Rectisol expands its scope in China

A brief glance on Lurgi’s syngas-based activities in China presented at the GTC Conference 2006, Washington

by U.Koss, Lurgi AG
More than half a Century ago......

......*Rectisol was unique*

- Reached synthesis gas quality using one single technology
- Paved the way for huge-scale Ammonia and Fischer Tropsch Synthesis
- Removed trace contaminants people did not even know about

Rectisol at Sasol in Sasolburg, RSA, 1955
“Five-in-one”:

1. Trace contaminant removal  
   COS, CS₂, NH₃, HCN .......

2. Deep Desulfurization  
   directly to synthesis feed quality  
   (Total S < 0.1 ppmv)  
   only with Rectisol®!

3. Bulk CO₂ removal  
   100 % CO₂ can be recovered

4. CO₂ purification  
   CO₂ can be purified to Total S < 5 ppmV

5. Acid Gas Enrichment  
   Claus-suited acid gas even at a  
   CO₂/H₂S ratio of > 500

are five tasks to be performed by a set of five processes or one Rectisol®.  
So, set up the right B.L. when comparing costs!
1950- 2005: The whole Story

Capacity installed and operating
[in MM Nm³/day]

Today, Rectisol purifies
75% of the world’s syngas produced from oil residue, coal, & wastes
90% of all of this syngas fed to a synthesis (non-IGCC use)
## Lurgi – Rectisol references 2000-2006

<table>
<thead>
<tr>
<th>Date of Order</th>
<th>Client</th>
<th>No. of Units</th>
<th>Feedgas</th>
<th>Main Product</th>
<th>Secondary Product(s)</th>
<th>Capacity Nm³/d</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>Fujian Petrochemical P.R. of China</td>
<td>1</td>
<td>Shell Oil Pox</td>
<td>Hydrogen</td>
<td>IGCC Fuel Gas</td>
<td>7,860,000</td>
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<tr>
<td>2005</td>
<td>Yanzhou Coal Mining, C&amp;E Co. P.R. of China</td>
<td>1</td>
<td>GE Coal Pox</td>
<td>Methanol Synthesis</td>
<td></td>
<td>6,970,000</td>
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<tr>
<td>2005</td>
<td>North West Upgrading Canada</td>
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<td>Lurgi MPG Oil Pox</td>
<td>Hydrogen</td>
<td>Steam</td>
<td>4,920,000</td>
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<td>2005</td>
<td>Jindal Steel &amp; Power Ltd., India</td>
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<td>Lurgi Coal Gasification</td>
<td>Reduction Gas for Iron ore reduction</td>
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<td>7,560,000</td>
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<td>2005</td>
<td>Confidential, P.R. of China</td>
<td>1</td>
<td>Shell Coal Pox</td>
<td>Propylene via Methanol</td>
<td>Fuels</td>
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<td>Conoco Phillips Germany</td>
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<td>Shell Oil Pox</td>
<td>Hydrogen</td>
<td>IGCC Fuel Gas</td>
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<td>2006</td>
<td>Shenhua Ningxia Coal Industry Col, P.R. of China</td>
<td>1</td>
<td>Siemens Coal Pox (formerly GSP)</td>
<td>Propylene via Methanol</td>
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<td>Shell Coal Pox</td>
<td>NH3 Synthesis</td>
<td>CO2 for Urea Synthesis</td>
<td>6,380,000</td>
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<td>2 2003</td>
<td>Sinopec Hubei, P.R. of China</td>
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<td>Shell Coal Pox</td>
<td>NH3 Synthesis</td>
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<td>Sinopec Anqing, P.R. of China</td>
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<td>CO2</td>
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<td>Methanol Synthesis</td>
<td>CO2</td>
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<td>Number/Value</td>
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<tr>
<td>New references worldwide:</td>
<td>15 plants</td>
<td></td>
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<td>Thereof in the P.R. of China:</td>
<td>13 plants</td>
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<tr>
<td>New capacity worldwide:</td>
<td>113,050,000 Nm³/day</td>
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<td>Therof installed in China:</td>
<td>90,610,000 Nm³/day</td>
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<tr>
<td>Category</td>
<td>Applications</td>
<td>Count</td>
<td></td>
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<tr>
<td>Classic</td>
<td>Fertilizer plants: 1)</td>
<td>3</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Methanol plants:</td>
<td>5</td>
<td></td>
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<tr>
<td>Modern</td>
<td>Refinery hydrogen &amp; Power:</td>
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<td></td>
<td>DME production: 2)</td>
<td>1</td>
<td></td>
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<tr>
<td>New Age</td>
<td>Coal- to- Propylene: 3)</td>
<td>2</td>
<td></td>
<td></td>
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</tbody>
</table>

