

OLEFIN RECOVERY SECTION

Application Solutions Guide

Challenge

The goal is to make products that have the most value in the marketplace while controlling costs. To do that, olefins producers need to maintain throughput without interruption and match the output of ethylene, propylene, butylene, etc. to downstream demand. That requires the ability to react as rapidly as possible to an ever-changing operating environment, including the variability of feedstocks coming from the cracking furnaces and cracked gas compressor, market prices, and fluctuating energy prices.

The path to improved distillation performance

Safe, reliable, and energy efficient – it's not a goal, it's a necessity. And it's achievable. The key is implementing various advanced control applications based on continuous monitoring with smart, highly accurate instrumentation – such as state-of-the-art online analyzers – that allow the columns to operate closer to known constraints.

Emerson's SmartProcess™ Distillation Column Optimizer for recovery encompasses a range of technologies and best practices that can be tailored to improve distillation operations in any olefins plant. Potential results include 5-10 % additional capacity, 40-80 % reduction in standard deviation, 2-5 % energy reduction, more stable operations, or a combination of these.

Performance Challenges	Business Consequence	Improvement Opportunities
Yield/Throughput impacted by: <ul style="list-style-type: none"> Recovery loss when capacity exceeded High "quality giveaway" due to poor composition control Off-spec material lost in flaring 	Reduced Profitability	Operate closer to your constraints because of reduced process variability and achieve higher product quality because of improved composition control.
Maintenance Cost impacted by: <ul style="list-style-type: none"> Equipment degradation and failure Damage due to excess vapor flow (jet flooding) 	Increased Maintenance Cost	Avoid costly shutdowns and keep critical assets operating longer by implementing a predictive maintenance strategy with the help of enhanced diagnostics.
Energy Management impacted by: <ul style="list-style-type: none"> Inefficient heat recovery Poor composition control Excessive reflux to avoid off-spec material 	Increased Energy Cost Reduced Productivity	Operate at minimum reflux to optimize product recovery versus energy consumption. Improve heat balance by optimally controlling reflux.
Safety, Health, and Environment impacted by: <ul style="list-style-type: none"> Leakage at feed pumps and/or reflux valves Fires caused by hydrocarbon leaks 	Increased SH&E Risk	Performance diagnostics identify faulty valves, and vibration monitoring helps you to prevent pump failures.

Chemical Application Solutions Guides are available on the following applications:

Furnace Cracked Gas Compressors **Recovery Section**

CUSTOMER PROVEN

Improving the performance of recovery section operations can save a company millions of dollars. For example, at Huntsman Corporation, advanced process controls on six distillation columns were updated, resulting in 18% per year reduced energy usage, improved product quality, and a 10% increase in throughput.

After an outmoded control system was replaced with Emerson's state-of-the-art DeltaV™ automation system, the company also needed to replace the existing multivariable advanced controller, which had been applied on top of the legacy control system for the distillation columns. While advanced controls for this critical part of the process might have been obtained from other sources, the advanced control package embedded in the DeltaV system offered the greatest potential for improving the distillation process with the least cost to implement.

Huntsman engaged two Emerson process control consultants to study deficiencies and opportunities for improvement in the existing distillation control scheme. They were challenged to determine if greater energy efficiency and increased throughput could be achieved. Following the study, the consultants' recommendations were accepted, and Huntsman chose to implement Emerson's SmartProcess distillation control package which utilizes model predictive control (MPC) embedded in the DeltaV system.

