INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Programme of Study	:	Ph.D.

Thesis Title: Sustainable dry hard turning of AISI 52100 hard steel with new coating material (HSN2) on carbide insert and simulation of forces

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SHORT ABSTRACT

In this work, a newly developed 2nd generation TiAlxN super nitride (i.e. HSN^2) is selected for PVD coating on carbide tool insert and further characterized using TGA and DSC for oxidation and thermal stability at high temperature. Later, HSN^2 coated carbide inserts are successfully tested for their sustainability to expected tool life for turning AISI 52100 steel. In the present study, forces, surface finish and tool wear are used as a measure to appraise the performance of hard turning process. Experimentally, it is found that speed, feed and depth of cut have considerable impact on forces, tool wear and surface roughness of the machined surface. Further, a relationship is built between input process parameters i.e. cutting speed, feed and depth of cut with output responses i.e. main cutting, radial and feed forces, maximum flank wear and surface quality of work piece. Statistical design of experiment is used to examine the consequence of cutting parameters on machinability prospects. Also, the regression models are developed to correlate between input process parameters with output responses. Further, the cutting parameters are optimized using response surface method and validated using confirmation tests.

Also, in the present thesis an attempt has been made to examine the development of white layer in hard turning at different cutting speeds. All the experiments are executed on AISI 52100 grade steel (having hardness 55 HRC) with newly developed HSN^2 coated carbide insert having fresh edge for each experiment. Field emission scanning electron microscope, optical microscope and X-ray diffraction are used to analyze white layer at different cutting conditions on machined surface as well as bulk material. In addition, micro hardness of the machined surfaces is measured. Also, workpiece surface and chip temperatures are studied. Also analysis of white layer effect after machining and correlate this white layer to the XRD results.

Further for the simulation purpose AISI 4340 steel has been taken as a workpiece and Al2O3 coated carbide tool as a tool insert. In the present study, hard turning operation of AISI 4340 work piece is simulated using finite element based software package ABAQUS® while subjected to given loads or boundary conditions to accurately determine the responses.