

Study of Mechanical Behaviour of Nickel during Machining - A Review

S.Manoj¹, Veeramani.C², Vignesh.S³, Pradeep kumar.S⁴, Senthil kumar.M⁵

Assistant Professor, Department of Mechanical Engineering, TRP Engineering College, Tiruchirapalli, India¹

UG Scholars, Department of Mechanical Engineering, TRP Engineering College, Tiruchirapalli, India^{2,3,4,5}

ABSTRACT: Turning is a conventional machining process where the material is removed using lathe. The machining is done mainly using HSS tool in the older days, in present scenario use of inserts have come into existence which has improved the surface finish, machining time and productivity. The inserts have improved the life of the tool and has more temperature withstanding capacity and high hardness. Nowadays material of the size 10^{-9} m known as the Nano materials are coated to improve the surface characteristics of hard and brittle material. Nano particles are coated on the cutting tool to improve the surface roughness value and to increase the tool life. The two main fundamental properties of our coating are high hardness and lubricity. The present objective of our work is to coat the inserts with Nickel Nano material and the machining parameters are investigated which resulted in the increase in surface finish and reduced the machining time for optimum speed, feed and depth of cut.

KEYWORDS: Inserts, Nano material, Surface finish, Machining time..

I. INTRODUCTION

Today the market is very competitive. Anyone has to produce high precision goods to survive the competition. There is a cutting tool for every application. As a critical part of the overall machining system, cutting tools are often targeted when manufacturers look for improvements in overall productivity. Technologies such as high-speed machining, dry machining and continuing development of tough work piece materials place extreme demands on cutting tools. To keep pace, tool suppliers must continue to develop products that can perform at higher speeds and last longer under vigorous operating conditions.

In the past, high speed steel tools were used in major, the problem in using HSS tools are, higher rate of wear, life is less, breakage of tool is frequent, regrinding of tool takes it's own time. In order to overcome that inserts are used in the machining process. These inserts have greater life and wear rate is decreased. Even though the life of the insert is high, the manufacturers look forward to increase the surface finish and reduce the insert wear. So to increase the precision we coated nickel nano material on inserts and process parameters are investigated

II. TURNING

Turning is an engineering machining process in which a cutting tool, typically a non-rotary tool bit, describes a helical tool path by moving more or less linearly while the workpiece rotates. The tool's axes of movement maybe literally a straight line, or they may be along some set of curves or angles, but they are essentially linear (in the non-mathematical sense).

Usually the term "turning" is reserved for the generation of external surfaces by this cutting action, whereas this same essential cutting action when applied to internal surfaces (that is, holes, of one kind or another) is called "boring". Thus the phrase "turning and boring" categorizes the larger family of (essentially similar) processes. The cutting of faces on the workpiece (that is, surfaces perpendicular to its rotating axis), whether with a turning or boring tool, is called "facing", and may be lumped into either category as a subset.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Special Issue 8, May 2016

Turning can be done manually, in a traditional form of lathe, which frequently requires continuous supervision by the operator, or by using an automated lathe which does not. Today the most common type of such automation is computer numerical control, better known as CNC. (CNC is also commonly used with many other types of machining besides turning).

This operation is one of the most basic machining processes. That is, the part is rotated while a single point cutting tool is moved parallel to the axis of rotation. Turning can be done on the external surface of the part as well as internally (boring). The starting material is generally a workpiece generated by other processes such as casting, forging, extrusion, or drawing.

