Feasibility of Friction Welding Inconel 600 and Stellite 6

Overview
Our sponsor - Curtiss-Wright Target Rock - has been manually welding Inconel 600 and Stellite 6 to manufacture valves that will be used in nuclear power plants. Traditional, manual welding processes are very dependent upon experienced welders who have practiced and can teach methods to newer workers. Since the skill gap between novice welders and the skilled welders is large and the number of experienced welders is decreasing, our sponsor tasked the team with determine whether friction welding could be used to join the two metals in question, in the hopes that the process could be automated.

Objective
The team aimed to send samples of both metals out to companies so as to get them friction welded. We needed to be able to test out various weld recipes and their outcomes so as to determine the best parameters for welding the two metals (if that was possible in the first place). Finally, the team aimed to conduct various metallography testing on the samples received from the friction welding companies - testing that included hardness value determination, microstructure analysis, tensile testing and non-destructive testing (liquid penetrant inspection). The team then intended to use the results from the experimentation on the welded samples to create a metallurgical test report.

Approach
- Researched automated welding techniques and realized friction welding was the best technique to use on metal bars
- Communicated with Learning Factory personnel and professors who are doing research in friction welding to determine if Penn State had equipment capable of doing the welding
- Sent metal samples provided by Curtiss-Wright Target Rock to Coldwater Machine and Pierce Industries for welding services, both companies collected data for the team regarding the rotational speeds and forces used to weld.
- The team performed metallurgical tests on the welded samples which tested the bond strength of the welds.

Outcomes
The team was able to complete the task Curtiss-Wright Target Rock wanted an answer to, can stellite 6 and Inconel 600 be welded together through an automated process? The answer is yes the two metals can be welded together through friction welding, both Inertia and Direct Drive. Pierce Industries, inertia friction welding, resulted in the best welds of the two metals, shown to the right. Further experimentation will need to be completed in order to pinpoint the best welding parameters. The team recommends that Curtiss-Wright Target Rock pursue another semester of capstone work in hopes of receiving more testing results and also to reach out to Pierce Industries for an opportunity to start contract work for the welding of these metals for various valve components Curtiss-Wright manufactures.