The Development and Testing of Composite Materials for Pump Wear Rings

Overview
Flowserve currently uses two hardened steel wear rings, one rotating with the impellor, the other sitting stationary along the casing of their centrifugal pumps. These two wear rings are being sought to be replaced by one, composite wear ring that will sit stationary and wear along the impeller surface. The use of composites, which will reduce the amount of working materials in the pump is believed to cut down on pump operating, maintenance, and assembly costs.

Objectives
Our teams objectives were to design a method, from formulating a test plan to constructing a test rig, to test various composites from multiple vendor. Three designated composites will be test in the test rig, and analytical calculations for theoretical wear rates for each composite will be used to determine which composite chows the best wear characteristics.

Approach
- The first step was to understand what exactly Flowserve wanted in terms of the replicating the wear mechanisms that would occur inside normal pump operating conditions.
- Flowserve representatives visited our facilities at Penn State to help explain the demands they sought, where various equipment was presented to them and ideas exchanged
- The concept of using a machining lathe to perform wear tests was the concept that would best simulate sample wear occurring inside a centrifugal pump
- It was decided that a test rig, shown in the image below, needed to be designed and constructed to meet various constraints and objectives.
- Flowserve representatives guided our ideas by providing multiple conceptual ideas through Solidworks models.
- A finalized test rig was constructed, shown below
- In the meantime, vendors were contacted to donate sample rings for testing
- Testing was performed using a matrix-based method.
- Results were validated through use of Environmental Scanning Electron Microscopy on the worn samples

Outcomes
- Flowserve will use the resultant data to and vendor rankings when making a decision on the types of wear rings to be used in the pumps, again, in order to cut down on the costs previously mentioned.