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More Accurate Predictions of Tool Life:

The Colding Model in Milling Compacted Graphite Iron

Much of the global economy relies on just a few types of manufacturing processes, with machining, i.e. subtractive manufacturing being used for almost every physical product or otherwise for making the machines that made that product. Hence, even tiny improvements to these high-value adding operations can lead to great returns. Additionally, tools lasting for longer not only contributes to reductions in production costs, but leads to more sustainable manufacturing. The research in this thesis tackles one aspect of such developments, particularly the milling of compacted graphite iron (CGI), an increasingly common material, using cemented carbide tools.

Being a cast iron with superior mechanical properties, CGI is increasingly chosen for manufacturing robust engine blocks, replacing heavier alternatives made from traditional cast iron in trucks and heavy vehicles. However, historically, machining CGI has been a challenge, as its strength and durability, also make it difficult to use. In the world of manufacturing, where efficiency and sustainability are the gold standard, improvements to these are highly desirable.

This thesis therefore explores the application of the Colding tool life model to cemented carbide cutting tools during the milling of CGI. As the Colding model is traditionally used in predicting tool life in turning, a geometrically simpler machining operation, this thesis tests the use of an adapted version of the model.

The associated research involved a series of milling experiments to observe tool wear over time, which was then used to create a predictive model. The results show that the adapted Colding model fits the data well, predicting tool life with high accuracy. The research also found some trends in the effects of cutting parameters on tool life. While more work is needed to expand the model, what the results showed was that the Colding model is applicable in milling, allowing it to be used to identify the best machining parameters to reduce wear, and thereby significantly enhancing tool life.

The impact of this research extends beyond the lab environment. By optimizing tool life, manufacturers can boost overall production efficiency, enhance product quality, and lower costs—benefits that are particularly valuable in today's competitive market. Moreover, longer-lasting tools mean fewer replacements, contributing to more sustainable manufacturing practices.

The results of this research serve as a guide for future studies in machining optimization, promising not just economic benefits but also supporting the quest for environmental sustainability in industrial practices. This thesis therefore is also a stepping stone towards smarter, more sustainable manufacturing. It demonstrates that with the right approach, even tough materials like CGI can be machined more efficiently, paving the way for a future where we do more, with less.