Synopsis Seminar

Seminar Title	: Development of advanced machining strategies for difficult-to-cut Ni-based superalloy Inconel 617
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Venue	: Seminar Hall ME Department
Date and Time	: 05 Nov 2024 (4.30PM)

Abstract

: Inconel 617 is a solid-solution strengthened nickel-based superalloy. It is gaining popularity as a potential structural material for different components of nuclear reactors like very high-temperature reactors (VHTR) and pressurized water reactors due to its exceptional resistance to corrosion and high-temperature oxidation, formability and weldability, and ability to maintain its structural integrity under high temperatures. The exceptional properties of Inconel 617 are also attributed to the formation of a protective oxide layer on its surface by chromium and aluminium, as well as, the strengthening of its solid solution by molybdenum and cobalt. Despite the fact that Inconel 617 has prominent industrial applications, the machining characteristics of the same alloy are relatively unknown. Therefore, the first phase is investigation into microstructural characterization and properties of Inconel 617. Microstructure of as-received Inconel 617 reveals presence of larger particles comprising of Ti (C,N), $M_{23}C_6$ and M_6C phases. It is also evident that the distinct non-uniformity of the hard and abrasive phases is expected to have serious implications during machining of Inconel 617 particularly in terms of tool wear. The next phase of current work aims at comparative evaluation of performance of WC, SiAlON and $SiC_w + Al_2O_3$ tools under different cutting parameters during dry machining of Inconel 617. Solid solution strengthening due to Ni-Cr-Mo-Co phases and precipitation strengthening due to $M_{23}C_6$ carbide present in Inconel 617 specifically lead to rapid rate of tool wear. Finite element (FE) simulation is carried out to predict cutting zone temperature and tool wear followed by experimental validation. The third phase of current research is to evaluate the performance of physical vapour deposition (PVD)-AlTiN coated WC. The coating is done based on cathodic arc evaporation (CAE) and high power impulse magnetron sputtering (HiPIMS) techniques to identify the best possible coating technique during the machining of Inconel 617. The final phase of the research focuses performance evaluation of uncoated and coated ceramic tools under dry condition, similar to preceding chapter, however at higher cutting speed.