**Adaptive monitoring of health-state and performance of centrifugal compressors**

1. A framework was investigated and devised to model the performance of compressors by means of physical aerodynamic relationships.
2. A monitoring algorithm was developed that incorporates these models and can detect and predict the effect of fouling, erosion and corrosion on the performance.
3. The degradation effects were investigated on-site on an industrial compressor.
4. The monitoring information are used by D. Xenos in its condition-based optimization framework.

**Aerodynamic impact of fouling in centrifugal compressors**

- **Fouling is the build-up of material inside the compressor.**
- **Material and methods:**
  - **1st approach:** Influence of different fouled conditions on the performance parameters of the compressor.
  - **2nd approach:** Influence of different fouled conditions over blade suction side/pressure side on the performance parameters of the compressor.
  - **3rd approach:** Real fouling injection in order to study the location and its influence on the performance parameters of the compressor under different operation conditions.

**Optimization of centrifugal compressors operation and maintenance**

The focus is on multiple compressors operating in parallel considering the overall plant (optimization of the system rather than one unit).

- A Real Time Optimization (RTO) scheme reduced the power consumed compared to typical industrial strategies.
- The RTO was applied to a 12h operation.
- The RTO reduces the configuration of the compressors from the solution of scheduling.

**Control systems for centrifugal compressors**

- The Condition Based Maintenance optimization minimized the overall costs compared to a typical preventive strategy.
- The integration of condition monitoring and scheduling has given the first results.

**Research Aim:**

- The main consequences are reduction in flow capacity, reduction in pressure ratio and efficiency; and therefore a reduction in operation range.

**Research:**

- **WP2-Turbomachinery**
  - **Objective 1:** Develop scalable and complete equipment monitoring systems.
  - **Objective 2:** Devise new algorithms for overall performance monitoring and control.
  - **Objective 3:** Study ways that energy savings can be achieved.

**To reduce the energy usage for gas compression, we need smart ways to operate compressors!**

1. Models of the compressors translate experimental observations into a mathematical formulation suitable for control, monitoring and optimization applications.
2. Monitoring algorithms implement physical knowledge to reveal gradual degradation and prevent gross failures.
3. Optimization frameworks make use of monitoring information to systematically increase the system efficiency and reduce the overall energy requirement.
4. Advanced control systems implement the results of the optimization ensuring the achievement of the optimization potential while respecting safety constraints.

**INTRODUCTION:**

- The focus of this project is on control and operation of centrifugal gas compressors for carbon dioxide application.

**RESULTS:**

- The performance of the capacity controller was improved by proposing a control system based on the map of the compressor.

**Control systems for centrifugal compressors**

- Enterprise planning
- Optimal operation and maintenance scheduling
- Monitoring
- Real-time set-point optimization
- Sensing

**Scheduling**

- Optimization
- Fault diagnosis
- Equipment monitoring
- Advanced control
- Parameter identification
- Real-time optimization
- Maintenance
- Optimization
- Process industries