Practical Design Optimization Techniques Applied On Industrial Refrigeration

Author block: E. Almakrami, A. Alwarthan, Saudi Aramco

Abstract

Objectives/Scope: This paper summarizes the design and operational optimization techniques applied to process refrigeration system. It shows that optimization must be a target from the start and sometimes iterations are required where available technology options, design constraints and operational scenarios must be taken into consideration to achieve the optimum design. The steps taken by the design and operations teams are showcased with achieved results and resulting savings.

Methods, Procedures, Process: Simulation has been used to conduct iterative prototyping while calculating the resulting net present value for each case. Each iteration added a feasible approach toward energy efficiency within practical constraints.

Results, Observations, Conclusions: The proposed paper shows how the design team started with a single one stage propane compressor and with successive optimization ended up with optimized system having two propane compressors sized at 50%, and equipped with inlet guide vanes with two stages and a subcooler as the optimum design. Also, the paper cover what operation team did for further optimization where design estimated that one compressor could be kept offline for only 4 months per year but with some operational changes a compressor could be kept offline for upto 6 months a year with much greater energy savings.

Novel/Additive Information: Available literature mostly covers the theory behind refrigeration cycle design. This paper augments this through showcasing the steps taken by a large-scale project team despite being pressured to deliver within a short design duration. Practical considerations and design constraints are also presented, which are seldom covered in pure theoretical articles.