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Drillability of Titanium Alloy 6Al-2Sn-4Zr-6Mo: Cutting Forces Point of View

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Abstract. This paper concerns on drillability of Ti-6Al-2Sn-4Zr-6Mo (Ti-6246) from the point view of thrust force (Fz) & torque (Mz) using a TiAlN CVD coated carbide tool. The condition of the material was varied with three different heat treatments. Whereas, the machining parameters were varied in cutting speed, feed rate and cooling application method. Taguchi method L-18 was employed to design the experiments. The thrust force and torque were measured using a Kistler dynamometer, and the data were analyzed using a Minitab 17 software. The thrust force was influenced by the cutting speed 24%, depth of drilling 21%, heat treatment 13%, and feed rate 11%. The torque was influenced predominantly by feed rate up to 94%. Coolant application has no effect on reducing both thrust force as well as torque.

1 Introduction

Drillability term is derived from machinability, which means how easy the material be drilled with a drill bit. This paper discuss drillability of Titanium alloy 6Al-2Sn-4Zr-6Mo when being drilled with TiAlN-coated carbide from forces point of view. Cutting forces is a measure of machinability. Usually, a lower cutting force is preferable. Cutting force can stimulate the vibration of the spindle axis, resulting in poor quality of drilled surface. It may also cause premature failure of drills and reduce tool life. High torque, as indication of increasing friction between the drill and workpice, can emerge a huge of heat, causing higher temperature at tool-workpiece interface [1]. It is interesting to study the forces in drilling as they directly affected the surface quality [2].

In drilling, there must be two different movements: cutting speed and feed rate. Cutting speed makes the tool cut the work piece only once of full rotation and feed rate keeps the cutting going on. Torque is the force that make the drill able to rotate along vertical axis; it relates to cutting speed. While, thrust force is the force that make the drill move along vertical axis (Z-axis) and it relates to feed rate.

Some previous researchers have observed relation of forces that works during machining titanium alloys and the machining parameters. Cutting force (Fc) and feed force (Fk) have been discussed on machining three kind of titanium alloys Ti-6Al4V, Ti-54M and Ti-10.2.3 with variation in machining parameters. They concluded that feed rate was

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