixed Butylene

Natural Gas

Gas Separation Unit

Methane, Ethane (Fuel Gas)

93%

90%

90%

Refinery FCC Unit, Steam Cracker, Reformer

Butane, Lt Naptha, Propane, Ethane

7%

Pygas/Reformate

Heavy Aromatics, C5/C6

Pygas/Reformate

Benzene

Pygas/Reformate

Toluene

Crude C4

MDI

Polyols

Other Derivatives

Conversion Unit

Propylene Oxide

Other Propylene Technologies:
- Propane Dehydro
- Metathesis

Other Propylene Derivatives:
- Heavy Aromatics, C5/C6
- Butane Oxide
- Ethane, Propane, Butene
Toluene Has High Octane Value

- Octane is a knock index for proper internal combustion
- Toluene is a valued blend component with high octane ratings
- Toluene’s floor price is set by its value in the gasoline/octane pool
Historical Overview: TDI Raw Material Costs

Toluene

Source: CMAI May 2008

June 1
$3.84 (US)

1st Change
'04-'06
$2.29 (US)

2nd Change
'02-'03
$1.15 (US)

'07

Cents/Gallon
Other Cost Factors Overview

- Transportation Costs
- Flame Retardants
- Catalysts
- Dyes & Colorants
- G&A/Energy/Fixed Costs
Transportation Costs

As manufacturers, we are experiencing a step change in our transportation costs. Diesel prices have increased nearly 2X since early 2007.

Source: American Trucking Association
Source: Association of American Railroads March 31, 2008
Source: Energy Information Administration

Flexible Polyurethane Foam
Flame Retardant Costs

Flexible Polyurethane Foam

Flame Retardant Material

Oct-05  Dec-05  Feb-06  Apr-06  Jun-06  Aug-06  Oct-06  Dec-06  Feb-07  Apr-07  Jun-07  Aug-07  Oct-07  Dec-07  Feb-08  Apr-08  Jun-08

0.00%  5.00%  10.00%  15.00%  20.00%  25.00%  30.00%  35.00%
Of the Nearly 275 Chemicals used to make all Polyurethane Foam……the industry received increases in the cost of 235 in June 2008!
Given current Polyurethane technology, polyol is the only candidate for renewable material replacement.

Corn & Soybean based products are most viable and most economic alternatives.

So ............
Renewable Alternatives

Flexible Polyurethane Foam

Corn Up 140% Since January ‘06

Soybeans Up 105% Since January ‘06

Source: USDA WASDE Report 6-10-08
Renewable Alternatives

Maximum renewable replacement (while keeping minimal performance standards) is 15-20% of the polyol content.

Separate tanking, buying in smaller quantities cuts into any potential savings

Net Result - equal pricing
We need to educate each part of the value chain about the step change in hydrocarbon and energy costs.

At the same time, we all must work together to effect a viable energy policy among policymakers throughout the world that will generate more exploration and production.

We know that our success depends on helping our customers succeed ... we are in it for the long-term ... but we all must achieve re-investment levels in order to continue to serve our customers and our shareholders.
Working Together

Flexible Polyurethane Foam

Costs to Produce Polyurethane Foam - October 2005 Benchmark

Graph showing the percentage increase in costs to produce polyurethane foam over time, with months and years from October 2005 to June 2008 on the x-axis and percentage increase on the y-axis. The graph includes data points for TDI, TRANS, Polyol, FR, G&A, and Other categories, with TDI showing the highest increase at 125.58%.
Working Together

Cost vs BF Price

Weighted Actual Costs
Average BF Pricing
Summary

- The step change in crude oil and natural gas prices have caused a step change in manufacturing costs.

- The changes in costs cannot be absorbed by manufacturers and need to be passed along.

- All polyurethane chemicals (Polyols, MDI, and TDI) are affected.

- As manufacturers, we must find ways to pass the escalating raw material, hydrocarbon and energy costs through the chain.

- **July increases do not account for additional $15-$30 per barrel we have just seen.**
Interview Dow to boost polyurethane prices further

10 June 2008 19:20  [Source: ICIS news]
By Joseph Chang

NEW YORK (ICIS news)--US-based Dow Chemical is raising prices in its polyurethane business 8-24% globally in June and July, and additional increases are likely to follow, the president of Dow Polyurethanes said on Tuesday.

“We are under siege with this step-change in energy and feedstock price volatility,” said Pat Dawson. “The 1970s pale in comparison to what’s happening in crude oil today, and it cannot be business as usual.”

Crude oil prices rose by over $2 (€1.28) to around $137/bbl on Tuesday afternoon, close to its record high of over $139 last week.

For June and July, Dow Polyurethanes will raise prices 14-24% in North America, 10-18% in Europe and 8-18% in Asia, depending on product and grade, said Dawson.

