PYROLYSIS FURNACE

Application Solutions Guide

Achieving safe, reliable, and profitable furnace operation presents Olefins producers with multiple challenges. Rarely can these challenges be easily addressed because poor performance is often caused by a number of contributing factors. Understanding the relationship between these factors is the first step toward gaining immediate and long-term performance improvements.

The path to improved furnace performance.
Building on Emerson's unique PlantWeb® digital plant architecture, we are able to offer a set of complementary solutions to protect, control, and reliably manage your furnace operations.

Because safety is your highest priority, Emerson's smart safety solutions ensure that start-up, routine operation, abnormal situations, and shutdowns are safely and robustly executed.

With safety of the furnace operations ensured, Emerson's smart performance management capabilities can go to work, providing you with valuable data and effective controls that allow you to economically optimize performance.

Add the predictive capabilities of Emerson's asset optimization offerings and you have laid the groundwork for ensuring you run your furnaces at their maximum capacities – with optimal product yields, while minimizing the rate of coking.

Performance Challenges	Business Consequence	Improvement Opportunities
Furnace Coking impacted by: • Control variability on feed, steam, and coil outlet temperature (COT) • Steam/hydrocarbon ratio imbalance • Poor operator visibility to coking rate • Poor flame distribution	**Reduced Unit Availability**	Optimize the decoking cycle through tighter control and temperature stability to improve furnace performance and run length.
Maintenance Cost impacted by: • Frequent decoking • Cracking tube replacement • Frequent low and ultra-low NOx burner maintenance • Analyzer maintenance • Transfer line exchanger cleaning	**Increased Maintenance Cost**	Extend intervals between decoking and furnace maintenance with the help of advanced diagnostics, key performance calculations, and optimal analyzer design.
Energy Management impacted by: • Excessive fuel consumption • Fluctuating fuel gas composition • Poor combustion control • Steam system operation	**Increased Energy Cost**	Reduce energy cost through better combustion control, tightly controlling stack O_2, and improved response to fuel disturbances.
Safety, Health, and Environment impacted by: • Thermal shock from emergency shutdown • Spalling, which creates transfer line exchanger issues • Insufficient emissions monitoring (CO_2, CO, NOx, SOx) • Inconsistent startup and shutdown • Boiler feedwater and steam loss	**Increased SH & E Risk**	Reduce safety, health, and environmental risks with improved control and better visibility to asset health and process variabilities.

Chemical Application Solutions Guides are available on the following applications:

Furnace Cracked Gas Compressors Recovery Section

EMERSON™
Process Management

CUSTOMER PROVEN

"When we looked at the functionality provided by the SmartProcess® Ethylene Furnace, it was a no-brainer for us. You either have to develop similar functionality yourself from scratch or you use a standard application that is developed and supported by Emerson. And the additional opportunity for using some of the advanced control features that are embedded in DeltaV™ adds icing on the cake. Why wouldn't you do it?"

Michael Polasek, Technical Staff Engineer, **Eastman Chemical Company**

"When you look at the complexity of building 10 units at one time, and asking all of them to start up in a short timeframe with minimum disruption, it's pretty amazing. At the beginning, we saw no probability of finishing in early 2005, but we were able to finish three months earlier than originally planned, and Emerson deserves much of the credit for making that happen."

Jack Brinly, Deputy Project Director, **SECCO**

"EP-rich cracked gas is not only our number-one source of furnace BTU but very tricky to control due to large BTU/scf variations. Mass measurement eliminates the majority of the variation."

Principal I&CS Engineer, **Major Global Olefins Producer**

"With so many contractors, SECCO realized that partnering with one main automation supplier early – that is, using the MIV approach – would be critical for the success of the project."

Danny McHugh, Process Control Manager, **SECCO**

SERVICES & SUPPORT

Whether you are upgrading to a modern digital control system, expanding your plant, or building a new one, Emerson's consultants can help you design, justify, and implement improved cracking furnace control.

