Flowserve - Research and Development of Composite Materials for Pump Pressure Vessel

Overview
Flowserve has contracted our team to create a composite pressure vessel to analyze the feasibility of using composites in the barrel of pumps. Currently the barrel of a pump is made out of metal; however, using composites can offer many benefits like cost efficiency and low weight. A critical part of the feasibility study is to hydro-test the pressure vessel to 1000 psi and check for deformation. The biggest challenge the team faces is an unsuccessful hydro-test due to a leak.

Objectives
- Design a pressure vessel that adheres to ASME standards as well as Flowserve’s standard
- Machine and assemble a composite pressure vessel at the Learning Factory
- Hydro-test the composite pressure vessel up to 1000 psi and examine the pressure vessel for deformations and leaks
- Discuss the feasibility of using composites as a replacement for metals in the barrels of pumps

Approach
- Visit the sponsor to discuss the project scope and elaborate on the deliverables
- Translate the problem scope into customer needs and metrics
- Conduct a patent search for composite pressure vessels and winding techniques
- Generate concepts for the pressure vessel material, shell shape, end cap, and seal
- Use a series of concept scoring matrices to determine the optimal pressure vessel design
- Conduct hand calculations and an FEA analysis to ensure the design is safe
- Modify the design based on calculations, FEA analysis, and conversation with the sponsor
- Model all the pressure vessel components using SolidWorks
- Use SolidWorks to conduct an FEA analysis of the pressure vessel
- Create a prototype of the pressure vessel
- Perform a hydro-test on the pressure vessel to determine if the vessel can withstand 1000 psi
- Analyze the feasibility of using composites in the barrels of pumps based on the test results

Outcomes
- The sponsor could capture a new market as a result of this project
- Composites could reduce weight and production time, while increasing the operating temperature and stress range for pumps
- Testing had to be stopped due to a leak in the pressure vessel
- Based on testing composites are a feasible replacement for metals