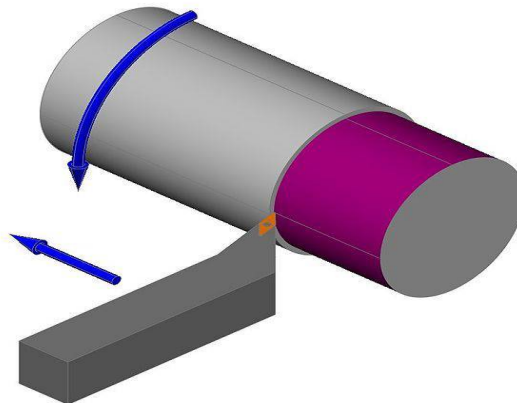


Fig. 1 Turning Operations

III. LITERATURE SURVEY

Prasanna Gadhari, Prasanta Sahoo studied Ni-P-Al₂O₃ composite coating developed by electroless process by varying the content of nickel sulphate, sodium hypophosphite and investigated the effect of alumina content on the surface morphology, roughness, hardness, friction, and wear and concluded that Co-deposition of alumina particles within Ni-P coating matrix changes the roughness and the surface morphology of composite deposits from a smooth state to a non-smooth state. The hardness, coefficient of friction and wear resistance of Al₂O₃ composite coatings increase in the presence of Al₂O₃ particles, whereas the maximum hardness and wear resistance are achieved in heat treated coating at about 400°C. Abrasive wear is the most dominant mechanism for wear of Ni-P-Al₂O₃ coatings

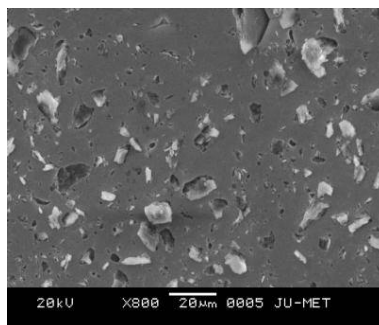


Fig. 2 SEM image Al₂O₃ composite coating,

R. Abdel-Karim and A. F. Waheed studied Nano structured Ni-Fe alloys, produced by electro-deposition technique and concluded that provide material with significant improved strength and good magnetic properties, without compromising the coefficient of thermal expansion

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Special Issue 8, May 2016

Jothi Sudagar, Jianshe Lian, Wei Sha studied different electroless nickel alloy, composite, nano plating, bath techniques, preparation, characterization, new depositing mechanism and concluded that The properties of electroless nickel coatings are improved continuously by suitable surface treatments (heat, laser, etc.) and the incorporation of various elements (copper, tungsten, etc.) and particles (SiC, TiO₂, etc.) by the various researchers to suit the various applications.

Ron Parkinson studied Electroless nickel plating and concluded that properties that have contributed to the success of electroless nickel include corrosion and wear resistance, hardness, magnetic response, solderability, lubricity and thickness uniformity.

Sanjib Kundua, Suman Kalyan Dasa and Prasanta Sahoo studied properties of electroless nickel and found that as-deposited Ni-P coatings outperform heat treated ones in case of wear resistance at elevated temperatures. Addition of a third element (silver) or particle (SiC, MoS₂, BN, etc.) also influences the elevated temperature performance of EN coatings.

Ray Taheri conducted experiments to evaluate various properties of three types of EN coatings, namely, low, medium, and high phosphorus. They concluded that EN coatings have excellent adhesion properties. No sign of separation, branching, chip off, or delamination of the coatings was observed. In particular, high phosphorus EN coating shows better corrosion resistance (due to its nano-crystalline microstructure) whereas low phosphorus EN coating shows better wear resistance (due to its high hardness value). The results of erosion-corrosion experiments showed that EN coatings had excellent erosion-corrosion resistance at a high temperature, 100°C, in a potash brine environment.

Niraj, Satnalika, Ankesh Khandelwal (2013) suggested that the hard turning operations to be performed in the inserts with a single layer of TiCN coating on the inserts. They coated it up to a layer of 15-18 microns. The coatings were applied over the cemented carbide. The cemented carbide is also known as the Tungsten carbide along with cobalt matrix. They obtained the result such that it had a semi continuous finish and obtained a hardness of 3000 Hv

M. Narasimha, R. Reiji Kumar (2009) considered TiN coated tool for turning the AISI 1018 steel under dry conditions. They conducted experiment over the CNC turning for uncoated and the coated tool. They concluded the uncoated tool experienced more flank wear and tool wear, coated tool produced 50% less wear compared to the uncoated tool, TiN coatings had more wear resistant than other coatings.