FEED SERVICES

Many customers involve Emerson from the conceptual design phase when building a new plant so that best practices – across all aspects of the control platform – can be specified early.

Our engineers have performed Front End Engineering Design (FEED) to automate some of the world's largest ethylene complexes, specifying a complete set of deliverables, a detailed project plan, and costs within ±10% accuracy. Emerson's comprehensive set of deliverables can include field devices, control systems, safety systems, advanced control and optimization, mass balancing, and interfaces to Enterprise Resource Planning (ERP) systems.

OPTIMIZATION AND LIFE CYCLE SERVICES

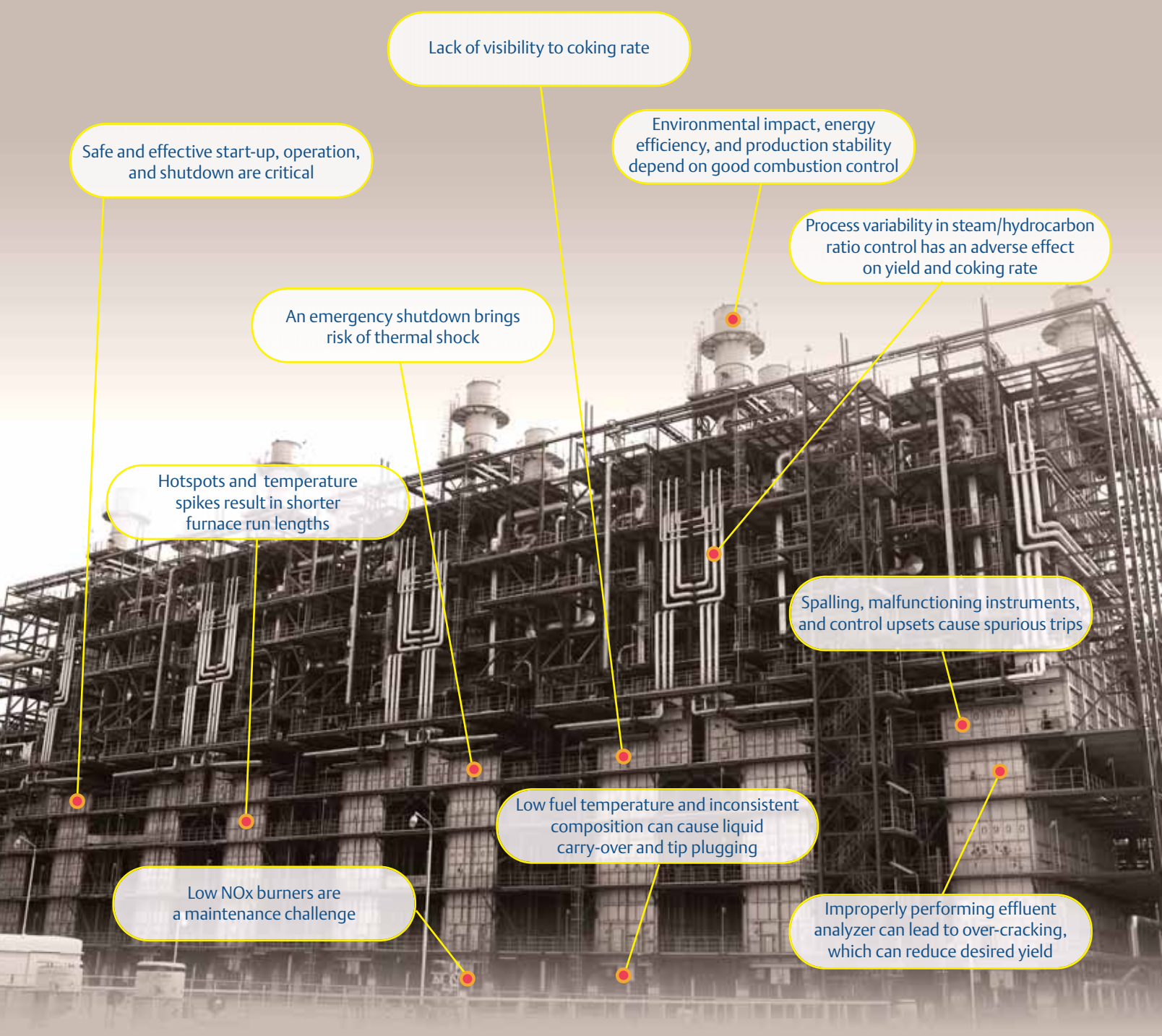
When building a new plant or upgrading or expanding an existing plant, Emerson's experienced Advanced Applied Technologies consultants and the SureService℠ portfolio of services can help you optimize furnace performance while reducing maintenance costs. Emerson provides the best technologies to improve your competitive advantage and help you protect your investment by ensuring your system is routinely supported and serviced.

