

## CASE STUDY: JOHN CRANE DRY GAS SEALS

# John Crane Custom CO<sub>2</sub> Dry Gas Seals Help Open New Markets for Russian Fertilizer Producer and Leading Compressor Manufacturer



### BACKGROUND

**Industry:** Chemical  
**Site:** Fertilizer production plant  
**Location:** Russia  
**End Product:** Urea



*From experience gained on CCUS projects, John Crane's Type 28XP dry gas seals were optimized for use with supercritical CO<sub>2</sub>*

### CUSTOMER NEED

- In 2012, as a leading Russian producer stepped up fertilizer production to keep up with international and domestic demand, it also faced an aging manufacturing infrastructure
- For example, a urea production plant in western Russia had long produced high-analysis (more than 30% available nutrient) nitrogen-release fertilizer with antiquated reciprocating compressors driven by crankshaft-driven pistons
- A market-leading, global compressor manufacturer knew the time was right to approach the fertilizer producer with more efficient and reliable CO<sub>2</sub> technology that would help it meet increased production goals
- In turn, by successfully demonstrating its CO<sub>2</sub> compressor capabilities, new market opportunities would open for the compressor company
- To bring the company's and nation's expansion visions to fruition, the compressor manufacturer needed an experienced and reliable CO<sub>2</sub> dry gas seal supplier



✓ 145°C/293°F  
✓ 37,500 rpm

### HIGHLIGHTS

- To keep up with rising domestic and international demands, a Russian fertilizer producer planned to upgrade an aging production plant
- A leading international compressor manufacturer partnered with John Crane and approached the plant with a CO<sub>2</sub> compressor that included time-tested dry gas seals
- Following the successful demonstration, the plant began a staged upgrade to two new eight-stage integral gear compressor machines
- The seals proved they could withstand the high heat and pressure conditions of the supercritical CO<sub>2</sub> compressor application
- Mean time between failure (MTBF), output and efficiency improvements have enabled efficient operation of the compressor and met demanding production targets

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### APPLICATION

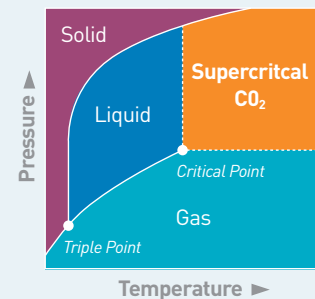
- To simulate the demanding operating conditions at the production facility, the manufacturer worked with John Crane to develop a CO<sub>2</sub> test loop including a single compressor stage
- The test loop, equipped with John Crane custom dry gas seals, simulated the 145°C/293°F heat and 37,500 rpm conditions to process ammonia used in the urea fertilizer
- After making optimization adjustments to the compressor test loop and the seals, the compressor company presented the trial concept to plant engineers
- The engineers accepted the results of the trial and in 2015 the compressor company began a staged installation of two eight-stage integral gear CO<sub>2</sub> compressor machines
- As the machines entered commissioning phases in 2016, John Crane engineers continued to modify the seals to handle the specific conditions of the supercritical CO<sub>2</sub>

### SOLUTION

- The final four stages of each eight-stage compressor were equipped with John Crane custom dry gas seals — eight spares were kept in inventory
- Based on John Crane's proven Type 28XP single, non-contacting gas seal design, the spiral groove patterns of the seals face were optimized to prevent clogs or damage from the CO<sub>2</sub> supercritical fluid
- During dynamic operation, the non-contacting seal eliminated wear — the mating ring and primary ring maintained a sealing gap of approximately 5 µm/0.0002"
- The specially designed, dynamic contactless dry gas seal minimized CO<sub>2</sub> leakage to atmosphere
- The compact length of the seal also provided a shorter overhang and was part of the rotor plan to manage cross coupling effects

### RESULTS

- Today, the fertilizer operation reports that the new machines are significantly outperforming the previous reciprocating compressors
- Due to the special physical characteristics of supercritical CO<sub>2</sub> John Crane has improved the seal design further and has significantly increased MTBF



- Overall plant urea output has improved and is in line with expansion goals; the new CO<sub>2</sub> compressors with John Crane dry gas seals enable the production capacity to **exceed 3,000 tons daily and 1 million tons annually**
- Additionally, the importance of the dry gas seals is also featured in the OEM's marketing of the eight-stage CO<sub>2</sub> compressor

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**80%** OF ALL CO<sub>2</sub> INJECTION CAPACITY  
USES JOHN CRANE DRY GAS SEALS

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