Rajnik R Chadaniya, Harshad D Patel, Alpesh H Makwana studied the effect of cutting tool coating material and coating process found that the coating material and number of coating layer affects the tool flank wear during cutting. Increasing coating layer tool flank wear decreases. Feed rate increase tool life decrease and surface finish increase. PVD coating process was better for thin and multilayer coating process. During machining of SS304 Built up edge and poor surface finish produces during machining

T. Cselle, O. Coddet, C. Galamand, P. Holubar, M. Jilek, J. Jilek, A. Luemkemann, M. Morstein studied PVD coating in detail and concluded that the new generation of PVD coatings TripleCoatings3® uses the advantages of conventional (TiN, CrN, TiAlN, AlTiN) and nanocomposite coatings (nc-TiAlN/a-SiN, nc-AlCrN/a-SiN, nc-AlTiCrN/a-SiN). TripleCoatings3 are applicable for general purposes but they achieve the best results in high-performance machining. The coating takes place in coating units using LARC®- and CERC®-Technology. The TripleCoatings3® were introduced in the spring of 2007 and are widely being used extensively in the manufacturing industry all over the world.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Special Issue 8, May 2016

IV. CONCLUSION

The problem is mainly lack of precision. Out of all factors material properties and material coating play a vital role in precision as we see from the literature review. So required material coating can be chosen and turning of workpieces using this material coated insert can be analyzed and a process control chart can be formed. Experimental set up for turning can be done using methods studied in literature review. The parameters which affect turning can be taken as input parameters and machining time and surface roughness can be taken as output parameters. We can observe that machining time and surface roughness has reduced due to nickel nano coating on insert

