

Espey WKA802 for sealing a CO₂ gear compressor



Multi-stage gear compressor

The fertilizer industry produces millions of tons of CO₂, which usually will be applied for EOR (enhanced oil recovery) or alternatively stored in underground geologic formations (CCS) to prevent the atmosphere gathering greenhouse gas. For the transportation to use in EOR the CO₂ has to be pre-compressed and dehydrated by means of a gear compressor. The American customer operating in the nitrogen fertilizer industry has chosen MAN Diesel & Turbo SE as their supplier for compressors - providing latest technology.

Process description

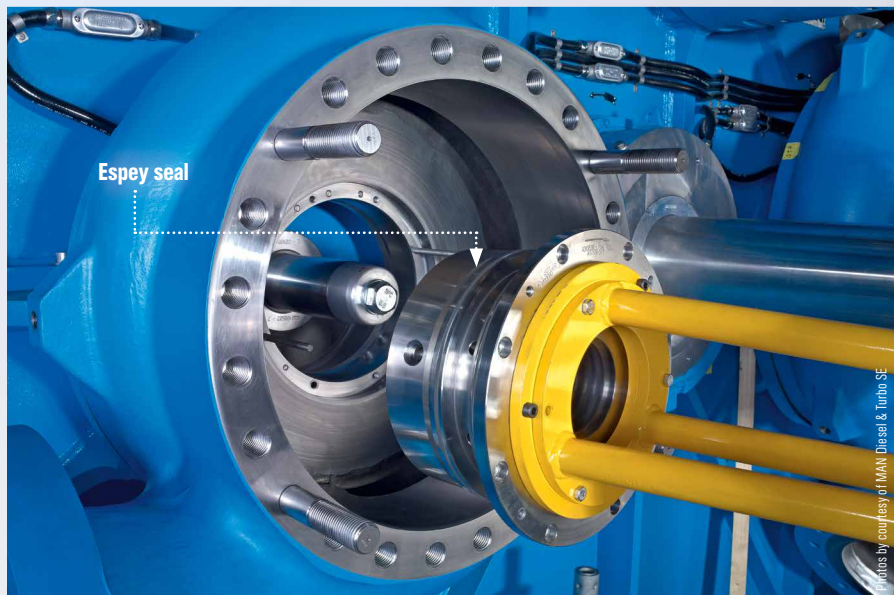
Nitrogen fertilizer production converts nitrogen from the atmosphere into urea, a form of nitrogen fertilizer. This process uses enormous amounts of heat and pressure to convert atmospheric nitrogen into a form usable for plants. The required heat and pressure is usually generated by natural gas, which gives off CO₂ when combusted. After combustion the CO₂ is separated, pre-compressed and dehydrated in a multi-stage gear compressor. From stage to stage the CO₂ gets more compressed and dryer, starting from 10.3 % water vapor in the first stage to 0 % in the last one. Thereby the medium content of CO₂ increases, starting from nearly 90 % in the first stage to 100 % in the last one. The dry and pure CO₂ is fed into a pipeline to a high-pressure compressor for transportation to an EOR or CCS field.

Problem and challenge

The gear compressor for serving this application includes 8 stages. Each stage requires an individual seal with the shortest possible installation length to avoid large overhangs and thereby vibrations. From stage 1 to stage 8 the shaft diameter decreases from 165 to 65 mm (6.50" to 2.56"), the revolutions increase from nearly 10,000 to 26,000 min⁻¹ and the maximum operating pressure increases from 3 up to 109 bar (43.51 up to 1,580.91 PSI). The design temperature varies from 130 to 150 °C (266 to 302 °F). Ambient temperature moves between 4 and 38 °C (39.2 and 100.4 °F). Caused by the toxic and aggressive CO₂ all seals have to be designed with a barrier gas port for dry instrument air.

EagleBurgmann Espey solution

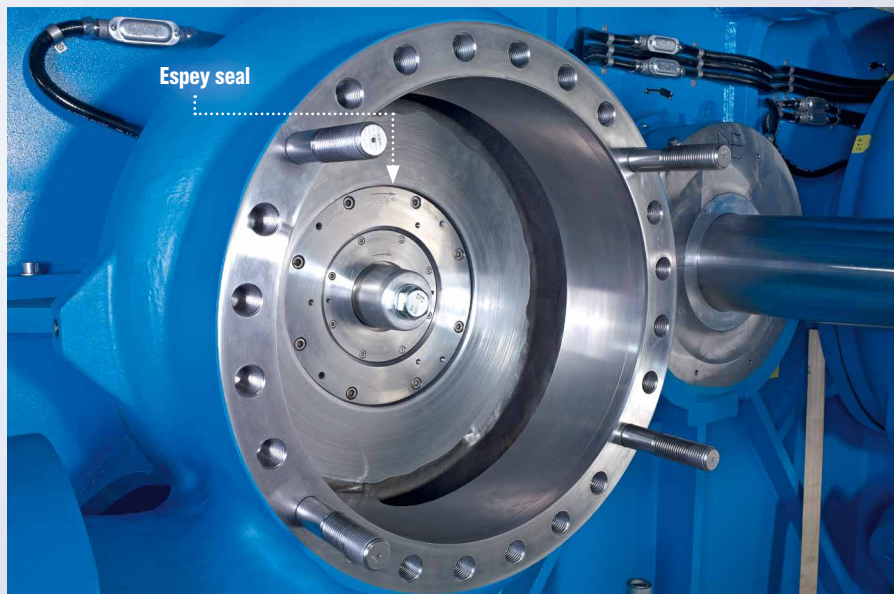
To fulfill the application requirement of no CO₂ and lowest barrier gas leakage to atmosphere with regard to revolutions, design temperature and operating pressure Espey designed the carbon floating ring seal Espey WKA802 with one-piece seal rings made of a carbon/titanium combination, barrier gas and recirculation ports. Espey WKA802 is based on a modular design, means that any seal parts can be combined in order to application requirements. The seal lengths vary from 145 mm (5.71") in stage 1 to 170 mm (6.69") in stage 8 to guarantee the required short installation length with view to long labyrinth seals. The seals guarantee a long-term operation time without maintenance.



Espey WKA802 during installation into a gear compressor

Operating conditions

Application: multi-stage gear compressor
Seal type: Espey WKA802
Medium: water vapor, CO₂
Operation temperature: 130...150 °C
(266...302 °F)
Pressure abs.: 3...109 bar
(43.51...1,580.91 PSI)
Revolutions: 10,000...26,000 min⁻¹
Shaft diameter: 65...165 mm (2.56...6.50")
Radial play: max. 0.01 mm (0.0004")
Barrier gas: dry instrument air



Espey WKA802 installed in a gear compressor