Our consultants can customize a solution tailored to address your furnace challenges, including:

- **Project-to-Operations Transition Support**
  Introducing new technologies and work practices can often strain site resources. Emerson's experts can help you ensure seamless commissioning and start-up of your process units. And we can help you make sure your plant personnel is ready to adopt the new technology. With our complete operator training solutions we can bring your plant personnel to the required level of expertise – without the complexity and cost associated with typical simulation systems.
- **Control Performance Improvement**
  Through control loop troubleshooting and process diagnosis, our experts help you stabilize your furnace operations and eliminate excursions that cause excess fouling and poor yields.
- **Safety Services**
  Emerson's functional safety engineers, the highest number certified in the industry, use our TÜV-certified safety process to help you properly design safety systems and burner management systems to minimize spurious trips.
- **Reliability Maintenance Services**
  Assets deteriorate over time. That can't be avoided – but you can plan for it. Emerson can audit your furnaces and other assets and provide recommendations to help you avoid unplanned outages and extend the life of your assets.

With Emerson's experienced consultants and comprehensive set of services, combined with pre-engineered SmartProcess application packages, you'll see immediate results on your company's bottom line.

FURNACE CHALLENGES



You can achieve greater efficiency in your furnace with less downtime.

Emerson Process Management has the expertise, technology, and experience to make it happen.

STRATEGY FOR A SMART FURNACE

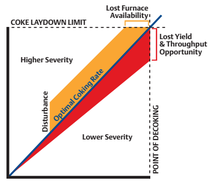
Predictive Intelligence and the Power to Use It

Emerson's PlantWeb digital Smart Furnace architecture enables you to harness the power of predictive intelligence to operate more efficiently, safely, and effectively.

With PlantWeb you gain unmatched capabilities to improve profitability through reduced cost and improved output.

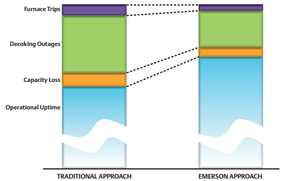
PLANTWEB IN ACTION

Improved Yield



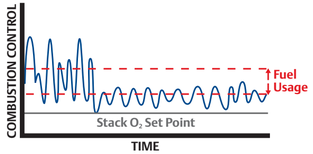
Emerson's SmartProcess pyrolysis furnace application provides control functions designed to maximize the yield of high-value products from each of your cracking furnaces. Improved control of furnace severity, charge rate and dilution steam ratios, combined with pass outlet temperature balancing, ensures furnaces can be operated at maximum severity and still achieve your desired run length between decoking cycles.

Increased Uptime



Recent benchmarking studies say cracking furnace upsets and unplanned outages are the primary cause of lost production. Emerson's control technologies dramatically improve equipment reliability through advanced diagnostics and control strategies to improve your furnace uptime by reducing furnace trips and extending the time between decoking cycles.

