Tapping Tool Life Assessment in Vertical Milling Centre in the CNC Production Centre

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Abstract. Tapping process in Computer Numerical Centre, is a key for the process because of its difficult to hold the close tolerance. During this study different types of tapping tool manufacturer have taken with same tapping tool material specification for the consideration. And also to find the relationship between the previous operational performances with tool and its parameter influence in the computer numerical control system has also taken for the consideration. During drilling process the new drill bit (drill bit 4) have higher tool life than the regained tool bits (Drill bit 1, 2 & 3). During tapping process, Emuge tool 2 and Emuge tool 3 have has higher production rate such as 434 and 356 components respectively. This Emuge tool 2 and tool 3 have previous working tool in the drilling process is drill bit 4 (New Drill Bit). Which has improved the surface roughness than the other drill bit. Due to reduced surface roughness causes the tapping tool to ease in there processing which resulted in the higher production rate in tapping tool than the other conditions.

1. Introduction

During HSS (High Strength Steel) tool are mostly used in the machining process because of its quality of hardness and too cost [1]. The utilization of martensitic and super martensitic structures are gives improved tool life for the HSS tool because for the reason of higher hardness. It also has the nearness of a hard martensitic stage which is near to grating particles of chromium carbides. The martensitic stainless steels are utilized as a part that requires great elastic, disfigurement and withstanding qualities are blended with heat resistance [2]. The super martensitic stainless steels have been effectively used in the fabrication
of funnels and other hardware tools used particularly in the oil and gas industry. This shows that HSS with martensitic and super martensitic compositions have higher tool life than the normal HSS.

Tapping is one of the regularly utilized machining operations for getting inside strings in numerous parts. Since there are numerous issues experienced in the tapping procedure, many inquiries about tap breakage & intolerance because of unnecessary torque & non-optimized tapping parameters [3]. A few issues as are regularly occurring during the tapping procedure incorporate dimensional intolerance and surface roughness [4]. The reason which is most likely to causes the taps wear. Other than the normal wear because of tapping process, there are many elements which may also have such as device wear, for example, wrong tap determination, high tapping speed, deficient or off base oil, gap work solidifying, obsession unsteadiness and misalignment amongst taps and workpieces [5]. Since tapping is normally the last procedure in most creation methods, if any issue happens in this stage, the makers could endure incredible financial misfortunes because of numerous terrible items [6].

During tapping process in Compute Numerical Centre, is a key for the process and it is difficult to hold the process with the close tolerance. In industries, it is mandatory to maintain the cost effectiveness with quality [7]. During this study different types of tapping tool manufacturer have taken for the consideration for with same material composition. And also to find the relationship between the previous operational performances in the computer numerical control system has also taken for the consideration [8].

2. Experimental Work

Figure 1 shows the vertical milling center are used to perform the work with following machine parameters for the drilling and tapping process are shown in table 1 and table 2 respectively. Tapping tool used in the process is shown in figure 2. Both the tool bit’s drilling and tapping are made of High Strength Steel (HSS) tool material with same material composition.

| Table: 1 Drilling operation parameters in VMC |
|---------------------------------------------|
| Parameter              | Descriptions     |
| Type of the Operation | Contact          |
| Operation Number       | 130              |
| Number of Edges        | 1                |
| Machine Number         | DTC 400 XL       |
| Tool Name              | 7.45 Drill       |
| Speed (rpm)            | 400              |
| Feed (mm/min)          | 550              |
Table: 2 Tapping operation parameters in VMC

| Parameter          | Descriptions              |
|--------------------|---------------------------|
| Part Name          | Contact                   |
| Operation Number   | 130                       |
| Number of Edges    | 1                         |
| Machine Number     | DTC 400 XL                |
| Tool Name          | M8x1.25 - 64 Tap          |
| Speed (rpm)        | 340                       |
| Feed (mm/min)      | 425                       |

Figure: 1 Vertical Milling center

Figure: 2 Tapping Tool
3. Result and Discussion

Here tool life in the tapping process are plotted for the make for the 2 tapping tool manufacturer such as Emuge and Ghuring. Each of this tapping tool bit taken for 3 trails as mentioned in table 3. Drill bit tool life for previous drilling process with 4 trails are mentioned in table 4. The tool worn out identified by the checking the dimension of the product. The condition of tool worn out for tapping tool bit and drilling tool bit are also recorded.

3.1 Tapping Tool Life

Figure 3 and figure 4 has plotted with the help of table 3. Figure 3 clearly shows that the Guhring tapping tool have consistent tool life around 260 -290 components. In other hand Emuge has tool life varying from 260 to 430.

