5.2.3. Low-Emissions Rod Packing

Description
Reciprocating compressors are fitted with pressure packing, a series of precision-machined mechanical rings that form a tight seal around the piston rod to prevent compressed gas from escaping but still allow the piston to move freely. Leaks in the packing system are common, with the size of the leak depending on fitting, cylinder pressure, and alignment of packings parts. These leaks can be one of the largest sources of emissions at natural gas compressor stations. Piston rods wear more slowly than packing rings, so as systems age, leak rates increase due to the uneven wear. These leaks allow methane gas to enter the atmosphere through the packing vents on the flanges. Replacing traditional packing rings and piston rods with low-emissions packing not only reduces methane emissions1, but also achieves operational benefits such as increasing the lifespan of existing equipment, improving operating efficiencies, and realizing cost savings.

Technology Group
Engines and Compressors – Recommended Practices.

Site Applicability
Natural Gas Compressor Stations.

Emissions Reduction
Installation of low-emissions rod packing has the potential to drastically reduce emissions.

A Simplified Formula to Estimate GHG Emission Reductions:
Annual GHG Reduction (tCO₂e/yr) = Reduction of vented gas via measurement (mcfd) x 1000 scf/mcf x 1 m³/35.315 scf x 0.6784 tCO₂e/1000 m³ x mole fraction of CH₄ in natural gas x 21 GWPCH₄ x # of operational days (days/year)

Calculations of emissions reduction rates and economic analysis require pre- and post-installation measurements. It is important to measure the rate of gas leak before installing any new low emissions packing. Once the low emissions packing systems are installed, the new leak measurement must be performed immediately after installation of new seals, as this serves as the default baseline for the new packings.

Baseline:
Most natural gas compressors operate using standard rod packing with the expectation of some leak and loss of compressed gas over time.

Economic Analysis
The economic analysis will be site-specific. The following metrics should be calculated to understand the economic benefits of the project.

1 An EnCana presentation regarding the CECO LEP trial given at the 2010 Gas Processing Association Annual Meeting reports an average venting reduction of >90%.
Capital Cost: Capital costs including installation, materials, and design are estimated at <$100,000. However, installation costs vary depending upon the site location and specifics.

Operating Cost: Total Annual Savings ($/yr) = Annual operational cost before implementation ($/yr) – Annual operational cost after implementation ($/yr)

Payback Period: Simple Payout (years) = Capital cost of the project ($) / Total Annual Savings ($). The prevailing natural gas price has a significant impact on the economics of the project.

Marginal Abatement Cost: GHG Cost Abatement ($/tCO\(_2\)e) = Annual GHG Reduction (tCO\(_2\)e/yr) x Project Life (year) / Capital Costs of Installing Low Emissions Packing ($)

Reliability

Expected Lifetime: Installation of LEP will not change the expected lifetime of equipment, which will remain in line with standard life-expectancy for compressors. Regular monitoring is required to ensure proper lubrication and cooling to help reduce wear, as high operating temperatures accelerate ring deterioration. It is important to continue to monitor for leaks even after installation of low-emissions packing as the rings or the rods can still become worn out in a few years.

Maintenance: Low-emissions packing does not require additional maintenance nor special skills beyond existing operations. However, if additional equipment is added to a wellsite, the maintenance workload would increase accordingly.

Safety

Low-emissions packing does not pose any additional safety hazards compared to standard packing.

Regulatory

- Operators must obtain and demonstrate compliance with relevant facilities codes and regulations.
- Alberta Climate Change and Emissions Management Act

Service Provider/More Information on This Practice

Low-emission rod packing is available from various vendors in an assortment of sizes and specifications for application in different operating and process conditions.