Reduced Energy Costs and Environmental Impacts



While pyrolysis furnaces are generally designed to be highly efficient, you can further boost efficiency by using stack O_2 and CO analyzers to minimize excess air, variable speed drives for induced draft fans, and abnormal situation prevention (ASP) techniques to detect flame instability.

Protection, Control, and Asset Optimization

Smart safety, smart digital control, and asset management systems power PlantWeb by enabling operations and maintenance staff to optimize production and availability as well as run their plants safely.

Fed by rich and reliable process information from intelligent field devices, you are empowered to raise performance, improving overall yield and profitability.

At the same time, asset health diagnostics give you clear direction on which assets – including automation, electrical, process and rotating equipment – are in most need of attention, and how to avoid operational interrupts.

SMART SAFETY

The key to maintaining safe operations is early visibility to deteriorating conditions – backed by a reliable, integrated safety loop when the situation becomes critical.

Our smart SIS takes advantage of the proven predictive intelligence of PlantWeb to give you the visibility you need – with time to correct issues. You'll operate with greater confidence through improved burner management, remote testing of SIS, and safely and automatically decoking.

And when a shutdown is unavoidable, you'll have the most reliable, integrated safety loop available, giving optimal response time for emergency shutdown, fire and gas systems, and safely managing the furnace during shutdown and restart.

www.EasyDeltaV.com

SMART DIGITAL CONTROL

Gain better furnace control with DeltaV:

- Embedded Advanced Process Control tools used with smart field instruments can help improve stability and avoid excess coking by balancing passes, compensating for process disturbances, predicting constraint violations, and automatically calculating optimal tuning parameters for all process control loops.
- Standard shutdown logic modules can automatically detect when a signal is bad or out of service, generating a PlantWeb alert, but avoiding downtime.
- SmartProcess's automatic startup, shutdown, and decoking sequences provide a safe, consistent, and robust system that minimizes downtime for decoking operations and maintains furnace integrity during transient conditions.

www.EasyDeltaV.com

SMART ASSET OPTIMIZATION

Avoid excess coking and the associated decrease in availability with AMS® Suite:

- AMS Suite reports potential problems with your key mechanical assets, electrical system, instruments, and valves.
- Valve accuracy and fuel flow consistency capabilities of AMS ValveLink® SNAP-ON™ allow for more efficient maintenance planning.
- AMS Meter Verification SNAP-ON allows for online meter verification and problem detection, ensuring fuel gas measurement stability and accuracy.

www.EmersonProcess.com/Optimize

Process Variables

Health Diagnostics

Field Intelligence

With the right intelligence, your field assets not only provide more precise and reliable information on the process, but they also self-diagnose their health and alert you to potential problems.

Devices, instruments, and software designed with best-in-class intelligence power PlantWeb by enabling you to extract rich and reliable data from your process to optimize control.

What makes PlantWeb better?

- It's the only digital architecture with proven success in thousands of projects.
- Predictive intelligence enables detection and avoidance of potential problems.
- It's networked, not centralized.
- It's engineered to seamlessly gather and manage information to enable highly optimized operations.
- It uses open standards at every level of the architecture.
- It provides process control, plus asset optimization and integration with other systems.

www.EmersonProcess.com

SMART FINAL CONTROL

Designed for high temperature service and low emissions:

- Improved response time and reduced dead band decrease process variability that leads to excessive coking
- Fisher® ENVIRO-SEAL® graphite ULF packing system reduces fugitive emissions and minimizes valve friction
- Fisher FIELDVUE® instrument provides in-service performance diagnostics to maintain control valve reliability and enable predictive maintenance

Featured Technologies:
Fisher Digital Valves

www.EmersonProcess.com/Fisher

SMART ASSETS

- CSI 9330 Vibration Transmitter or CSI 9420 Wireless Vibration Transmitter monitor induced draft fan vibration to avoid mechanical issues related to excess imbalance, alignment, and unfavorable damper settings.
- AMS Suite's predictive diagnostics for mechanical assets and field devices allow for more efficient furnace performance by alerting plant personnel to:
  - Coil Outlet Temperature (COT) drift
  - Analyzer issues
  - Feed and steam valve issues
  - Excess imbalance and misalignment

