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ADAPTED VERSUS PROJECTED MACHINING CENTERS ENERGY CONSUMPTION FOR MQL TECHNIQUE

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INTRODUCTION

Cutting fluid application is a vital technique to achieve the expected result in most machining processes. However, besides having a high cost, 10 to 16% of the machining cost, the cutting fluid application represents also a risk to the environment due the oil chemical characteristics. The Minimum Quantity Lubrication (MQL) is an alternative when looking for reduction of oil consumption and a more environmentally friendly process. Furthermore, there are authors who defend the improvement of machining force, tool life increase and energy consumption decrease due to the withdrawal of the high pressure pump from the flood system, although there are divergences.

A literature review has shown that many predictive models of machine tool power consumption do not consider the consumption of the required air compressor in MQL. These models are based on a study carried out in 2006 at MIT. Withal, they are still under development with some calculations oversized, while others ignore components of the machining center. This paper's motivation is the divergent points analysis and test models to predict the energy consumption of machine tools using MQL and flooding in two cases.

EXPERIMENTAL PROCEDURE

The material used for testing was gray cast iron DIN GG 25 with 182 HB, this material is used in the manufacture of motors and gears.

All specimens were milled to 380x240x37mm dimensions to ensure perpendicularity to the machine axis. Drilling operations were carried out with carbide drills, 13.5 mm diameter, 140º tip angle and TiAlN coated by Mapal.

In order to define machining parameters for drilling operation, dry tests were performed on the Romi D800. The strength and power data collection were taken simultaneously to the tool life test to compare these effects. Figure 1 illustrates the test´s flowchart.

For tests with adapted MQL, the ROMI D800 was used with a Bielomatik 1 channel system. The tests with designed MQL were performed on the GROB G550.

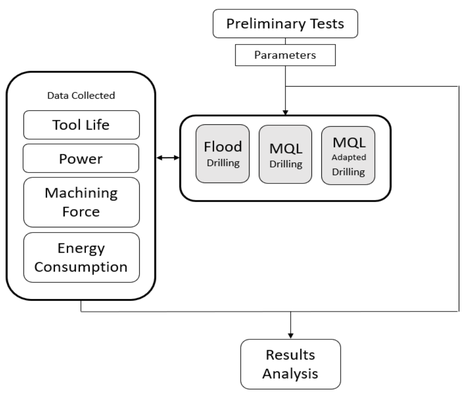

Figure 1 – Flowchart test.

	Vc [m/min]	f [mm/rot]
1	110	0.3
2	110	0.4
3	140	0.3
4	140	0.4

Table 1 – Cutting speed and feed rate used in each setup.

RESULTS AND DISCUSSION

- In general, the MQL technique showed lower energy consumption.
- Using a machining center designed to use MQL, the consumption is lower than the adapted one.
- Adapted machining centers shorten tool life.

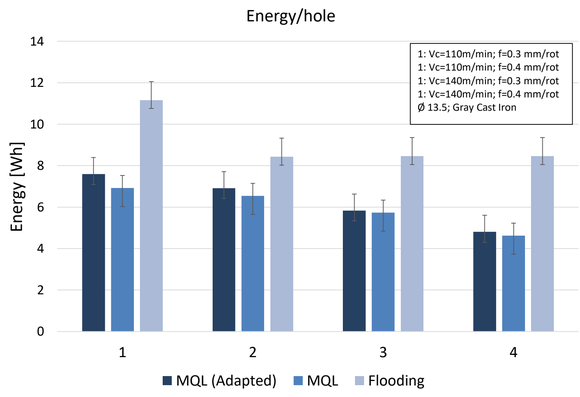

Figure 2 – Energy consumed in each hole for each set of parameters.

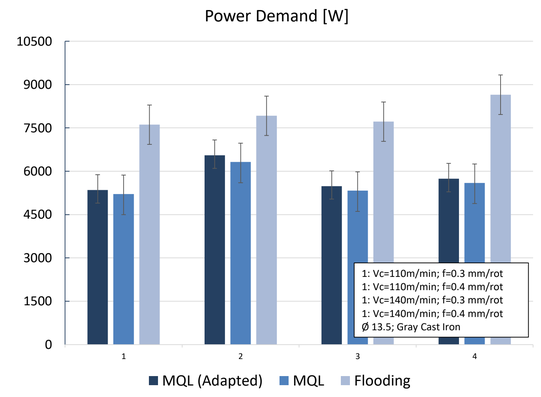

Figure 3 – Machine tool active power demand for different cutting conditions in drilling operation.

Figure 4 – Energy consumed according to each mode.

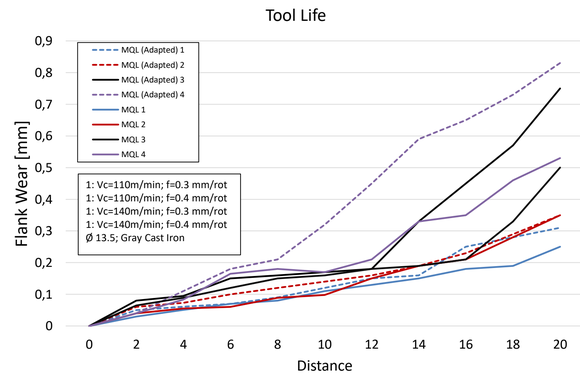

Figure 5 – Tool life.

CONCLUSION

Energy Consumption

- Machining centers designed for MQL are more energy efficient. This can be explained by new spindles and more modern components;
- The machining center designed for MQL had a 10% lower consumption than the adapted;
- The energy models are closer to the flood technique. The difference in consumption for MQL may be related to an under-consideration of the compressed air system.

Tool Life

- Tool life in the adapted center was shorter than that designed in all machining conditions;
- The rigidity of the system adapted with a lower cutting fluid application efficiency may have decreased tool life.

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