Design and Manufacture of 3D Seals from Flat Gasket Material to Seal Gaseous Carbon Dioxide

Overview
John Crane Inc is a manufacturing company that produces products such as mechanical seals, seal support systems, hydrodynamic bearings, power transmission couplings and filtration systems. For this project, John Crane wanted the team to provide a fresh perspective on an existing segmented bushing in one of their mechanical seals. The team was not given many rigid requirements but was pushed in the direction of using flat gasket material to create a 3D seal.

Objectives
Develop and manufacture a prototype to replace a segmented bushing in a seal that is currently used to prevent leakage using modeling software and other design methods.

- Evaluate the various materials that possess the appropriate mechanical properties to allow for our design to function while remaining inexpensive enough for practicality.
- Design and simulate different labyrinth patterns to determine which shapes provide the most effective properties.
- Develop two 3D printed prototypes; one out of the default 3D printer material to show the parts separately and one 3D printed prototype out of rubber to show bushing assembled.
- Determine a viable method for manufacturing the solution.
- Utilize FEA Analysis to determine the stress values for the prototype to make sure that it is within constraints of temperature and material properties

Approach
- Contact the sponsor contact to gain further clarity into the request
- Research origami shapes and alternative designs to origami
- Develop 3 concepts
- Use AHP Matrix to determine the best concept
- Create proposal and present concepts to Mike
- Choose the best concept with Mike
- Create SolidWorks models of concept
- Use FEA, CFD, and fatigue simulation to develop optimal design for the anticipated environment
- 3D print prototypes
- Compare our design with the original bushing

Outcomes
- Developed a unique design to replace the current part
- Material cost at retail price: $315.10 per part
- Improved sealing capabilities compared to the segmented bushing (real world testing needed)