Machining of Compacted Graphite Iron

Overview
During the machining process, a coolant fluid is sprayed on the cutting tool for lubrication, helping to prevent tool wear. Due to the difficulty of machining Compacted Graphite Iron (CGI), Quaker Chemical Corporation currently offers the coolant Quakercool 7020CG to its customers. A new coolant, Quakeral 700CG, has been developed and needs to be tested against Quakercool 7020CG in the SL-30 turning center to determine which coolant performs better.

Objectives
Design and conduct a set of experiments in which each coolant is used for machining CGI in the SL-30 turning center. Three different cutting speeds will be used, and machining will be periodically paused to take tool wear measurements. The data will be analyzed to determine which coolant is better at reducing tool wear. Also, the data will be used to derive the Taylor tool life equation for each coolant.

Approach
- Create a program for each cutting speed using MasterCam software. The programs are used to set the machining parameters and to direct the movement of the cutting tool while machining.
- Mix Quakercool 7020CG and pump it into the SL-30 coolant fluid tank.
- Load the programs in the SL-30 and machine cylinders of CGI at the cutting speeds of 190, 250, and 310 m/min using Quakercool 7020CG. Collect measurements of the tool flank wear.
- Mix Quakeral 700CG, clean out the coolant fluid tank, and pump in Quakeral 700CG.
- Repeat the machining of CGI cylinders at the cutting speeds of 190, 250, and 310 m/min using Quakeral 700CG. Collect measurements of the tool flank wear.
- Plot tool wear vs. distance machined and derive the Taylor tool life equation for each fluid.

Outcomes
- Quaker’s new coolant, Quakeral 700CG, outperformed Quakercool 7020CG in terms of distance machined before reaching a designated tool wear failure level. At 190 m/min the cumulative distance machined was improved by 31.20%. At 250 m/min the cumulative distance machined was improved by 25.53%. Finally, at 310 m/min the cumulative distance machined was improved by 18.14%.
- Derived Taylor tool life equation for Quakercool 7020CG:
  \[ T = \left( \frac{468.27}{V} \right)^{\frac{1}{10}} \]
- Derived Taylor tool life equation for Quakeral 700CG:
  \[ T = \left( \frac{504.08}{V} \right)^{\frac{1}{10}} \]