Urea Plant Update

WDEA Annual Meeting
November 1-2, 2017
Agenda

• Dakota Gasification Company Overview
  – Gasification Process
  – Products
  – Strategy- DGC Initiative

• Project - Urea Plant
  – Why Urea
  – Process

• Construction
  – Project Timeline
  – Major Challenges
  – Project Completion

• Market

• Economic Impact
Gasification Process
Anhydrous Ammonia Process
Strategy - DGC Initiative

• Started June 2012

• Evaluate and recommend long-term options to maximize value of DGC assets

• Reduce financial risk and diversify DGC’s product mix

• Incorporate current and underutilized assets
Urea Production
The Concept

SYNGAS → AMMONIA PLANT

AMMONIA PLANT → UREA PLANT

AMMONIA PLANT → UREA STORAGE AND LOADOUT (Two - 30,000 Ton Tanks)

CARBON DIOXIDE

STEAM

AIR

UREA

UREA STORAGE AND LOADOUT
• Why Urea

• Ammonia Plant was operating around 65% on-stream capacity

• Diversify product mix by adding urea
  – Ag urea, DEF, NOx power plant & animal feed

• Reduce risk when weather hinders NH3 application
Project - Urea Plant

• Why Urea
  
  • Reduce risk if regulatory actions mandate NH3 transportation or production
  
  • Reduce risk because urea is much safer to store and transport than NH3
  
  • Large and growing local demand mainly supplied by imported product
Project - Urea Plant

Process

NH₃ 622 TPD
CO₂ 808 TPD

HIGH PRESSURE SYNTHESIS

RECTIFICATION

DEF (275 Eqv. TPD)

EVAPORATION

GRANULATION

UREA 1100 TPD

RECYCLE
Granulator
Stamicarbon Granulation

- 224 film spray nozzles
- 98.5 % feed
- 0.3 wt% formaldehyde
- Low dust recycle
Storage and Load Out

- **GRANULATION**: 46 TPH
- **STORAGE**: 53,000 TON, 300 TPH
- **SCREENING**: FINES RECYCLE
- **LOAD OUT**: UREA TRUCK, UREA RAIL, DEF TRUCK, DEF RAIL
- **DEF**
3D Urea Plant Model
Storage and Load Out

STORAGE
53,000 TON
Project - Urea Plant Project

• Product options include:
  – Granular Urea
    • Uses
      – Ag Fertilizer
      – Feed Grade Urea
      – Urea Formaldehyde Resins
      – Synthesis of Melamine
  – Urea Liquor
    • Uses
      – Diesel Exhaust Fluid (DEF)
      – NOx Abatement
  – Carbon Dioxide
    • Uses
      – Small EOR projects
      – Fracking Oil Wells
Construction - Project Timeline

- Receive Permit to Construct
- Break Ground
- Mechanical Completion
- Commissioning/Startup

Dec 2013

2014

2015-2017

Dec 2017

Early 2018

- Begin Detailed Design
- Order Long-Lead/Special Metallurgy Equipment
- Construction
- Full Production
Construction - Major Challenges

• Logistics
  – Major equipment from Austria
  – Drought in area caused delays in bargeing the equipment on the Danube River to Amsterdam

• Housing
  – Hazen RV Park
  – New Hotel prior to construction
  – Private Sector Housing - Commuting from all over the area

• Traffic
  – Schedule around shift change
Construction - Major Challenges

• Engineering
  – Started project limited detailed engineering
  – Took longer than planned slowing down contractors that were already on site
  – Redesign the storage facilities floor due to subsoil structure adding additional pilings and supports

• Tie-Ins to existing facility
  – Scheduled during our normal operations

• Power requirements greater than what FEED Study provided
  – Build additional 25kw sub-station
25kw Sub-Station
Construction - Major Challenges

• Wind Event
  – Significant wind event experienced at site and surrounding area.
    • Approximately 6:15 p.m. on Sunday, July 3.
    • Wind speeds gusting to 76 mph measured by DGC one mile from plant; no wind data directly at urea site.
    • Zero visibility.
  – Storage building collapsed.
  – Large HVAC unit in outside storage area moved ~ 180 feet.
  – Control room building roof penetrated with flying debris.
Storage Building

- Before Event ~ 39%
- 700’ x 210’
- 21’ sidewall; 90’ peak height
Storage Building

- Current Condition
Storage Building

- Current Condition
Construction - Major Challenges

• General Contractor
  – GC difficulties leading to removing them from site
  – Basin take over all the sub-contractors
Project Completion

- Currently 98.6 % complete
- Mechanically Complete by end of November
- Commissioning has started on completed areas
- Estimated startup is end of January
C02 Compressor Bldg
Melt & Granular Building
Screening tower
Inside Load-Out Facility
Inside Storage Facility
Market - Urea

- Urea, CO(NH$_2$)$_2$ - a white crystalline solid containing 46% nitrogen, is synthesized from carbon dioxide and ammonia, and is used especially in synthesis (as of resins and plastics) is widely used in the agricultural industry as an animal feed additive and fertilizer
- White granular or prill
Market - Urea
Market - Urea (ND, SD, MN, & MT)

- Demand is almost 2.8 million stpy
- Forecast to increase to 3.3 million stpy by 2025
- No urea producers in core market
- Local production will replace imports
Market - Urea
(200-mile radius)

There is a total of 726,000 tons of Urea demand in the area. DGC’s Urea plant has the capacity to produce approximately 380,000 tons of Urea per year.
Market - DEF

• Diesel Exhaust Fluid (DEF) is urea liquor, which is required, by law, for modern diesel engines for emissions control. It is injected into the exhaust stream to react with harmful greenhouse gases. DEF is a non-hazardous solution comprised of 32.5% urea and 67.5% de-ionized water. DEF is used in by Selective Catalytic Reduction (SCR) technology to remove harmful NO\textsubscript{x} emissions from diesel engines.

• Made from urea liquor & deionized water
• Commonly sold in 32.5% or 50% urea solution
• Used to filter Nitrogen Oxide (NO\textsubscript{x}) particulates
• Implemented in Europe around 1968
Market - Selective Catalytic Reduction

Example of a Selective Catalytic Reduction (SCR) System

Exhaust leaves engine with the pollutants NOx and PM.

Particulate Matter (PM) is trapped in the Diesel Particulate Filter (DPF).

DEF is injected into the exhaust system.

Ammonia (NH3) and Nitrogen Oxides (NOx) react in the catalyst to form nitrogen and water.

DEF solution "hydrolyzes" into ammonia gas (NH3) which mixes with exhaust.
Market - DEF
Market - North America DEF Demand

North American DEF
(Millions)

- Heavy-Duty Trucks
- Passenger Vehicles
- Off Highway
DEF Market
Diesel Engines

• 25 million gallons in Area (ND, SD, MN, MT)
  – Equivalent to 38,109 tons of Urea

• Expected growth of 15% per year for the next 5 years
Economic Impact

• Construction Jobs
  – 48 month project
  – 30 Contractors
  – Over 1000 workers at peak construction

• Housing
  – RV Parks
  – Local apartments and rental homes

• Local goods and service providers

• Operational Jobs
Thank You!