ENHANCED OIL RECOVERY (EOR) OPERATOR OPTIMIZES PROCESS USING CONTINUOUS MEASUREMENT OF CO₂ BREAKTHROUGH FROM THE PRODUCING WELLS

Customer
A national oil company in the Middle East.

Application
Detection and analysis of CO₂ breakthrough by an EOR operator managing a large number of oil wells.

Challenge
Many oil producers use EOR to gain more production from mature fields. One practice injects CO₂ into the oil deposit to increase underground pressure and push more oil to the surface. When working properly, the well produces a mix of crude oil, water, and natural gas—while CO₂ remains in the ground. This has the benefit of increasing oil production, while sequestering CO₂ that would normally be released to the atmosphere. This sequestration can offset the eventual carbon effects of the oil when consumed.

At this facility, CO₂ is supplied via pipeline from a nearby steel mill at a 98% concentration and 250 bar pressure, ideal for this EOR application. Down-well injection flow is monitored by a Micro Motion™ Coriolis Flow Meter to match injection rates with well production. Eventually, each individual well becomes depleted, and production slows significantly. The first indicator of this is the return of CO₂ mixed in with the natural gas produced from the formation.

Once this happens, production at that individual well must stop as EOR efforts have reached their limit, and the CO₂ being injected is wasted and contaminates whatever natural gas is being produced. Eventually it will be released to the atmosphere and the sequestration lost. The challenge for operators is recognizing when this break point has been reached.

Results
• Improved throughput of oil wells with continuous detection and quantification of CO₂ from the reservoir to determine the break point
• Optimized operational efficiency with early identification of depleted oil wells using real-time process gas analytics
• Neutralized emissions intensity of oil production by reducing CO₂ released from mature wells
Identifying the presence of CO₂ in natural gas requires an analyzer capable of performing the task of evaluating basic natural gas quality, while quantifying CO₂ content.

A continuous gas analyzer is ideal for this service, but it requires a clean flow of dry gas, with no residual oil or water. In practice, this requires a sand filter station; a gas, oil, and water separator (GOWSP); a final moisture removal system; and an oil and moisture interlock to protect the CO₂ analyzer in the event of a GOWSP failure. The GOWSP is specially designed to handle the tough operating conditions of the application, and it requires only minimal utilities. It is also equipped with a sampling system connected to the CO₂ analyzer, and it provides two stages of refrigeration to knock out traces of water.

Solution
Since starting the project in 2014, this Middle East oil producer has installed Emerson’s Rosemount™ X-STREAM Enhanced XEFD Continuous Gas Analyzer on each of their eight oil/gas separators, with each separator serving up to 30 - 40 individual wells. Emerson specially designed the sampling systems with a GOWSP and necessary hardware to connect the separator and CO₂ analyzer. All the control elements—including the Micro Motion™ Coriolis Flow Meter for CO₂ injection and Emerson’s Roxar™ 2600 Multiphase Flow Meter for the mixed-stream of the unprocessed well output—work in conjunction with the Rosemount X-STREAM Enhanced XEFD Continuous Gas Analyzer.

With this comprehensive setup, operators can determine the practical production limits for each individual well. Based on overall output, combined with CO₂ content in the natural gas, operators can optimize CO₂ injection to maximize oil production without waste. As production for a given well reaches its limit, they know when to stop CO₂ injection based on data from the Rosemount X-STREAM Enhanced XEFD Continuous Gas Analyzer. This allows them to move to the next well before releasing CO₂ from the well and reducing output.

This complete solution also included remote administrative control of the site, allowing operators to isolate the system in case of operation disruptions, and simplifying the operation of the system, without the need to staff each remote location.
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Using this approach, the company has continued to drive production from this mature field, taking advantage of its low production costs. It has also fostered sustainability for itself and the neighboring steel mill, and it has made critical steps to reach its goal of sequestering 5 million tons of CO₂ by 2030.

"The complete gas analysis solution helped optimize CO₂ injection to maximize oil production without waste."

Resources
Rosemount X-STREAM Enhanced XEFD Continuous Gas Analyzer
Emerson.com/RosemountXEFD

Rosemount Gas Analysis
Emerson.com/RosemountGasAnalysis

Carbon Capture and Storage
Emerson.com/Carbon-Capture-Solutions

For more information, visit Emerson.com/RosemountContinuousGasAnalyzers