“Asia is due for even more price increases in July that could drive up that range, however,” said Doug Warner, business director for polyols in Dow Polyurethanes. “This is being driven by the large spike in naphtha prices in Asia, which is coming through to propylene oxide [PO] producers. PO is being nominated right now for increases close to 20%,” he said.

Polyol prices will likely follow PO prices closely, Warner added.

Asian naphtha traded at a new record high of $1,149/tonne late on Monday as crude values hit the $139/bbl mark, according to global chemical market intelligence service ICIS pricing.

Naphtha traded at $1,149/tonne cost and freight (CFR) Japan between Sietco and Glencore for the second half of July contract. The contract had earlier hit a record high, trading at $1,125/tonne as Itochu sold to Mitsui Oil Asia Hong Kong two weeks earlier.

The moves in Dow Polyurethanes are in line with Dow’s overall strategy to raise prices by up to 20%, which the company announced on 28 May.

Dow Polyurethanes also plans to implement surcharges for transportation and packaging of its products in July, said Dawson.

“These are the only areas where we would implement surcharges - not on the products themselves,” he said.

($1 = €0.64)

*To discuss issues facing the chemical industry go to ICIS connect*
<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>PRODUCER</th>
<th>INCREASE</th>
<th>EFFECTIVE</th>
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<tbody>
<tr>
<td>Thermoplastic moulding materials</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Polyethylene</td>
<td>Dow Europe</td>
<td>150 [euro]/tonne on LDPE, LLDPE and HDPE and Affinity and Engage polyolefin elastomers.</td>
<td>6/1/2008</td>
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<tr>
<td></td>
<td>Dow Europe</td>
<td>50 [euro]/tonne on LDPE, LLDPE and HDPE.</td>
<td>5/1/2008</td>
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<tr>
<td>Other polyolefins</td>
<td>DuPont Packaging &amp; Industrial Polymers</td>
<td>80 [euro]/tonne on Elvax EVA copolymer. Up to 200 [euro]/tonne on Nucrel acid copolymer.</td>
<td>6/1/2008</td>
</tr>
<tr>
<td>Styrenics</td>
<td>Dow Europe</td>
<td>45 [euro]/tonne on GPPS and 55 [euro]/tonne on HIPS and Styron A-Tech advanced technology polystyrene.</td>
<td>5/1/2008</td>
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<tr>
<td></td>
<td>Ineos Nova</td>
<td>10 [euro]/tonne on GPPS and 40 [euro]/tonne on HIPS. Expandable polystyrene up 50 [euro]/tonne.</td>
<td>5/1/2008</td>
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<td>Other plastics materials</td>
<td>Evonik Industries</td>
<td>Average 10 per cent increase across the entire range of high-performance polymers and monomers depending on region, product type and invoice currency.</td>
<td>6/1/2008</td>
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<td>Elastomers</td>
<td>Evonik Industries</td>
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<tr>
<td>Thermoplastic elastomers</td>
<td>Evonik Industries</td>
<td>150 [euro]/tonne on Affinity and Engage polyolefin elastomers.</td>
<td>6/1/2008</td>
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<td>Additives</td>
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<td>Flame retardants</td>
<td>Chemtura Corporation</td>
<td>Increases on PHT4-based flame retardants: Firemaster 550/552/600/602/BZ54/BZ54HP used in polyurethane cushioning up by $0.35/kg; PHT4 Firemaster 504 used primarily in rigid polyurethane foam, up by $0.17/kg.</td>
<td>6/1/2008</td>
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<td></td>
<td>Albemarle</td>
<td>Antblaze TMCP flame retardants and TMCP blends increased by up to 20 per cent; Saytex RB-79 flame retardant blends containing phosphorus, Antblaze TCCP flame retardant and TDCP blends, Antblaze V6 flame retardant and V6 blends, Antblaze V490 (DEEP) flame retardant and other Antblaze products not listed here all increased by up to 15 per cent. NcendX P-30 by $0.45/kg.</td>
<td>5/15/2008</td>
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**NOTE**: All illustrations and photos have been removed from this article.
Summary

June 24, 2008 - USA Today
Current and Future Impact on Polyols

- Propylene pricing follows crude oil and natural gas pricing. Have we felt the full effect of the current step change in oil and natural gas costs yet?
- Strong propylene demand and small increases in propylene supply will add cost pressure to propylene above its gasoline floor value and therefore to polyols.
- Other raw materials are forecasted to remain tight and therefore will increase the cost of polyols.
- The doubling of transportation fuel costs will also increase the cost of polyols.
- The need for future price increases will continue to be driven by these factors.

……..prices will continue to rise through the rest of this year and beyond
**Current and Future Impact on TDI**

- Strong global demand and short supply for TDI will not ease until new capacity is added.
- Toluene’s alternative as an octane booster will be widely used as gasoline demand increases further pressuring TDI’s costs.
- The doubling of transportation fuel costs will also increase the cost of TDI.
- Business returns above TDI’s costs are needed to continue to reinvest in the TDI business.

…….prices will continue to rise through the rest of this year and beyond