Sustenance of CGC Operation through Harnessed Fouling
A case study of Ethylene plant

Authors Name

Mangesh Shenwai, Ingenero ✹ Manas Karnure, Ingenero

Cracked Gas Compressor (CGC)

- Cracked gas compressor (CGC) is critical equipment in ethylene plants and efficient operation of compressor plays a significant role in governing the plant economics.
- Fouling in compressor is the most common cause for inefficient operation of CGC. Hence, is the matter of concern for most of the ethylene plants.

A case study of ethylene plant detailing sustenance of CGC operation through harnessed fouling is presented below

- Ethylene plant consistently operating between 104-106% of design plant capacity, and further increase in throughput was limited due to various constraints with limitation in CGC being one of the constraints.
- Limitation in CGC will be a major one as it is upstream of other equipment's that are operating at the limit.

Evaluation of CGC Performance

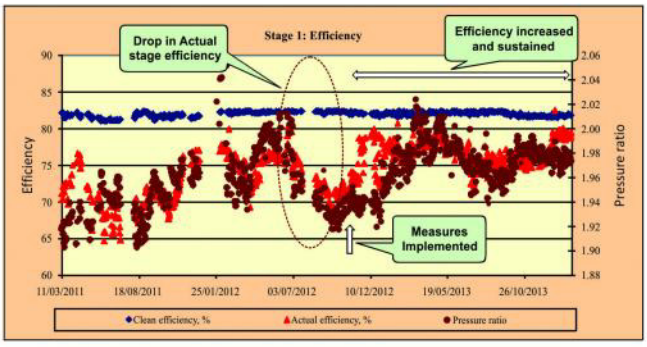
- Analysis of online operating parameters (like increased BFW injection, CGC turbine extraction & condensing stage demand valves (% Opening), CGC suction/discharge pressure) indicates loss in polytropic efficiencies of CGC.
- Simulation indicates increased power consumption, significant drop in CGC 2nd stage efficiency and slight drop in CGC turbine extraction stage efficiency.
- Increased CGC suction pressure reduces overall ethylene yield.
- Further loss in efficiency of CGC train will require reduction in plant throughput.
- Alternatively if throughput is maintained at current level (106% of design), increase in suction pressure will be required.
- Both the cases will result in loss of ethylene production.

Effect of decrease in CGC polytropic efficiency represented as follows:

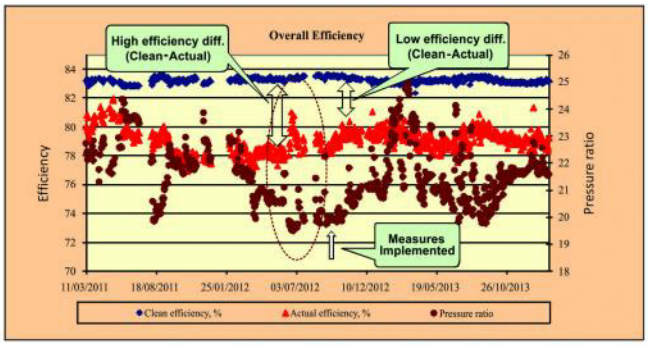
Suggestions for sustenance of CGC operation

- Controlled test with modified wash oil dozing rate and frequency was carried out for CGC 1st stage
  - Significant improvement was observed in 1st stage efficiency after modified wash oil injection rates and arrested further drop in CGC 2nd stage efficiency.
- Suggested modified wash oil dozing plan for LP as well as MP casing based on the results of trial
- Max possible water injection without affecting integrity of casings determined and suggested to maintain possible water injection rate in each stage.
- Suggested to analyze polymeric material from CGC 1st stage inter-cooler and CGC casing low point drains to identify the fouling mechanism and precursors.
- Suggested to install flow meters for measuring BFW injection flow rate to each stage during next available opportunity. This will help in accurate tracking of CGC efficiencies.

Improvement in CGC 1st stage efficiency after implementing recommendations are illustrated in the following graph



Improvement in CGC efficiency difference (Clean-Actual) after implementing recommendations are illustrated in the following graph



Recommendations were implemented and performance of CGC was evaluated to ascertain its effect

- 1st & 2nd stage efficiency improved in 2013 compared to 2011-12
- 3rd stage efficiency remains steady
- 4th & 5th stage efficiency slightly decreased in 2013 compared to 2011-12
- After-cooler pressure drop is steady.
- 5th stage discharge & cold box DP increased slightly after Nov'13.
- CGC turbine extraction & condensing stage efficiencies are steady.
- BFW injection is steady but higher than design.

Feedback from Client:

From this evaluation, it is clear that the performance of CGC is stable (rather improved) and no further deterioration is seen past 2012 data. And no sign warranting for plant load reduction (because of CGC performance) is expected