Syngas: The Universal Platform for Chemicals, Fuels and Energy
SYNGAS PRODUCTION
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Clariant at a Glance

A GLOBALLY LEADING COMPANY IN SPECIALTY CHEMICALS

6377
Sales 2017 (CHF m)
from continuing operations

302
Net result 2017 (CHF m)
from continuing operations

4
Business Areas

974
EBITDA 2017 (CHF m)
before exceptionals

15.3 %
EBITDA margin 2017
before exceptionals

156 in 52
companies in countries

18,135
Employees 2017

CARE CHEMICALS

CATALYSIS

NATURAL RESOURCES

PLASTICS & COATINGS
**Catalyst Business Unit**  
**Creating Performance Technology**

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CUSTOM CATALYSTS tailor-made for specified applications
Feedstock to Syngas perspective is different in each region, which offers new opportunities and requires unique solutions

**NORTH AMERICA**
- Shale gas boom in the US
- Oil sands in Canada
- Natural gas already 30% of primary energy consumption

**SOUTH & CENTRAL AMERICA**
- Major new oil and gas source
- High potential for renewables
- 25% increase in renewables from 2012

**EUROPE & EURASIA**
- Push for renewables
- Shale gas imports being investigated
- Focus on specialty chemicals

**CHINA**
- Increasing use of coal for chemicals
- Coal currently 67% of energy consumption in China
- Diversifying into gas and imports for downstream development

**AFRICA**
- High development potential
- Strong dependence on fossil resources (93%)

**MIDDLE EAST**
- Oil and natural gas 99% of energy consumption
- Refinery integration
- Focus on diversification to downstream applications

Source: Industry reports; BP Statistical Review of World Energy 2014
Feedstock to Final Product

Feedstock:
- Natural Gas
- Biomass, Coal, Petcoke, etc.

SYNGAS
“happens here”

Final Products
Syngas Catalyst Design and Performance Considerations

**INTRINSIC ACTIVITY**
- Active Metal / support interaction
- Metal dispersion
- Metal content

**APPARENT ACTIVITY**
- Diffusion, pore volume
- Pore size distribution
- Geometric surface area

**PRESSURE DROP**
- Shape physical integrity

**STABILITY**
- Metal/support interaction
- Physical integrity

**HEAT TRANSFER**
- Shape, Density

**CARBON FORMATION**
- Feedstock
- Operation flexibility

**Metal crystallites**
- CO+H₂ products
- CH₄+H₂O reactants

**Catalyst pellet**
- Pore
- Reaction zone

Catalyst Performance

Public, Syngas: The Universal Platform for Chemicals, Fuels and Energy
Holli Garrett, Clariant Catalysts, 08.10.2018
Syngas: The Universal Platform for Chemicals, Fuels and Energy

SYNGAS TO HYDROGEN
SYNGAS TO AMMONIA
SYNGAS TO METHANOL
Syngas to Hydrogen
Steam Methane Reforming

ReforMax LDP Plus
• In the tubular primary reformer, ReforMax LDP Plus enables natural gas (methane) to catalytically react with steam to syngas
• Decrease of pressure drop by approx. 20% compared to standard shape reduces energy usage, improves heat transfer, and increase throughput.
• Suppression of carbon formation, especially if ReforMax® 330 LDP Plus is combined with ReforMax® 210 LDP Plus

End Products
• Hydrogen (H2): Used in the processing of fossil fuels, in ammonia production, as coolant, or energy carrier
• Ammonia (NH3): > 80% of the global ammonia production are used to manufacture nitrogen fertilizer for agriculture
• Methanol (MeOH): For gasoline blending, to produce propylene (MTP), olefins (MTO), acetic acid, formaldehyde

High activity due to high geometric surface area
Energy savings in hydrogen, ammonia and methanol production process
Improved heat transfer by increased hole diameters
Increase of gas throughput by up to 11% (if no other limitation) thanks to lower pressure drop
Syngas to Hydrogen
CO Shift

ShiftMax 120 HCF

- Based on over 30 years of proven industry performance for longevity
- Reduces the content of hexavalent chromium to non-detectable levels in the fresh catalyst as confirmed by an independent institute
- Eliminates health and safety concerns during handling and commissioning
- Superior activity and well established ability to survive small waste heat boiler leaks

End Products

- The high temperature shift (HTS) section increases the hydrogen yield of the process by driving the water-gas shift reaction
- Confirms to REACH Regulations (Annex XIV to EC No 1907/2006)
Impacts of Water on Shift Catalyst
Syngas to Ammonia Catalyst to feed the world’s growing population

AmoMax 10
- Wustite instead of traditional Magnetite through a tailor-made and optimized set of promoters
  - Stabilization of small Fe crystallites
  - Significant increase of surface area
  - High activity at low temperatures and pressure with extreme stability

End Products
- Over 80% of ammonia production is used to produce nitrogen fertilizer
- Nearly 20% are used to produce Hydrazine Nitro, General nitration, Amino Acids, Acrylonitrile, Explosives etc.

Increased Ammonia production for crop fertilizer through more efficient and environmentally compatible means.

Earlier start of ammonia production due to shorter start-up time.

Energy savings: less recycle and lower loop pressure: up to 10 bar less.

Less consumption of natural gas for catalyst reduction.
Syngas to Methanol
From Gas and Coal

MegaMax Series
• Promoting methanol synthesis from gas and coal and other feedstocks
• Lower investment and production cost through lower pressure operation
• Greater flexibility in feedstocks and plant size
• Selectivity

End Products
• Synthesis of methanol as end product
• Or methanol as intermediate product to produce propylene (MTP), olefins (MTO), acetic acid, formaldehyde

Better lifetime productivity by high catalyst activity. Customers can produce more of the desired methanol or derivatives.

Longevity: Great physical robustness in commercial operation.

Solutions for China: Supporting customers in all major process steps when converting coal to plastic.
Summary

- Catalyst performance on plant operation is important for syngas production
- Feedstock perspectives are different in every region and not considered barriers
- Catalyst Design and Performance Feature Consideration
- Catalyst can contribute to yield improvements
THANK YOU