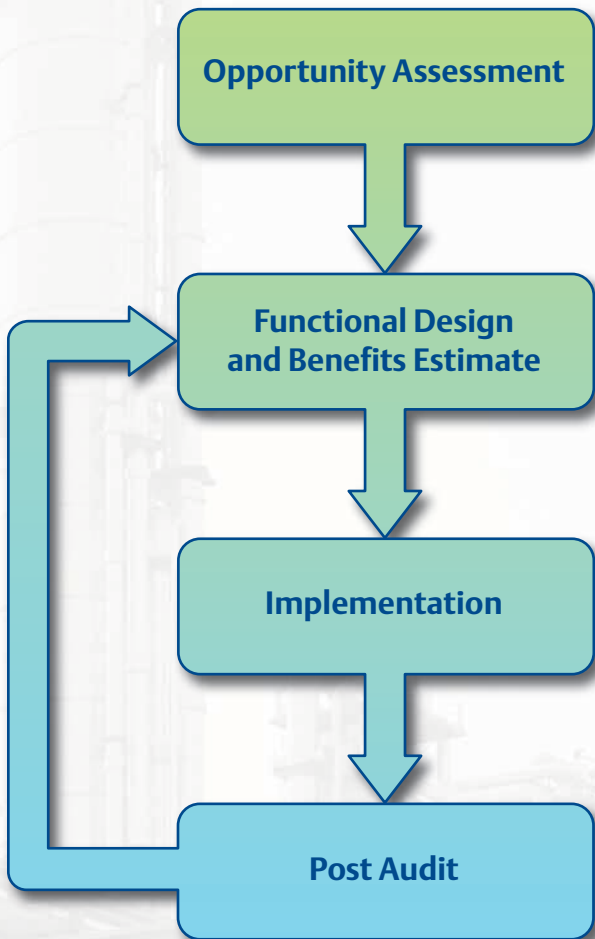
One immediate benefit of this solution was a faster, easier, and less expensive deployment of their advanced process control strategy, implemented by a close-knit Emerson/Huntsman partnership. The PlantWeb™ architecture also includes Micro Motion® mass flow meters, Fisher® valves and FIELDVUE™ digital valve controllers, Rosemount® instrumentation, and AMS™ Suite: Intelligent Device Manager predictive maintenance software.

The combination of advanced process control and other Emerson technologies and services is enabling Huntsman to meet their goals for improving their recovery operations.

“We implemented Emerson’s SmartProcess distillation application and the embedded MPC with the help of their control experts. In the first phase, MPC helps us maintain a project accomplishment of about 18% energy savings over past performance. The second phase is currently underway, and the project effort has achieved about 6% improvement on some of our biggest energy users so far. Although the performance of the system in the long term remains to be seen, we are hopeful the SmartProcess distillation application and MPC will help us maintain these savings – without other adverse impacts.”

David Johnson
Maintenance and Engineering Manager
Huntsman Corporation

OPERATIONAL EXCELLENCE



Emerson can help you achieve operational excellence through our **OpX Advantage Program** – a proven method for applying a combination of process automation technologies that increase recovery, reduce energy, lower maintenance costs, and make your people more productive in their jobs. Improvement may be achieved by correcting faulty field instruments, tuning controllers, implementing better control schemes or advanced process control, and utilizing asset optimization and information systems.

Working closely with plant personnel, Emerson’s chemical process control experts assess your recovery section, the way it is operated, and its performance compared with industry benchmarks. Our consultants evaluate current operating and maintenance practices, collect data, identify improvement possibilities, and estimate the financial impact of possible automation investments. Prospective projects are prioritized according to need and potential.

Each selected project is defined in a functional design specification, including a more rigorous analysis of costs versus benefits. Detailed discussions with department managers, engineers, and operators about current operating practices, process upsets, off-spec incidents, process efficiencies, and reliability issues provide a basis for designing an automation system addressing your specific requirements and objectives. Our consultants examine performance records and test data to find opportunities to maximize recovery, reduce energy usage, operate against multiple equipment limits, and improve quality control. Their recommendations always include detailed estimates of costs and benefits.

We’ll then help you implement an effective program, often beginning with loop optimization to be certain the control foundation is sound, eliminating excess variability and stabilizing column operation. Any changes to process control strategies are done in a way that minimizes the risk of disrupting the process. Results are tracked and used to manage and fine-tune the system, and Key Performance Indicators (KPIs) are built into every solution so supervisors can watch unit performance to be certain the benefits are not lost.

A formal post audit is recommended to confirm that the expected benefits were achieved. Of course, your Emerson team stands ready to return and make whatever adjustments are necessary to maintain operational excellence.

