Propylene production via propane dehydrogenation (PDH)

Warsaw, 27 March 2015
Poland has a net deficit of propylene, with annual imports of ca. 150,000 tonnes. Most of this is purchased by Grupa Azoty Z.A. Kędzierzyn for the purpose of OXO alcohols production.

**Volume of propylene imported into Poland (2013)**

- **Germany**: 75%
- **Russia**: 9%
- **Azerbaijan**: 9%
- **Czech Republic**: 7%

**Grupa Azoty**

Zakłady Azotowe Kędzierzyn

Grupa Azoty’s plant in Kędzierzyn is one of the biggest propylene users in Poland. Volume consumed equals ca. 120 - 140 kt annually. Propylene is used for the production of OXO alcohols.

*Source: GUS*
In the coming years, a decrease of propylene production is expected in Western Europe. A new PDH unit will have a distinct advantage over other producers in the region.

Propylene production in Western Europe

- **Metathesis**: 1.5%
- **PDH**: 3.6%
- **Steam crackers**: 68.2%
- **Refineries (FCC)**: 26.7%

Currently, the deficit of propylene in Germany is close to 850 kt annually.

**PDH**

- Due to the shale gas boom in the USA, the availability of propane increased, which caused global prices to fall.

**Steam crackers**

- Most European crackers are fed with naphtha. The shift of feedstock to ethane requires substantial investment and considerably decreases propylene yields.

**Refineries (FCC)**

- Since 2009, 15 refineries have been closed in Europe. According to International Energy Agency’s forecasts, in years 2013-2020 the throughput of oil will decrease by further 65 mln tonnes, i.e. 10%, causing further drop of propylene output.

Source: Argus DeWitt, International Energy Agency
The construction of a propane dehydrogenation (PDH) plant will enable Grupa Azoty to fully cover its current propylene deficit and provide a basis for the development of next investment projects.

**Simplified diagram of PDH plant (400 kt)**

- **Propane** - Feedstock widely available on the market
- **PDH** - Main product
- **Propylene**
- **Hydrogen** - By-products, which can be processed in existing plants of Grupa Azoty
- **C4’s**

**CAPEX**
1,7 mld PLN
There are currently 18 operating PDH plants in the world

Existing propane dehydrogenation plants and their capacities (kt)

UOP
ThyssenKrupp
CBI Lummus

Source: publicly available data
The location of the investment in Police is optimal in terms of logistics and provides synergies with existing infrastructure.

- **Baltic Sea as a main transport route**
- **Proximity of Western European market**
- **Integration with the current infrastructure of Grupa Azoty plants in Police**
- **Increase of stability of supply to Kędzierzyn by fully covering the plant’s propylene consumption**
- **Propylene as a basis for further development of Polish chemical industry**
- **Propylene is a fundamental product of industrial chemistry. Its surplus might be placed on the market or processed to advanced chemical products within Grupa Azoty’s potential future investment projects**
Propylene is a fundamental product of industrial chemistry, providing a basis for further processing into more advanced chemical products.

### Further Products Based on Propylene

<table>
<thead>
<tr>
<th>Category</th>
<th>Example Products</th>
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<tbody>
<tr>
<td>Polypropylene</td>
<td>Polypropylene, OXO alcohols</td>
</tr>
<tr>
<td>SAP</td>
<td>Phenolic resin</td>
</tr>
<tr>
<td>Butyl acrylate</td>
<td>Plasticizers</td>
</tr>
<tr>
<td>2EH acrylate</td>
<td>Propylene oxide</td>
</tr>
<tr>
<td>Ethyl acrylate</td>
<td>Cumene</td>
</tr>
<tr>
<td>Methyl acrylate</td>
<td>Propylene glycol ethers</td>
</tr>
<tr>
<td>Polyols</td>
<td>HMDA</td>
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<tr>
<td>OXO alcohols</td>
<td>Phenolic resins</td>
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<tr>
<td>Polypropylene glycol</td>
<td>Bisphenol A</td>
</tr>
<tr>
<td>Polyacrylic acid</td>
<td>Polyacrylic acid</td>
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<tr>
<td>Acrylic acid</td>
<td>Acrylic acid</td>
</tr>
<tr>
<td>Acrylonitrile</td>
<td>Acrylic plastics and fibres</td>
</tr>
<tr>
<td>EPDM</td>
<td>TPO</td>
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<tr>
<td>Propylene glycol ethers</td>
<td>Acrylamide</td>
</tr>
<tr>
<td>HMDA</td>
<td>Phenol</td>
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<td>Phenol</td>
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The recent changes in the oil market have an impact on prices of petrochemicals. However, they don’t aggravate the prospects for Grupa Azoty’s investment in PDH plant.

Last year, the fall in propane prices was more significant than the corresponding fall in propylene prices.

Increase of PDH margin

Source: publicly available data
Total investment expenditures are equal to 1,7 bln PLN. The plant will increase Grupa Azoty’s annual revenues by around 2 bln PLN.
The analyses of PDH technology have been conducted by Grupa Azoty for the last couple of years. Currently, we’re entering the basic engineering phase.

2008
Initial analyses of PDH plant by Grupa Azoty

2014
Feasibility Study of the investment

2015
Corporate decisions
Selection of technology and basic engineering

2019
Planned start-up of the PDH plant
Reputable and reliable consultants with extensive experience in chemical and petrochemical industry have been engaged in the project

Economic advisor

Market advisor

Technical advisor

Technical advisor

pwc

Nexant

APS KTI Poland

Tecnimont
• Propylene is a fundamental product of industrial chemistry
• Poland has a high net deficit in propylene trade;
• Grupa Azoty ZAK uses propylene to produce OXO alcohols;
• Grupa Azoty’s PDH project will be the biggest plant of this type in Europe (around 400 kt of propylene);
• PDH will make Grupa Azoty independent of external propylene suppliers;
• PDH will become a basis for further investment projects, processing propylene into more advanced chemical products
• Total investment of 1,7 bln PLN will increase Grupa Azoty’s annual revenues by around 2 bln PLN annually
• Planned start-up - 2019
Thank you for your attention!