![Figure 3 Productivity of the Tapping Tool](image)

Figure 4 shows that the Guhring have contributed 45% of production in the components where Emuge has 55% production. After the specific number of production the components manufactured through the tapping tool is become 0.1mm error in the tolerance & fit which makes that tool lesser efficient & components failed in quality because of it’s required standards. This is mentioned in table 3 as remarks after machining.

| Name of Tap Manufacturer | Production Date | No of Components Produced | Remarks - After Machining |
|--------------------------|-----------------|---------------------------|---------------------------|
| Guhring 1                | 21.7.17         | 60                        | 0.1mm Bulging , Outer Dia gets Bigger |
|                          | 26.7.17         | 75                        | Tap can be used for fixed contact method |
|                          | 27.7.17         | 128                       |                           |
Guhring 2
28.7.17 172 0.1mm Bulging, Outer Dia gets Bigger
29.7.17 120 Tap can be used for fixed contact method
Total 292

Guhring 3
31.7.17 45 0.1mm Bulging, Outer Dia gets Bigger
1.8.17 175 Tap can be used for fixed contact method
2.8.17 60
Total 280

Emuge 1
2.8.17 120 0.1mm Bulging, Outer Dia gets Bigger
3.8.17 65 Tap can be used for fixed contact method
4.8.17 81
Total 266

Emuge 2
5.8.17 92 0.1mm Bulging, Outer Dia gets Bigger
7.8.17 182 Tap can be used for fixed contact method
8.8.17 60
9.8.17 100
Total 434

Emuge 3
10.8.17 50 0.1mm Bulging, Outer Dia gets Bigger
11.8.17 166 Tap can be used for fixed contact method
12.8.18 140
Total 356

Total Components Manufactured 1891

Figure: 4 Comparison of Tapping Tool Life

3.2 Drilling Tool Life

Table: 4 Drill Bit Life Assessments

| S.No. | Production Date | No of Components Produced | Remarks - After Machining |
|-------|----------------|---------------------------|---------------------------|
| 1st Drill | 21.7.17 | 60 | Regrind Drill bit get wear out |
|       | 26.7.17 | 75 | |

| Date   | Quantity | Reason                  |
|--------|----------|-------------------------|
| 27.7.17| 128      | Regrind is Needed       |
| 28.7.17| 172      |                         |
| Total  | 435      |                         |

### 2nd Drill

| Date   | Quantity | Reason                  |
|--------|----------|-------------------------|
| 29.7.17| 120      |                         |
| 31.7.17| 45       | Regrind Drill bit get wear out |
| 1.8.17 | 175      | Regrind is Needed       |
| 2.8.17 | 60       |                         |
| Total  | 400      |                         |

### 3rd Drill

| Date   | Quantity | Reason                  |
|--------|----------|-------------------------|
| 2.8.17 | 120      |                         |
| 3.8.17 | 65       | Regrind Drill bit get wear out |
| 4.8.17 | 81       | Regrind is Needed       |
| 5.8.18 | 92       |                         |
| Total  | 358      |                         |

### 4th Drill

| Date   | Quantity | Reason                  |
|--------|----------|-------------------------|
| 7.8.17 | 180      |                         |
| 8.8.17 | 65       | New Drill Bit as in Manufactured |
| 9.8.17 | 120      | Dill bit is good condition   |
| 10.8.17| 55       |                         |
| 11.8.17| 166      |                         |
| Total  | 586      |                         |

**Total Components Manufactured**: 1779

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**Figure: 5 Productivity of the Tapping Tool**
During drilling process drill bit tool life is normally 350 to 430 components for the regrained tool for the new tool bit which has tool life is around 600 and some time it will be more. This shows that the newer tool bit have 2 twice their tool life than the regrained tool bit. Which has observed in the table 4. Figure 5 and figure 6 shows that the drill bit 4 (new) have higher production rate than other regrained tool bit.

![Comparison of Drilling Tool Life](image)

Figure: 6 Comparison of Tapping Tool Life

4. Suggestion

During high speed machining, wear rate of the HSS tool is increased. Due to wear on HSS tapping tool, the close tolerance, misalignment, choosing wrong tap for the process, excessive use of tap with minimum lubrication and coolant. To counter the problem coating the HSS tool with various tool coating agents such as vapor deposition methods to get the CVD-Ti(C,N)/TiC/Al2O3 and PVD-TiN. This solidified carbide prevented the rough wear.

5. Conclusion.

From the tool life analysis of tapping process and drilling process. Following key observations are made. During drilling process the new drill bit (drill bit 4) have higher tool life than the regained tool bits (Drill bit 1, 2 & 3). During tapping process, Emuge tool 2 and Emuge tool 3 have has higher production rate such as 434 and 356 components respectively. This Emuge tool 2 and tool 3 have previous working tool in the drilling process is drill bit 4 (newer). Which has improved the surface roughness than the other drill bit which causes the taping tool to ease in there processing which resulted in the higher production rate in tapping tool than the normal. This also proves that the tool bit for drilling process has indirectly influencing the tapping tool life. Coating the drill bit and tapping tool will have chance of improving with
different coating process and materials of CVD-Ti(C,N)/TiC/Al2O3 and PVD-TiN will gives improved tool life.

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