

Espey labyrinth seal for an integrally geared expander



Terephthalic acid is a significant source especially for the packing and textile industry. About 90 % of annual production are used to manufacture PET e.g. as base material for drink bottles and textile fibres. Terephthalic acid production requires tailor-made turbo machinery. The customer operating in the chemical industry has chosen MAN Diesel & Turbo SE as their supplier for the turbo machinery train - providing latest technology.

Process description

Terephthalic acid is produced by oxidation of p-xylene by means of atmospheric oxygen. The typical turbo machinery train required for this process consists of following main components: compressor to supply compressed air, an expander to recover energy of the process tail gas, and mostly steam turbine and motor-generator to provide an optimal energy balance. An expander of integrally geared design features a multi-shaft arrangement with multiple radial stages and with an integrated gear, each stage composed of impeller, guide blading and casing.



Turbo machinery train for terephthalic acid production: steam turbine, air compressor, integrally geared expander



Espey labyrinth seal, composed of housing and labyrinth ring

Problem and challenge

The gear expander for serving this application includes 2 pinion shafts. Both pinion shafts carry an impeller on the end. To prevent gas leakage to atmosphere and construction elements the shafts require a seal. The medium temperature moves between 100 and 200 °C (212 and 392 °F) and rises considerable in individual cases. The medium in this application is tail gas from the chemical reaction contaminated with traces of acids, bromides and others. The end users are focused on a classical labyrinth seal due to longtime reliable experience with this seal type. This point is especially to consider when designing a shaft seal type. The operating pressure in the seal area is up to 15 bar (217.56 PSI). The revolutions move between higher four-figure and lower five-figure range. The installation length of the seal has to be moderate. The shaft diameters of the 2 shafts are 310 and 155 mm (12.2" and 6.1") in this case.

EagleBurgmann Espey solution

With regard to the contaminated tail gas characteristics having need for buffering, no restrictions to build as short as possible and consideration of the end users' focus Espey designed a classical labyrinth seal to serve this process, consisting of a labyrinth ring with clearance for shrink fit on the shaft and a housing with shrunk in carbon labyrinth for assembly to the casing. The seal lengths are 206 and 131,5 mm (8.11" and 5.18") in this case. The labyrinth seal provides a long-term operation time without maintenance, even if badly contaminated medium attains the sealing surface.

Operating conditions

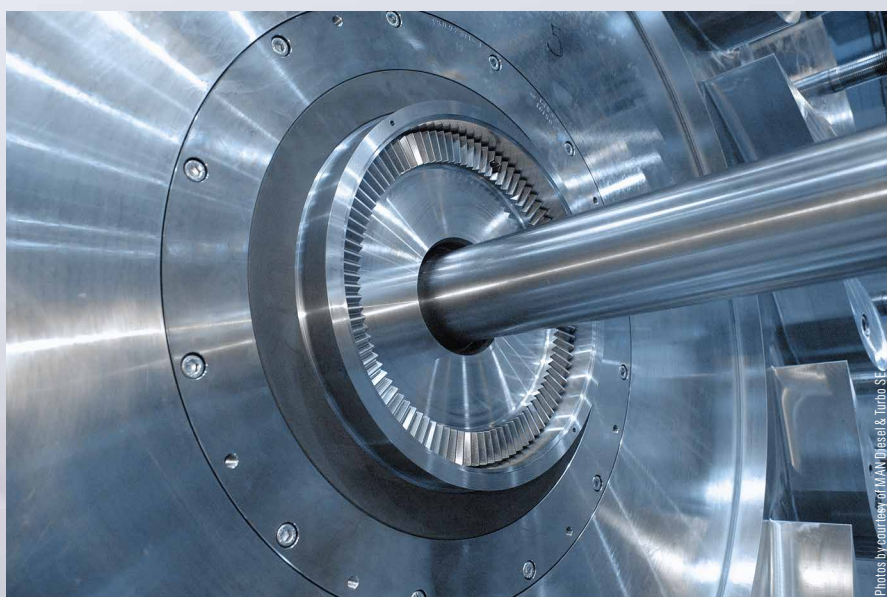
Application: integrally geared expander
Seal type: Espey labyrinth seal
Medium: tail gas, contaminated
Operation temperature: 100...200 °C (212...392 °F) during normal operation
Pressure abs.: up to 15 bar (217.56 PSI)
Revolutions: higher four-figure...lower five-figure range
Shaft diameter: 310 and 155 mm (12.2" and 6.1")
Radial and axial play: present
Buffer gas: yes



Integrally geared expander



During installation: labyrinth ring shrunk on shaft



Espey labyrinth seal, completely installed