RECOVERY CHALLENGES

Over-purifying finished product streams is energy inefficient and reduces production volumes

Columns are operated with excessive reflux to avoid going off-spec

Close boiling points of components in C2 and C3 splitters make them difficult to control

Adjusting conditions in one column changes the heat balance in whole plant

Production is lost when flooding causes off-spec materials

No product storage so off-spec materials must go to flare and are lost

Bottom purification needs to be optimized to minimize product recycle to the cracking furnaces

Excessive vapor flow (jet flood) can cause mechanical damage

Icing on the control valve stems and impulse lines causes poor control

Inefficient heat recovery wastes energy

Leaks around pumps and valves can create safety issues

You can achieve greater separation efficiency by using Emerson's automation solutions.

Emerson Process Management has the technology and experience to meet and overcome your olefin plant challenges.

STRATEGY FOR A SMART RECOVERY SECTION

PLANTWEB IN ACTION



Predictive Intelligence and the Power to Use It

Emerson's PlantWeb digital smart recovery section 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.



Improved Recovery

PlantWeb enables you to maximize the recovery of olefins by reducing process variability so you can control the product quality at the required specifications. Recovery is optimized as the unit responds to shifting plant constraints, feedstock composition, and throughput. Online composition analysis and best-in-class measurement capabilities enable more consistent operations and faster, stable responses to disturbances.

Improved Capacity

With PlantWeb you can continuously optimize the recovery section operation. This means that the maximum capacity of the recovery section is always available, which reduces the frequency and duration of periods when the recovery section limits overall plant throughput. Extensive instrument and asset health diagnostics enable predictive maintenance practices which reduce the likelihood of equipment failures that affect plant capacity.

Reduced Energy Costs

Better control of column operation allows the opportunity to significantly improve separation effectiveness. With better separation efficiency, less energy is needed to achieve the same separation requirements. The distribution of energy from all available sources is optimally distributed across the recovery section, economically balancing separation, recovery, and energy consumption.

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 interruptions.

SMART SAFETY

The key to maintaining safe operations is early visibility to deteriorating conditions – backed by a reliable, integrated safety system 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. With remote testing of SIS functions and partial stroke testing, you'll operate with greater confidence that your safety release valves and emergency shutdown systems will respond appropriately in an emergency. And when a shutdown is unavoidable, you'll have the most reliable, integrated safety loop available.

www.EmersonProcess.com/DeltaVSI

SMART DIGITAL CONTROL

Emerson's SmartProcess Distillation application uses the DeltaV embedded advanced process control (APC) software combined with smart field devices to improve product quality, recovery, and energy usage in the entire distillation train:

- Optimize the allocation of limited utilities and automatically operate the columns at limiting constraints using the built-in linear program that comes with the APC solution.
- Achieve closed-loop control of product qualities based on real-time neural-net models updated periodically from on-line analyzers or laboratory samples.
- Easily identify instrumentation and control loop problems and automatically calculate optimal tuning parameters with DeltaV InSight.

www.EmersonProcess.com/DeltaV

SMART ASSET OPTIMIZATION

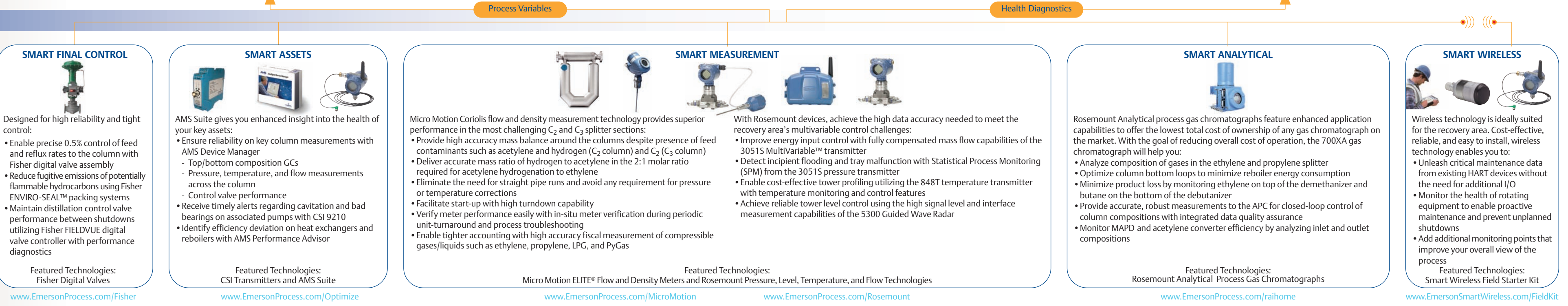
Running close to your plant's design constraints means you need to have complete confidence in your assets. There's no room for instrument drift on the many critical recovery area measurements, the energy losses associated with fouling heat exchangers, or malfunctioning pumps. With AMS Suite, maintenance becomes part of a strategic plan – not something you react to when problems become critical. Emerson's consultants can help you generate asset criticality numbers to determine which assets justify being monitored. And with AMS Performance Advisor, you'll know when your heat exchangers veer from their efficiency design specification so you can take corrective action.

