

WOOD MACHINING & TOOLING RESEARCH

TOOL MATERIALS / TOOL WEAR RESEARCH – Effect of Machining Parameters on Carbide Tool Wear for Machining MDF

Tool wear in peripheral milling operations has been found to depend on the total length of engagement with the workpiece that the tool experiences, which is related to the cutterhead diameter and depth of cut (to the $\frac{1}{2}$ power), and the total number of tool edge engagements (rpm*run time). In addition to these geometry related parameters, tool wear has also been found to depend on cutterhead peripheral speed, workpiece material properties, and carbide tool grade. The observations on tool wear from a series of cutting tests on MDF material conducted on a CNC router are summarized below.

Effect of Number of Knives: The effect of number of knives (and feed per tooth varied by varying number of knives) was evaluated by comparing the wear produced by a one knife cutter to the wear product by a two knife cutter with all other parameters held constant. The results showed no significant difference in wear between the one knife and two knife case, which confirms that number of knives / feed per tooth is not an important factor in tool wear.

Effect of Depth of Cut: Increasing depth of cut was observed to result in increased tool wear, with all other machining variables held constant. The experimental data indicated an increase in wear fairly close to the square root relationship predicted by the tool engagement length formulation.

Effect of Cutterhead Peripheral Speed: The effect of peripheral speed on tool wear was evaluated by comparing the wear of a 2.5 inch diameter, one knife cutter at several rpms. The feed rate was adjusted to maintain a constant feed per tooth. The depth of cut and number of knife engagements were also held constant. The experimental results showed an increase in tool wear with increasing peripheral speed.

Effect of Cutterhead Diameter: The effect of cutter diameter was evaluated by comparing cutters of different diameter operated at constant peripheral speed (rpm varied). The feed rate was varied to maintain a constant feed per tooth. The depth of cut and number of knife engagements were also held constant. Tool wear was observed to increase with cutter diameter in the approximate square root relationship expected from the tool engagement length formulation.

Effect of Workpiece Material: The effect of MDF composition on wear was evaluated. This evaluation consisted of subjecting a typical grade of carbide, designed for MDF, to several MDF workpiece materials. The effect of workpiece variations was found to be significant, with wear differences of up to 2X observed for different commercial grades of MDF.

Effect of Carbide Grade: Wear in all materials, especially man made materials, is highly dependent on the grade of carbide utilized. In general, carbide grades with smaller binder content and smaller grain size (and hence higher hardness) perform better in MDF, provided edge brittleness does not result in excessive chipping.

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