The precise and rapid analysis of process gases within an ethylene plant is vital to ensure safe and efficient operation. A range of process efficiencies can be achieved by shortening the residence time in the cracking furnace; rapidly adapting to changing feed-stocks; improving combustion control; optimizing fractionation; and improving process reliability. Safety is also improved as a result of fast, reliable process analysis technologies with high measurement availabilities.

As the world expert in gas analysis, Servomex has worked with ethylene producers worldwide to create gas analysis solutions that deliver optimum process efficiency while maintaining the highest levels of safety.

By offering operators the widest available range of gas measurement technologies, including breakthrough measurements for light hydrocarbons, Servomex delivers the precise correct measurement for each point in the process.

The result is measurable performance advantages, delivered with enhanced safety as standard. Servomex analyzers and systems are reliable and economical, designed to deliver high performance over a long performance lifetime with lower cost-of-ownership. Informed by our leading-edge expertise in hydrocarbon gas analysis, and supported by a global network of Service and Support, Servomex brings you control and confidence to every point in the ethylene process.
The SERVOTOUGH SpectraExact 2500 and SpectraScan 2400 (1) monitor the feed gas quality for high carbon monoxide (CO) and to maintain a consistent feed to the cracking unit, while the SpectraExact (2) monitors the feed treating for carbon dioxide (CO₂) removal. After the recycled ethane has been blended with the treated feed, the SpectraScan (3) maintains a consistent feed to the cracking unit. The SpectraScan (4) and H2Scan (5) maintain constant fire and heating rates of the steam boiler and cracking unit, with a real time, low maintenance BTU analysis, especially when hydrogen (H₂) and methane (CH₄) rich tail gases are recycled to the burners. Rapid, real time analysis of the feed gas (3) and heating rate (5) is vital to prevent under- or over-cracking, establish the conditions for maximum cracking efficiency and the longest interval between de-coking cycles.

Optimized and safe combustion and reduced fuel consumption is achieved by both detailed fuel analysis and rapid flue gas analysis. The SERVOTOUGH FluegasExact 2700 (6) and (8) offers analysis of both oxygen (O₂) and combustibles (CO₂e), while the SERVOTOUGH Laser 3 Plus Combustion (7) offers an average path analysis across the cracker unit. This delivers a fast and accurate analysis of O₂ and CO₂, as well as the added safety feature of measuring CH₄ breakthrough.

Continuous Emissions Monitoring Systems (CEMS) utilizing the SERVOPRO 4900 Multigas (9)(10)(11)(12) and Servomex sample systems are used to measure the stack emissions for legislative requirements of O₂, CO, NOₓ and SOₓ. The 4900 Multigas can also be installed either side of a Selective Catalytic Reduction Unit to monitor the SCR’s efficiency in reducing NOx emissions, while the Laser 3 Plus (13) monitors the NH₃ level, allowed to “slip” through the catalysis during the NOx reduction reaction.

On the outlet of the cracker unit a transfer line exchanger (TLE) rapidly cools the cracked gas to preserve the gas composition: the SpectraScan and H2Scan (14) monitor the gas quality after the cracking unit, ensuring the highest possible ethylene yield and to prevent under- or over-cracking. During the decoke cycle a SpectraScan (14) with added CO₂ channel can also be utilised to monitor CO₂ levels, as well as ensure the shortest decoking cycle with real time analysis, or a separate SpectraExact (15) can be utilised for this measurement.
After the cracking is complete, the gas feed needs to be cleaned and conditioned before fractionation. The gas is further cooled to remove any heavy hydrocarbons, while remaining CO₂ is also removed as this can freeze out in the liquefaction stages later in the process. This process is measured by the SERVOTOUGH SpectraExact 2500 (1), which measures <5 ppm CO₂ for rapid analysis of any CO₂ breakthrough.

The performance of the dryer/chiller stage is monitored by the SERVOTOUGH SpectraScan 2400, SERVOTOUGH SpectraExact 2500 and H2Scan (2) (3) (4), to ensure that only minimal levels of C₁ and C₂ are separated with the hydrogen (H₂). The H₂ can be further purified by a Pressure Swing Absorber (PSA), the output of which can be monitored for impurities by the SpectraExact, LaserExact 2950, SERVOPRO FID and DF-370 (3), depending on individual requirements.
The clean and dry cracked gas is now ready for fractionation into its component parts. The demethaniser separates the CH₄ and remaining H₂ from the cracked gas, the “tops” of the column can be monitored by a SpectraExact, SpectraScan, and H₂Scan (1) to ensure valuable hydrocarbons are not lost. A cold box or chiller is then used to split any H₂ from CH₄, producing H₂-rich and CH₄-rich tail gases which are monitored by the SpectraExact, SpectraScan, and H₂Scan (2) & (3). The “bottoms” of the Demethaniser are monitored by a SpectraScan (4) to ensure there are only low levels of CH₄ present.

The SpectraScan’s unique light hydrocarbon analysis then delivers multiple measurement points across the C₁ to C₃ fractionation (5) (7) (10) (11) (13) (14) (15), at each of these measurement points the SpectraScan is used to minimize hydrocarbon losses from the “tops” or “bottoms” of the fractionation columns, and due to the fast analysis of the SpectraScan real time optimization of the columns is possible for the first time. The SpectraScan and H₂Scan (6) (12) are used to optimise the hydrogenation units, which convert acetylene (C₂H₂) and C₃H₄ to ethylene (C₂H₄) and propylene (C₃H₆) by the addition of H₂. Too much H₂ is inefficient, risking over-conversion or the H₂ becoming a contaminant in the ethylene and propylene products. Before the ethylene is stored, trace O₂ as a contaminant can be measured using the DF-370 (9).