Machining of Compacted Graphite Iron

Overview
During machining, a coolant fluid is sprayed across a cutting insert for lubrication, lengthening the life of the insert. Because of the difficulty in machining Compacted Graphite Iron (CGI), Quaker Chemical Corporation has developed two new coolants: Quakercool 700-CG 2-Phase, and 6% Quaker Oil-HR + 3.5% Quaker Water ELCA. These are designed to hopefully outperform C-M50, a competitor’s coolant, which was used as a benchmark.

Objectives
In order to compare these coolants, a set of experiments had to be designed and conducted for machining CGI on the HAAS SL-30 turning center. The experiment will be run at two different speeds for each of the three coolants. The data that is generated will be analyzed using the Taylor Tool life equation, to determine which coolant is best at reducing tool wear for a range of speeds.

Approach
- Create a program for machining the cylinders using MasterCam software. The program sets machining parameters and allows the direct movement of the cutting tool while machining.
- Mix Quakercool 700-CG 2-Phase and pump it into the SL-30 coolant tank.
- Load MasterCam programs onto the SL-30 and machine cylinders of CGI at cutting speeds of 250 and 210 m/min. Collect measurements of tool flank wear.
- Mix C-M50, clean out coolant fluid tank, and pump C-M50 into the tank.
- Repeat the machining of CGI cylinders at cutting speeds of 250 and 210 m/min using C-M50.
- Mix 6% Quaker Oil-HR + 3.5% Quaker Water ELCA, clean out coolant fluid tank, and pump 6% Quaker Oil-HR + 3.5% Quaker Water ELCA into the tank.
- Repeat the machining of CGI cylinders at cutting speeds of 250 and 210 m/min.
- Plot tool wear vs. distance machined and derive Taylor tool life equation for each fluid.

Outcomes
Both of Quaker’s coolants, Quakercool 700-CG 2-Phase and 6% Quaker Oil-HR + 3.5% Quaker Water ELCA outperformed the competitors coolant in terms of distance machined before reaching a designated tool wear failure level. 6% Quaker Oil-HR + 3.5% Quaker Water ELCA had the largest distance machined for every speed in the range of speeds that we are interested in, between 210 m/min and 250 m/min. We recommend 6% Quaker Oil-HR + 3.5% Quaker Water ELCA.