1) Via ammonia and CO₂  
2) Via methanol  
3) Via Lurgi MegaMethanol and MTP®
ZE Syngas Technology

Hard Coal, Lignite, Oil Resid, Natural gas, Wastes, Biomass

Gasification

Air Separation

Gasification

Syngas Conditioning

H₂S Rectisol®

CO Shift Conversion

CO₂ Rectisol®

Rectisol® Regeneration

OxyClaus® SRU

Refrigeration Unit

CO₂, Liq.

Syngas Conditioning

PSA

Hydrogen

CC Power plant

CO₂-free Flue gas

Gas Turbine

Waste Heat Boiler

Steam turbine

Synthesis Plants

Clean Synfuels, Methanol, SNG Ammonia, Plastics

Sulphur Product

Pure CO₂

H₂ reg.
first PP cup made entirely from methanol
Polypropylene imports to China will still be strong by the end of the decade

Source: Nexant July 2005
MegaMethanol® – the Basis

1st MegaMethanol plant (Atlas, Trinidad)
Capacity 5,000 tpd Methanol
MTP®: Simplified Process Flow Diagram

- **Methanol**: 1.667 Mt/a = 5000 t/d
- **DME Pre-Reactor**
- **MTP Reactors**
- **Olefin Recycle**
- **Water Recycle**
- **Process Water 935 kt/a** for internal use
- **Product Conditioning**
- **Ethylene**: 20 kt/a
- **Propylene 474 kt/a**
- **LPG**: 41 kt/a
- **Gasoline**: 185 kt/a

1) Propylene Purity 99.6 wt. %
Scale-up of MTP

<table>
<thead>
<tr>
<th></th>
<th>PDU 308</th>
<th>PDU 305/7</th>
<th>Demo Unit</th>
<th>Commercial unit</th>
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<tbody>
<tr>
<td>Reactors</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>MeOH</td>
<td>0.3</td>
<td>1.2</td>
<td>15</td>
<td>104000 kg/h</td>
</tr>
<tr>
<td>feed per reactor</td>
<td></td>
<td></td>
<td></td>
<td>(2+1 reactor trains)</td>
</tr>
</tbody>
</table>
1. Chinese CtPropylene project
MTP® unit: General Layout
Fischer-Tropsch activities, GTL.F1

Synfuels, Mossel Bay, RSA
Bringing together first tier technologies and know-how...

GTL Plant

Natural Gas → Syngas → Fischer-Tropsch → Upgrading → Diesel

Utilities / Offsites

Partners:
- JMC
- STATOIL
- 3rd Party
- PetroSA
GTL.F1 AG: Demonstration of LT-FT Synthesis
Now, more than half a Century later……

……Rectisol is still unique

- Reaches synthesis gas quality using one single technology
- Allows very efficient CO2 bulk removal
- Is the only process having built-in drain where non-volatiles as solids, heat stable salts etc. are disposed through

Baling Rectisol Plant, PR of China
New opportunities for Rectisol:

- Giant-scale coal-based Fischer Tropsch
- Clean Coal: The Revival of IGCC’s, this time with Carbon Capture (Zero Emission IGCC)
- BtL- Gasification based Biomass-to-Liquids
A real-life operator commenting his long-term experience regarding performance, reliability and operational problems:

“Well, Rectisol is just pumping around liquids. That’s all what is it about.”
Thank you for your attention!

SNG to Gas Pipeline
CO₂ for Enhanced Oil Recovery

DGC, Beuhlah, North Dakota, USA