MACHINING OF HARD WEAR RESISTANT MATERIALS USED FOR ENGINE CYLINDER LINERS

Overview
Engine cylinder linings are heavy, which is costly to fuel efficiency. Replacing these liners with plasma spray coatings provides an innovative way to avoid such down sides. The team focused on simulating the fine boring operation of engine cylinders by turn cutting manganese steel cylinders of comparable composition and mechanical properties. The team completed this task by using a CNC turning machine, CBN inserts, manganese steel cylinders, and three different coolants provided by Quaker Chemical Corporation.

Objectives
The main objective asked of the team was to track and record the performance of three coolants: Quakercool 7450, Microcut 3680-89, and Quaker 2P, and determine which coolant provided the highest wear resistance.

Approach
- Conduct research of Quaker Chemical Corporation, CBN inserts, and manganese steel.
- Complete all necessary FAMELab training (CNC machine, optical microscope).
- Successfully write G-code with project-specific parameters.
- Mix a small-scale batch of coolant and measure its refractive index to ensure its accuracy.
- Mix a large-scale 43-gallon mixture of the coolant using the same ratio as the small-scale.
- Rinse the CNC machine with water to remove all prior coolants.
- One insert (both edges) was used per cylinder, and two cylinders machined per coolant.
- Collect wear-length data after every pass.
- Repeat steps above for two other coolants.
- EDM wire cut, mount, and polish 1 sample from an unmachined cylinder and 3 samples from machined cylinders used with each coolant.
- Etch each sample with 4% Nital and then perform comparative optical microscopy.

Outcomes
The team’s results led us to recommend Coolant 3, Quaker 2P, as it helped inserts achieve the slowest and most linear rate of wear of the 3 coolants tested. Microstructural analysis also showed less slip lines and deformation twinning in the cylinder machined with this coolant.