TECHNOLOGY EVOLUTION OF LNG REFRIGERANT TURBOCOMPRESSORS

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LNG Milestones

Thermoplastic seals

New thermoplastic seals can increase stage efficiency by reducing internal leakage, from 0.5 to 2 points, depending on flow coefficient. Standard material can reach 150°C maintaining mechanical properties, while more resistant material must be selected to reach higher temperatures (>180°C).

Performance Predictability

Performance recalculation after test should include:
- back-to-back with two balance drums
- straight through machine
- scale effect due to machine size (diameter can vary from 200mm to 2000mm)
- operating pressure & Reynolds effect; high pressure machines are typically tested at low pressure condition without Reynolds effect and should be compared with prediction at same level of pressure
- pressure and temperature probes
- test uncertainty

Casings

Giant barrel compressors were first used for a large LNG project in the Middle East and are coming back to fit with the single refrigerant LNG process; they fit well with a turbo compressor train with just one compressor that is coupled with a large gas turbine (LM5000D/LM9000/LMS100) or large EL (> 50MW).

Rotodynamics

With OMA it is possible to minimize the safety factor historically used to calculate compressor logarithmic decrement and design more modern compressors.

Efficient LNG startup from SOP without venting ... EZ-start

- No venting
- 24-48 hrs savings to recover production after depressurized start-up
- Capex savings for single shaft gas turbine driven refrigeration trains — minimal compressor startup torque

The improvement of the impeller design impacts the shape of the blade, making it fully 3D, instead of linear, to better fit with the flow inside the impeller. This new feature reduces separation or helps reach low velocity in the region inside the vane channel, increasing efficiency and operating range.

Impellers

Model test results ... Improved Predictability

The designer can change relative velocity, reducing the M1r, with positive impact both on efficiency and operating range. This can be achieved by modifying the velocity triangle, designing properly the volute and potentially adding some blades. In case of a varied sidestream an aeromechanics analysis should be performed to avoid dangerous crossing of modes.

Side Stream