www.EmersonProcess.com/Optimize

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.



SMART FINAL CONTROL

Designed for high reliability and tight control:

- Enable precise 0.5% control of feed and reflux rates to the column with Fisher digital valve assembly
- Reduce fugitive emissions of potentially flammable hydrocarbons using Fisher ENVIRO-SEAL™ packing systems
- Maintain distillation control valve performance between shutdowns utilizing Fisher FIELDVUE digital valve controller with performance diagnostics

Featured Technologies: Fisher Digital Valves

www.EmersonProcess.com/Fisher

SMART ASSETS

AMS Suite gives you enhanced insight into the health of your key assets:

- Ensure reliability on key column measurements with AMS Device Manager
 - Top/bottom composition GCs
 - Pressure, temperature, and flow measurements across the column
 - Control valve performance
- Receive timely alerts regarding cavitation and bad bearings on associated pumps with CSI 9210
- Identify efficiency deviation on heat exchangers and reboilers with AMS Performance Advisor

Featured Technologies: CSI Transmitters and AMS Suite

www.EmersonProcess.com/Optimize

SMART MEASUREMENT

Micro Motion Coriolis flow and density measurement technology provides superior performance in the most challenging C₂ and C₃ splitter sections:

- Provide high accuracy mass balance around the columns despite presence of feed contaminants such as acetylene and hydrogen (C₂ column) and C₂ (C₃ column)
- Deliver accurate mass ratio of hydrogen to acetylene in the 2:1 molar ratio required for acetylene hydrogenation to ethylene
- Eliminate the need for straight pipe runs and avoid any requirement for pressure or temperature corrections
- Facilitate start-up with high turndown capability
- Verify meter performance easily with in-situ meter verification during periodic unit-turnaround and process troubleshooting
- Enable tighter accounting with high accuracy fiscal measurement of compressible gases/liquids such as ethylene, propylene, LPG, and PyGas

Featured Technologies: Micro Motion ELITE® Flow and Density Meters and Rosemount Pressure, Level, Temperature, and Flow Technologies

www.EmersonProcess.com/MicroMotion

SMART ANALYTICAL

With Rosemount devices, achieve the high data accuracy needed to meet the recovery area's multivariable control challenges:

- Improve energy input control with fully compensated mass flow capabilities of the 3051S MultiVariable™ transmitter
- Detect incipient flooding and tray malfunction with Statistical Process Monitoring (SPM) from the 3051S pressure transmitter
- Enable cost-effective tower profiling utilizing the 848T temperature transmitter with temperature monitoring and control features
- Achieve reliable tower level control using the high signal level and interface measurement capabilities of the 5300 Guided Wave Radar

Featured Technologies: Rosemount Analytical Process Gas Chromatographs

www.EmersonProcess.com/rainhome

SMART WIRELESS

Wireless technology is ideally suited for the recovery area. Cost-effective, reliable, and easy to install, wireless technology enables you to:

- Unleash critical maintenance data from existing HART devices without the need for additional I/O
- Monitor the health of rotating equipment to enable proactive maintenance and prevent unplanned shutdowns
- Add additional monitoring points that improve your overall view of the process

Featured Technologies: Smart Wireless Field Starter Kit

www.EmersonSmartWireless.com/FieldKit



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and support locations in more than 85 countries,
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