Contact Cooled Air Compressor Cooling System

Overview
The goal of this project was to improve upon a pre-existing oil-flood rotary screw air compressor through proposing a new cooling system design. Finite element analysis (FEA) and heat transfer analysis were used on the current design to locate possible problem areas dealing with stresses and thermal loads. Improvements in the new design were inspired by results from FEA, heat transfer analysis, and known issues reported by the project sponsor.

Objectives
The objectives of this project were to determine if heat transfer in original design was sufficient, simulate crucial cooler components under test conditions, and propose a design to improve upon issues found with the original system.

Approach
- Customer needs for this project were gathered by talking to Mr. Zhu, the main project sponsor.
- Sponsor provided data and some CAD models for this project in order to help model and analyse the system properly.
- Many patents about cooling system and heat exchangers were researched in order to gain insight into the function and operation of these systems.
- Benchmarking of competitive products was performed while focusing on rival companies such as Gardner Denver, Quincy, Sullair, and Chicago pneumatic.
- To redesign the cooling system, seven potential concepts were generated with one eventually being selected as the most applicable to satisfying the customer needs; a 3-D model of this concept was then created using SolidWorks.
- A recreation of the internal fins was done in SolidWorks in order for them to be properly analysed using FEA analysis.
- Multiple FEA analysis were performed on the section of fins in order to find all the potential fail points that may occur during the operation of the air compressor.
- The results were compared to the actual failure points and showed that max stresses due occur in the header/fin connection.

Outcomes
- Max stress found in FEA analysis was smaller than yield strength of aluminium.
- FEA findings suggest failure of cooler system was most likely occurring from fatigue.
- Location of max stress found in the header, mimicking the real world failure point.
- Redesign of the cooler system focused on efficient ways to increase heat transfer and reduce stress.