Experimental Studies on Parallel Turning of Grey Cast iron Part B: Impact of Un-Cut Chip thickness

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ABSTRACT

The various process parameters in turning are un-cut chip thickness, cutting velocity and feed. In parallel turning additionally tool part-off distance also plays a major role. In this work parallel turning was performed on cast iron work material at three various cutting velocities in between 75 to 185 m/min for un-cut chip thickness in range of 0.5–2.0 mm and feeds of 0.08, 0.16 and 0.24 mm/rev. The experiment was focused to investigate the effect of un-cut chip thickness on cutting forces. The cutting forces are measured by means of Kistler dynamometer. An offset distance of 2 mm was found to be appropriate for the multi-tool turning as the two cutting tools showed similar dependencies on depth of cut, feed and cutting speeds as in a single tool turning.

Key words: Parallel Turning, feed, part-off distance, cutting speed, dynamometer.

INTRODUCTION

Opening up of global economy resulted in stiff competition in manufacturing sector. Apart from production quantity, product quality gained prime importance. Turning is a basic machining operation which is used in almost all manufactured products and hence a lot of research has been done on improving the process to increase quantity of production and bringing down production costs. In the first Part A impact of cutting forces and cutting temperatures in parallel turning process was discussed. The details of methodology are given in Part A. In the second Part B the impact of un-cut chip thickness was discussed. Literatures on multi-tool turning along with conventional turning was discussed in Part-A. In the following sections deals about influence of un-cut chip thickness on cutting forces of first and second cutting tool.

IMPACT OF UN-CUT CHIP THICKNESS ON FORCES

The results and discussion pertaining to cutting forces and temperature on parallel turning are presented in this section.

Load sharing means distribution of depth of cut amongst the two cutting tools. Three load sharing ratios of 1:2, 1:1 and 2:1, corresponding to ratio of depth of cut at the front and rear cutting tools respectively, are selected due to ease of distribution. The load sharing ratio of 2:1 is different from 1:2, as the depth of cut in the front is twice than that in the rear in former case and vice-versa in latter. A cutting of load of 1.5 mm has been distributed amongst the two cutting tools and turning experiment is performed at 75 m/min cutting velocity, 0.08 mm/rev feed and an offset distance of 2 mm is maintained between the two cutting tools.
The force distribution ratios of 1:1.08, 2:1 and 1:1.85 were observed for load distributions of 1:1, 2:1 and 1:2 respectively, Figure 1(a). Similar to force distribution, the tool-work piece interaction temperatures also showed the effect of load distribution. Temperature distribution in ratios of 1:1.2, 1.2:1 and 1:1.5 were observed for load sharing ratios of 1:1, 2:1 and 1:2 respectively, Figure (b).

**Effect of change in feed**

Cutting forces and temperatures were measured at three different feeds, viz. 0.08mm/rev, 0.16mm/rev and 0.24mm/rev with a uncut chip thickness of 1mm for each tool at a cutting speed of 75m/min. It was shown that with the raise in feed, both the forces [1] and temperature [2] were increased and the change in offset showed similar patterns of cutting force variation at all the feeds.

**Effect of change in cutting speed**

Cast iron workpiece were machined using two cutting tools each with a depth of cut of 1mm at cutting speeds of 75m/min, 120m/min and 185m/min. The feed rate was kept constant at 0.08mm/rev and parting off distance between the tools was varied from 2 mm to 50 mm for each cutting speeds. Not much change in the cutting forces was observed with variation in cutting velocity [1]; however the cutting temperature increased with the increase in cutting.
CONCLUSIONS

1. Cutting forces and temperatures were distributed in accordance with the load sharing ratios amongst the first and second cutting tools.

2. The cutting forces increased with increase in feed and depth of cut, while change in cutting speed did not have much effect on cutting forces.

3. Cutting temperatures increased with an increase in feed, cutting speed and depth of cut individually.

References
