Technical Framework for Optimization of Centrifugal Compression System: A Case Study

Saud AL Balushi

Abstract

Centrifugal compression system is widely used in oil and gas industry. There are many issues that affect the performance of this compression system such as surge, liquid carry over and improper configuration. The objective of this thesis is to optimize the performance of the centrifugal compression system and its reliability and make general guidelines for similar systems across the world.

Systems from existing oil fields have been used to integrate the mentioned common issues with the ideal system from literature and theoretical studies. Theoretical analyses were performed using Unisim and IPSM and then compared to actual field data.

The aspects discussed in this study are efficiency of the centrifugal compressors, power and capacity optimization, molecular weight of the process gas, optimum operating point in the compressor curves, operating point in the phase envelope and the proper configuration which can increase the reliability of the system.

Results indicate agreement between theoretical analysis and physical trials which led to several recommendations. These recommendations were divided into short and long term ones. The short term recommendations are very quick gains and with no or low cost. Examples of short term recommendations are optimizing suction and discharge pressure by only changing the set point which gives a gain of 4000 kW with no cost for the studied case. Also, increasing the suction pressure by 25 kPa has led to an increase in the total capacity by 375 kSm^3/d. Furthermore, for the given case, throttling suction pressure can reduce the compressors trips from 2 per day to zero trips by slight increase in the actual volume flowrate. Long term recommendations are actions which require money and time for implementation. An example of long term recommendations is rerouting the recycle line of the compressor upstream of the scrubber to increase the reliability of the compressor. One of the long term solutions is introducing another gas source to mix with the existing gas to increase the MW from 21.5 to 23.5 g/mol which will reduce the power consumption by around 5%. This reduction in power consumption will lead to a dramatic decrease in the plant OPEX over the plant life time.