Eastman and Gasification: The Next Step - Building on Past Success

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Eastman Chemical Company
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• Founded in 1920 as part of Eastman Kodak - wood to methanol plant
• Approximately $5 B in sales annually
• Over 400 Chemicals, Fibers and Plastics
• Headquarters - Kingsport, TN
• Manufacturing sites around the world
Acetyl Flow at Eastman

“Acetyl” means any chemical derived from acetic acid or acetic anhydride

\[
\text{CH}_3\text{COOH} \quad \text{(acetic acid)} \\
\text{CH}_3\text{CO} \quad \text{O} \\
\text{CCH}_3 \quad \text{(acetic anhydride)}
\]
Acetyl Flow at Eastman

- **Coal** and Oxygen are fed into the **Gasification** process.
- CO and H₂ products from Gasification are fed into the **MeOH Carbonylation** process to produce MeOAc (Methyl Acetate).
- Ac₂O (Acetone) is also used in this process.
- Epoxy (HOAc) is produced as a byproduct.

**Esterification** takes place, converting Cellulose into Cellulose Esters, which are then sold as Solvent Esters.

- **Spinning/Compounding** uses Cellulose Esters and other chemicals to produce various products:
  - Plasticizers
  - Dyes
  - Acetate Tow
  - Acetate Yarn
  - Plastic Esters
  - Film base

**Purch. Methanol** is also used in the process.

**Chemicals from Coal facility** are also utilized in the production of various products.
History of Chemicals from Coal Facility

• Prior to Coal Gas, all acetyl chemicals made from petroleum

• Start-up of complex in 1983 (1/2 of acetyl demand)

• Expansion of downstream plants 1991, (100% of acetyl demand)

• Debottlenecking - 1991 to Present
  Approx. 1300 Tons/Day of Coal converted to Higher Value Chemicals (Ac$_2$O, HOAc)
Gasification Basics

Eastman’s Configuration

Coal

Air Products

Oxygen

Texaco Gasifier

Steam

Particulate Removal

Co-products

Sulfur

CO₂/H₂S Removal

RECTISOL

Sulfur Recovery

SCOT/Claus

CO/H₂ Separation (Lurgi)

Syngas

CO₂

Sulfur

Solids Co-products

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Gasification Basics

Eastman’s Configuration

Syngas Conversion

Syngas

CO/H2 Separation (Lurgi)

CO2/H2S Removal

Syn Gas

Methanol

Methyl Acetate

Acetic Acid/Anhydride

Fibers

Plastics

Solvents

Trade Sales

Air Products

Oxygen

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Ac2O, HOAc, MeOH, MeOAc

Sulfur Recovery

SCOT/Claus

Sulfur

Solids Co-products

CO,

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Liquid Phase Methanol Plant

Eastman, Air Products, DOE Joint Venture
Gasification Basics

Power Option

- Oxygen
- Coal
- Petroleum Coke
- Refinery Co-products

Gasifier

- Steam
- Slag/Soot

Particulate Removal

CO₂/HS Removal

Syngas

- Sulfur Recovery

Combustion Turbine

Steam Turbine

Electricity

- CO₂
- Sulfur
- Solids Co-products

Chemicals: H₂O, O₂, MeOH, MeOAc

CO₂/H₂S Removal

Coal

Petroleum Coke

Coke

Refinery Co-products

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Gasification Basics

Total Package

Coal
Petroleum Coke
Refinery Co-products

Oxygen

Gasifier
Slag/Soot

Steam
Syngas
Particulate Removal

CO₂ & Sulfur Removal

Syngas Conversion

Combustion Turbine
Steam Turbine

Back-up/Peaking Fuel

Electricity
Chemicals

CO₂
Sulfur
Solids Co-products

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Chemical Co-production Benefits

• Decouples reliability of gasification block and power block
  – Produce MeOH while turbine is down or off-peak demand
  – Feed MeOH to turbine while gasifier is down

• Use MeOH to supplement when gasifier is rate limited

• Sell excess MeOH during low demand

• Use MeOH as start-up fuel

• Produce higher value chemicals for internal use or resale
Keys to Success

• Production Rate
• Reliability
• Maintenance
• Safety
• Environment
• Continual Improvement
Production Rate & Reliability

- Stable, continuous demand for downstream chemicals
- Continuous debottlenecking of downstream plants keeps demand growing
- No back-up supply
- “Downtime domino”

Current full rate is approximately 140% of the original design
Gasification Unit Operating Statistics

8/99 - 9/01 (Two Year Maintenance Cycle)

- Onstream: 97.8%
- Planned: 1.2%
- Unplanned: 1.0%
- Not Needed: 0.0%

Downtime: 2.2%

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Gasification Unit Operating Statistics
8/99 - 9/01 (Two Year Maintenance Cycle)

Secondary Measures:

Forced Outage Rate = 1%

Unplanned Outage/(On-stream + Unplanned)

Capacity Factor = 120%

Annual production/(Design full rate X 365 days)
1. Continually balancing reliability vs maintenance staffing
2. New process to increase % “planned” maintenance
3. Improvement projects targeted at increased reliability
4. Bi-annual shutdown efficiency improvements
5. Overall cost trending down
• Plant Site OSHA-R rate is 1.1
• Gasification area OSHA-R 1.0
• Last work day out case was 10 years ago
• Plant site received Tennessee OSHA “Volunteer Star” certification
Environment

- Sulfur removal is 99.9%
- $\text{NO}_x$ is not an issue
- Mercury removal since start-up
- Patented sulfur-free start-up process
- Excellent record and reputation with EPA auditors
Continual Improvement

Major Improvements and Enhancements

• Feed Injector Design Improvements
• Alternate Feedstocks
• Complex Shutdown Planning/Execution
• Gasifier “Quick-Switch”
• State-of-the-art Distributive Control System
• On-site expertise on refractory changeouts
• Sulfur-free start-up
Where is Gasification going?

• Most flexible (power, chemicals or both)

• Power industry holds the most promise (number of projects and scale)

• Raw material is cheap and stable

• “Cleanest” coal technology
  • \( SO_x, NO_x, \) PM very low
  • Some improvement on \( CO_2 \), Best option for \( CO_2 \) sequestration
  • Hg removal economical

• Proven technology
Where is Gasification going?

It’s on the verge of taking off!
Where is Gasification going

So what’s the problem?

- Capital Cost
- Reliability
Where is Gasification going

So what’s the problem?

- Capital Cost
  - This will naturally come down with duplication and scale
  - PC and NG are mature and have a head start
Where is Gasification going

So what’s the problem?

- Reliability
  - Eastman can solve this problem
Eastman will begin exploring O&M services options for the gasification industry

- Proven track record (18+ years experience)
- Industry leading performance
- Vast support services
- Commitment to excellence
Let’s take the next step together