REFERENCES

1. Mehdi Remadna, Jean Francois Rigal (2004-05), "Evolution during time of tool wear and cutting forces in the case of hard turning with CBN inserts", GMC LaMCoS, Domaine Scientifique de la DOUA, B'at. J.-Jacquard, 69621 Villeurbanne, France Received 8 January 2004; accepted 21 March 2005.
2. Gustavo de Siqueira Galoppi, Marco Stipkovic Filho (2008-09), "Hard turning of tempered DIN 100Cr6 steel with coated and no coated CBN inserts", a Laboratory of Manufacturing Engineering, Department of Mechatronics and Mechanical Systems Engineering, Escola Polit'cnica da Universidade de Sao Paulo, Av. Prof. Mello de Moraes, 2231, 05508-970, S. Paulo, SP, Brazil b Centro Universit'rio Instituto Mau'a de Tecnologia, Escola Mau'a de Engenharia, Pra'ca Mau'a 1, 09580.900 S'ao Caetano do Sul, SP, Brazil.
3. D. Smolenicki, J. Boos (2010-11), "In-process measurement of friction coefficient in orthogonal cutting", a Institute of Machine Tools and Manufacturing (IWF), ETH Zurich, Switzerland b Swiss Steel AG, Emmenbr'ucke, Switzerland c Rieter Machine Works Ltd., Winterthur, Switzerland Submitted by R. Z'ust (1), See-gr'aben, Switzerland.
4. P. Panjan, P. Gselman (2000-01), "Growth defect density in PVD hard coatings prepared by different deposition techniques", Jo'zef Stefan Institute, Jamova 39, 1000 Ljubljana, Slovenia b University of Maribor, Faculty of Mechanical Engineering, Smetanova 17, 2000 Maribor, Slovenia.
5. S. Sveen, J.M. Andersson (2007-08), "Scratch adhesion characteristics of PVD TiCN deposited on high speed steel, cemented carbide and PCBN substrates", Dalarna University, SE-79188 Falun, Sweden b Link'oping University, SE-58183 Link'oping, Sweden c Seco Tools AB, SE-73782 Fagersta, Sweden.
6. S. Olovsj'o, A. Wretland (2008-09), "The effect of grain size and hardness of wrought Alloy 718 on the wear of cemented carbide tools", Department of Materials and Manufacturing Technology, Chalmers University of Technology, 41296 G'oteborg, Sweden b Volvo Aero Corporation, 46130 Trollh'attan, Sweden.
7. H.Q. Sun, R. Irwan (2009-10), "Surface characteristics and removal mechanism of cemented tungsten carbides in nanoscratching", School of Mechanical and Mining Engineering, The University of Queensland, QLD 4072, Australia b School of Mechanical Engineering, The University of Western Australia, WA 6009, Australia.
8. Ihsan Korkut, Mustafa Kasap (2011-12), "Determination of optimum cutting parameters during machining of AISI 304 austenitic stainless steel", Technical Education Faculty, Gazi University, 06500 Besevler, Ankara, Turkey b Stellram Cutting Tool Company, 06370 Ankara, Turkey c Institute of Science and Technology, Gazi University, 06570 Maltepe, Ankara, Turkey Received 23 April 2003; accepted 20 October 2003.
9. N. Senthil Kumar And T. Tamizharasan (2010-11), "Finite Element Analysis And Optimization Of Uncoated Carbide Cutting Inserts Of Different Tool Geometries In Machining Aisi 1045 Steel", TamilNadu, India.
10. M. Narasimha, R. Reiji Kumar (2012-13), "Performance of Coated Carbide Tools", School of Mechanical and Industrial Engineering, Bahir Dar University, Bahir Dar, Ethiopia.
11. Ray Taheri, "Evaluation of Electroless Nickel-Phosphorus (EN) Coatings" Department of Mechanical Engineering, University of Saskatchewan, Saskatoon
12. A. Baron, D. Szewieczek, R. Nowosielski (2007), "Selected manufacturing techniques of nano materials", Institute of Engineering Materials and Biomaterials, Silesian University of Technology, Poland.
13. Prasanna Gadhari, Prasanta Sahoo (2014), "Study of tribological properties of electroless Ni-P-Al₂O₃ composite coatings", Department of mechanical engineering, Jadavpur, Kolkatta.
14. Nikunj Patel, Prof. R. K. Patel, Prof. U. J. Patel, Prof. B. P. Patel (2012), "Insert selection for turning operation on CNC turning centre using MADM methods", U. V. Patel college of Engineering, Mehsana, Gujarat, India.
15. Costas A. Charitidis, Pantelitsa Georgiou, Malamatenia A. Koklioti, Aikaterini-Flora Trompeta, Vasileios Markakis (2014), "Manufacturing nano materials: from research to industry", Department of material science and engineering, Athens, Greece.
16. Luther (Ed.) (2004), "Industrial application of nano materials-chances and risks", Future Technologies Division, Dusseldorf.
17. G. Cao (2004), "Nanostructures & nanomaterials: synthesis, properties & applications", Imperial College Press, Washington.
18. M. Steinfeldt (2012), "Proceedings of Safety Issues and Regulatory Challenges of Nano materials", San Sebastian, Spain.
19. Jothi Sudagar, Jianshe Lian, Wei Sha (2012-13), "Electroless nickel, alloy, composite and nano coatings", Department of Metallurgical and Materials Engineering, Indian Institute of Technology-Madras (IIT-M), Chennai, India
20. D. Szewieczek (2003), "Fundamental of Nanoelectronics", Forschungszentrum Julich Institute of Solid State Research.
21. R. Abdel-Karim and A. F. Waheed (2013), "Nanocoatings", Department of Metallurgy, Faculty of Engineering, Cairo University, Giza, Egypt.
22. Sherik M, Ajwad H, Rasheed A. H, Jabran A, Ortiguerra R. G (2008), "Adhesion and Corrosion Performance of Nanostructured Nickel and Cobalt-based Coatings", New Orleans, Los Angeles.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Special Issue 8, May 2016

23. Halim.J (2009), "Electro deposition and Characterization of Nano crystalline Ni-Fe Alloys", Cairo University, Egypt.
24. Gleiter.H (2000), "Nanostructured Materials: Basic Concepts and Microstructure. Acta Materialia", Egypt.
25. Brooks.I (2012), "Synthesis and Mechanical Properties of Bulk Quantities of Electrodeposited Nanocrystalline Materials", University of Toronto, Canada.
26. Low.C.T, Walsh.F.C (2006), "Electrodeposition of Composite Coatings Containing Nanoparticles in a Metal Deposit-Surface Coating Technology".
27. S.Kishore,J.GogulKumar,P.LeninXavier, G.Logesh(2015), "Experimental Investigation Of Process Parameters Involved in Dry Turning Operation Using Nano Coated Inserts",UG Final Year Project - Anna University
28. www.sciencedirect.com
29. www.researchgateonline.com
30. www.wikipedia.com
31. www.google.com