World Academy of Science, Engineering and Technology
International Journal of Industrial and Manufacturing Engineering
Vol:17, No:09, 2023

Tool Wear Analysis in 3D Manufactured Ti6AI4V

Authors : David Downey

Abstract : With the introduction of additive manufacturing (3D printing) to produce titanium (Ti6Al4V) components in the medical/aerospace and automotive industries, intricate geometries can be produced with virtually complete design freedom. However, the consideration of microstructural anisotropy resulting from the additive manufacturing process becomes necessary due to this design flexibility and the need to print a geometric shape that can consist of numerous angles, radii, and swept surfaces. A femoral knee implant serves as an example of a 3D-printed near-net-shaped product. The mechanical properties of the printed components, and consequently, their machinability, are affected by microstructural anisotropy. Currently, finish-machining operations performed on titanium printed parts using selective laser melting (SLM) utilize the same cutting tools employed for processing wrought titanium components. Cutting forces for components manufactured through SLM can be up to 70% higher than those for their wrought counterparts made of Ti6Al4V. Moreover, temperatures at the cutting interface of 3D printed material can surpass those of wrought titanium, leading to significant tool wear. Although the criteria for tool wear may be similar for both 3D printed and wrought materials, the rate of wear during the machining process may differ. The impact of these issues on the choice of cutting tool material and tool lifetimes will be discussed.

Keywords : additive manufacturing, build orientation, microstructural anisotropy, printed titanium Ti6Al4V, tool wear
Conference Title : ICNMPC 2023 : International Conference on Nontraditional Manufacturing Processes and Challenges
Conference Location : London, United Kingdom
Conference Dates : September 18-19, 2023