Flare Optimization- A Target for Energy Savings

IETC
New Orleans
May 31, 2012
LyondellBasell is…

- One of the world’s largest olefins, polyolefins, chemicals and refining companies with revenues of $41 billion (2010)

- The global leader in polyolefins technology, production and marketing

- A pioneer in propylene oxide and derivatives

- A producer of fuels and refined products, including biofuels

- Dedicated to ongoing research and development programs that meet the ever-changing requirements of our customers, including the creation of new catalysts, processes and products

- Listed on the New York Stock Exchange (NYSE) as a publicly traded company. Ticker symbol: LYB
**Fast facts**

- Third-largest independent chemical company in the world

**Five business segments**
- Olefins and Polyolefins – Americas
- Olefins and Polyolefins – Europe, Asia and International
- Intermediates and Derivatives
- Refining and Oxyfuels
- Technology

**Delivers exceptional customer value across the petrochemical chain**
- Vertically integrated facilities
- Broad product portfolio
- Manufacturing flexibility
- Superior technology base
- Operational excellence
Global reach

• 58 plants in 18 countries

• More than 14,000 employees worldwide

• Sales in more than 100 countries

Owned and operated by LyondellBasell, its subsidiaries and/or joint ventures
Diversified and vertically integrated portfolio

Wellhead

Refining

Olefins

Olefin Derivatives

2nd Level Derivatives

- Olefins & Polyolefins Americas
- Olefins & Polyolefins Europe Asia & International
- Intermediates & Derivatives
- Refining & OxyFuels
- Technology

Capturing value along the chain

Technology

Crude

Refining

Natural Gas Liquids

Aromatics

Fuels

Olefins Crackers

Olefins

Oxy Fuels

Polyethylene

Polypropylene

Polybutene-1

Propylene Oxide

Acetyls

Ethylene Oxide

Styrene

PP Compounding

Catalloy Process Resins

Glycols Glycol Ethers Butanediol

Glycols Glycol Ethers

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Our product lines and the end markets we serve…

Olefins & Polyolefins
- Americas
- Europe, Asia & Int'l

Intermediate & Derivatives
- Ethylene
- Propylene
- Polyethylene
- Polypropylene
- Catalloy process resins
- PP Compounds
- Polybutene-1
- Propylene Oxide
- Styrene Monomer
- PG and PGE
- Acetyls
- C4 Chemicals
- Ethylene Oxide
- EG and EOD

End Uses
- Food Packaging
- Textiles
- Automotive
- Appliances
- Films
- Flexible Piping

End Uses
- Insulation
- Home Furnishings
- Adhesives
- Consumer Products
- Coatings

Refining & Oxyfuels
- Gasoline
- Diesel
- Olefins Feed
- Oxyfuels

End Uses
- Automotive Fuels
- Aviation Fuels
- Heating Oil
- Industrial Engine Lube Oils

End Uses
- Polyolefin and Chemical Manufacturers

Technology
- Process Licensing
- Catalyst Sales
- Technology Services
- New Ventures

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Flare Optimization -
A Target for Energy Savings
Flares – Why do we need them?

- “The primary function of a flare is to use combustion to convert flammable, toxic or corrosive vapors to less objectionable compounds.” (API 521 paragraph 6.4.1)

- Critical process safety equipment for both….. emergency and routine operations.
Flows to Flare Systems

• Emergency
  – Pressure relief flows
  – Emergency depressurization

• Episodic
  – Venting required for maintenance
  – Venting required for regeneration
  – Shutdown/Start-up operations (de-inventorying)
  – Process Upsets

• Continuous – 99+% of Typical Operation
  – Sweep gas through the flare system piping
  – Process venting (continuous analyzer flows, gas seals, certain types of pressure control)
  – Pressure Relief Valve leakage

Main Focus for this discussion
Flare Operation – Main Areas of Evaluation

Purge Gas velocity
- Referenced against API 521, AIChE and LyondellBasell Engineering Stds.
- Current vs. required: Header & Flare tip

Purge Gas Btu Control
- Actual against EPA requirements
- Btu Control Mechanisms
- Off gas flow optimization
- Process Trends

Steam Optimization
- Manufacturer’s recommendation
- Automatic control systems

Inert gas
- Source identification
- Flow optimization
Areas Probed

- Flare Btu’s monitored?
- Is Natural Gas added to increase Btu value?
- Is Nitrogen used as purge for Flare header systems?
- Are flows monitored and instrument PMs performed?
- How is steam controlled?
Flare Assessment Tool

Calculations Performed

- Flare Gas composition
- FG Btu Value
- FG Header velocity
- Flare tip velocity
- Steam flow trends
- Inert composition
- Natural gas flow
Main Opportunity Themes- Low / No Cost

- High Flare header system velocities
  - Analysis of header flow inputs enables flow reduction
- Systematic analysis and minimization of Nitrogen purges
- NG addition minimization for purging
  - BTU control for the purge gas (usually between 200-300 Btu/SCF*) is essential
- Minimization of cooling steam to manufacturer’s recommendations
  - Fixed restriction orifices for tip cooling steam is a viable option
- Steam Optimization
  - Steam to hydrocarbon ratio control is recommended during episodic releases
- Component analysis reduces process leaks and minimizes product losses

* As defined in the Federal register 40 CFR 60.18 for 98% CE
Benefits

• Savings
  • High benefit to cost ratio
    – Energy Savings
    – Import purchase savings (Nitrogen, Nat Gas etc.)
    – Recover product loss in Flare

• Awareness
  • System design specification vs. actual operation
    – Optimum operation

• Environmental
  • Reduce pounds to the flare
  • Assure proper flare destruction efficiency (DE)
    – EPA Requirements
    – TCEQ Focus
Impact of Steam on DE

- Steam to HC ratio < 3 to 1 = 98% +
- Steam to HC ratio 5 to 1 = 82%
- Steam to HC ratio 6 to 1 = 69%*

*Based on testing protocols:
  - EPA / CMA joint testing program in 1982 (propylene / nitrogen / natural gas mixtures)
  - EPA / EER (Energy Environmental Research) testing program in 1984 to 1986 (H₂S / propane / nitrogen mixtures)
  - EPA / DuPont testing program in 1997 (hydrogen influence)
An optimized Flare system will have a significant impact on site Energy reduction and flare Destruction Efficiency improvement
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