Machining of Compacted Graphite Iron

Overview
This project simulated a turning operation resembling a compacted graphite iron, CGI, engine boring process. The purpose was to test three different coolants from Quaker Chemical Corporation, and their effect on the life expectancy of a cutting tool. One current commercial coolant Quakercool 7020-CG and two new experimental coolants, Quakercool 7350-BFF-S and Quakercool 7330-BFF-S. Simulation data was compiled and testing using regression analysis, as well as qualitative tests on the cutting performance and microstructure.

Objectives
1. Create a continuous turning operation to simulate an engine cylinder boring operation using the SL-30 lathe on Grade 450 CGI, and determine the impact of three different metalworking fluids on the flank wear of the cutting tool
2. For each fluid tested, conduct machining tests at two different cutting speeds to determine the Taylor Tool Life Expectancy Equation of each fluid tested
3. Provide regression analysis to test the significance of speed, lubricant choice and their interaction
4. Present the results and conclusions on the insert wear rates and relative performance of the three metalworking fluids tested
5. Perform microstructure analysis to determine effects of fluid and speed on Grade 450 CGI microstructure

Approach
- Lathe each coolant in two replications on the, SL-30, CNC lathe
- Record qualitative properties during lathe process
- Compile data into Minitab and build individual regression lines for each coolant speed combination
- Perform Regression Analysis, ANOVA, and F Test to determine significant factors
- Perform microstructure etch to gauge material deviations during cutting

Outcomes
- New coolants, Quakercool 7350-BFF-S and Quakercool 7330-BFF-S, outperform the current commercial product, Quakercool 7020-CG, in wear growth as function of time and speed
- Alternating speeds greatly increases wear; however, less the new coolants are less affected by this change
- Microstructure analysis shows thin surface layer correlates to tool wear
- Quakercool 7350-BFF-S and Quakercool 7330-BFF-S are statistically indifferent but have contrasted qualitative properties