CHAPTER 3

SELECTION OF DIFFERENT COATED TOOLS
FOR TURNING STAINLESS STEEL

3.1 INTRODUCTION

Coating on cutting tools is one of the ways to achieve an essential improvement in its cutting performance. However, there is such a variety of coating materials and coating processes that careful selection of a suitable coating becomes important. In order to select a suitable coating on tools, it is essential to identify the primary wear mechanisms inherent in the machining task. Most coatings generally increase tools hardness and lubricity. A coating allows the cutting edge of a tool to cleanly pass through the material without having the material stuck to it. The coating also helps to decrease the temperature associated with the cutting process and increases the life of the tool (Porat & Ber 1988, Roebuck & Gee 1989). Most of the researchers concentrated on the effect of the tool geometry and coating methods of the cutting tool. However coated tools in CNC turning on stainless steel have received less attention. In this work, an attempt has been made to investigate the different coated tools on AISI316 and AISI410 in CNC turning under dry conditions.

3.2 OBJECTIVE

The surface roughness and tool wear are the important turning characteristics in turning operation and hence minimization of surface roughness and tool wear were taken as objective of this research work.
3.3 SELECTION OF DIFFERENT COATED TOOL

Carbide cutting tools were preferred over high speed steel cutting tools. Carbon was not only used in the direct carbide tool, but also a combination of some other non-metals and metals. The combination of the two metals resulted in a fine grey powder and it was formed by a powder metallurgical method. The tool geometry of all the cutting tool was CNMG 120408 and the Vickers hardness for the uncoated carbide tool was 900 HV. The selection of coating insert should have all of the following characteristics (Tamizhmnii et al 2008b):

- 4.5 times Harder than the work piece
- High temperature stability
- Resists wear and thermal shock
- Impact resistant
- Chemically inert to the work material

The cutting tool coated with TiCN/Al₂O₃ was selected for case-I, TiCN/Al₂O₃ coated tool had chemical stability at high temperatures and increasing high resistance to resist abrasive wear, diffusion and adhesive wear. Vickers hardness of the TiCN/Al₂O₃ coated cutting tool was 1556 HV.

The cutting tool coated with TiAlN was selected for case-II, TiAlN coated tool had the higher harness, high temperature stability, thermal shock, resistance against the wear and lower coefficient of friction. Vickers hardness for the TiAlN coated cutting tool was 1633HV.

The cutting tool coated with Ti(C,N,B) was selected for case-III, Ti(C,N,B) coated tool had extremely hard, resistance to oxidation, diffusion
and adhesive wear. Vickers hardness for the Ti(C,N,B) coated cutting tool was 1400HV.

The cutting tool coated with B-TiC was selected for case-IV, B-TiC coated tool has non magnetic property, extremely high hardness, high resistance to adhesion, abrasion and chemically inert. Vickers hardness for the B-TiC composition coated cutting tool was 1478HV.

The cutting tool coated with B-Al2O3 was selected for case-V, B-Al2O3 coated tool has non magnetic property, lighter in weight and less costly than tungsten carbide, but in cutting tools it is more brittle, resistance to wear and corrosion. Vickers hardness for the B-Al2O3 coated cutting tool was 1478HV (Porat 1990, Ibrahim 2006).

The Rockwell and Vickers hardness of the different coated cutting tools are given in Table 3.1. The hardness of the different coated cutting tools is shown in Figure 3.1. It showed that the TiAlN coated cutting tool had higher hardness than the other coated cutting tools followed by the TiCN/Al2O3 coated cutting tool.

Table 3.1 Hardness of the different coated tools

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Coating composition</th>
<th>Rockwell hardness (HRD)</th>
<th>Vickers hardness (HV)</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Uncoated</td>
<td>76.1</td>
<td>900</td>
</tr>
<tr>
<td>2</td>
<td>TiCN/Al2O3</td>
<td>83</td>
<td>1556</td>
</tr>
<tr>
<td>3</td>
<td>TiAlN</td>
<td>84</td>
<td>1633</td>
</tr>
<tr>
<td>4</td>
<td>Ti(C,N,B)</td>
<td>81.5</td>
<td>1400</td>
</tr>
<tr>
<td>5</td>
<td>B-TiC</td>
<td>82.5</td>
<td>1478</td>
</tr>
<tr>
<td>6</td>
<td>B-Al2O3</td>
<td>82.5</td>
<td>1478</td>
</tr>
</tbody>
</table>
Figure 3.1 Hardness of the different coated tools