Featured Technologies:
CSI transmitters and AMS Suite

www.EmersonProcess.com/Optimize

SMART MEASUREMENT

- Decrease risk of meter impulse pipes plugging due to carbon fines with the unique non-clog design of the Rosemount® 8800D Vortex Flowmeter for HC flow
- With superior performance in the most challenging environments, Micro Motion® Coriolis flow measurement and vibrating element density technology:
  - Reduce rate of coking with better control of furnace feed, fuel, and coke inhibitor injection
  - Provide widest turndown (startup to max flow) with limited influence from gas composition changes, straight pipe runs, and pressure and temperature effects
  - Verify meter performance easily with in-situ meter verification during periodic unit-turnaround, decoking cycles, and process troubleshooting
- The Rosemount 848T Multi-Input Temperature Transmitter's multi-sensor measurement capabilities and diagnostics provide continuous monitoring of the tube-skin temperature, resulting in reduced risk of violating metallurgical limits of cracking tubes and fewer unnecessary trips to the field
- Reduce risk of losing critical process parameters that can decrease production with Rosemount 3144P Temperature Transmitter for COT control and advanced diagnostics, embedded redundancy, and safety-certified, dual-compartment housing ideal for harsh environments
- With integrated temperature, pressure, and flow in one device, Rosemount 3051SMV MultiVariable™ Mass Flow Transmitter enables:
  - Improved pressure/temperature compensation
  - Reduced furnace temperature fluctuations which reduce coking and improve yield
  - Easier, cost-effective installation and configuration
- The Rosemount 3051S with ASP™ Diagnostics Suite delivers:
  - 10x performance improvement with unprecedented reliability backed by a 12-year limited warranty
  - Advanced diagnostics that provide process insight to prevent problems associated with flame stability, plugging, coking rates, and burner fouling

Featured Technologies:
Rosemount Pressure, Level, Temperature, and Flow Technologies and Micro Motion ELITE® flow and density meters

www.EmersonProcess.com/Rosemount www.EmersonProcess.com/MicroMotion

SMART ANALYTICAL

Rosemount® Analytical combustion flue gas analyzers achieve:

- Increased fuel savings
- Safer, more reliable furnace operation
- Furnace optimization
- Effective diagnostics for identifying fouled burners and other furnace problems
- Better monitoring of NOx production

Rosemount Analytical Model 700XA Gas Chromatograph enables:

- Analysis of furnace fuel Wobbe index stabilizing burner flame characteristics
- Analysis of cracking furnace effluent
  - Fast update results for ethylene optimization
  - Feed-forward control to compensate for variations in furnace feed composition
- Elimination of the need for costly shelters due to the rugged, transmitter-style design

Featured Technologies:
Rosemount Analytical Gas and Liquid Sensors

www.EmersonProcess.com/raihome

SMART WIRELESS

With more monitoring measurements than anywhere in the plant, the furnace is perfect for wireless. Less expensive and easier to install you can:

- Unleash critical maintenance data on legacy non-HART® systems with the Smart Wireless THUM™ Adapter – without additional I/O
- Monitor the health of rotating equipment with the CSI 9420 Wireless Vibration Transmitter
- Monitor coking rate by measuring the coil DP (ΔP) wirelessly

Featured Technologies:
THUM and CSI 9420 transmitter

www.EmersonProcess.com/SmartWireless

With over 600 major sales, project execution, and support locations in more than 85 countries, we are here for you.

Please contact your local Emerson Process Management sales office or representative, or visit our website at www.EmersonProcess.com

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PlantWeb®

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D351573X012 / 00803-0100-6135 / MC-001142 / Printed in USA / 2.5K / 11-08