International Journal of Engineering Technology Science and Research
IJETSR
www.ijetsr.com
ISSN 2394 – 3386
Volume 4, Issue 5
May 2017

Carbon Steel EN8 and EN 19 Tool Wear Reduction by Cryogenic Treatment

Mr.Vasa Ramu
RMK College of Engineering and Technology, Puduvoyal

Nishok Sriram .S.R
Gandhi street, Padikuppam, Chennai

P.Hani Deep
Swarnabharathi street, Gannavaramkrishna

ABSTRACT

The high speed steel is used as a cutting tool, since it has good quality and reliability at cheaper rate when compared to other cutting tools. So it is very important to increase the ability of the tool further for its reliability. So the best way is to increase the hardness. We have brainstormed to find out alternate tool materials.

One novel method namely dipping the ordinary tool bit in a CRYOGENIC SOLUTION, which improves the wear properties of the cutting tool consequently machining time is also reduced.

Cryogenic treatment of high speed steel is one of the developments in manufacturing field. It offers much better wear resistance and hardness for the high speed steel. The conventional cryogenic treatment process involves cooling down the samples to 93k (-180°c) soaking for 15-20 minutes

In this project we have explained our approach and methodology to arrive at an optimum solution having two sample pieces of round of EN8 & EN19. A method called deep cryogenic process, subjects steel components placed in a specially constructed tank to temperature around 77k (196°c) for half an hour using liquid nitrogen as the refrigerant

The results are encouraging that, there is 34.17 seconds reduction in machining time and there is no tool wear when machining EN8 and when machining EN 19 there is 22.04 seconds reduction in machining time and 0.03g increase in tool wear resistance.

Keywords

Cryogenic solution, machining process

INTRODUCTION

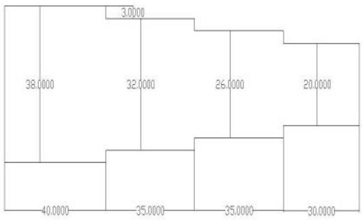
Crystal structure becomes consistent or homogenous through the conversion of austenite to the desired martensitic crystal. After heat-treating, nearly all steels have a certain percentage of austenite that was not fully transformed into martensite. This is what metallurgists call “retained austenite” or “RA”. It is widely accepted in the heat-treating industry that all heat-treated steels will have some percentage of RA and heat treatment recipes routinely specify that RA will “not exceed” a certain percentage. This can vary from processor to processor, but almost all steels have a certain percentage of RA or retained austenite. Cryogenic treatment promotes the additional transformation of RA into martensite, which is what 90% (or more) of the steel already is and the condition that is most desirable. By eliminating retained austenite (or RA), voids or imperfections in the steel’s microstructure are eliminated.

All metals not just steel, but also aluminum, copper, cast alloys, etc. benefit from the residual stress relief that deep cryogenic treatment promotes. All metals have residual stresses; they are created from the moment the metal “freezes” from its molten form into its solid form. Molten metal freezes or transforms from its liquid phase to its solid phase like water or other liquids that we are familiar with. As heat is extracted through cooling, dendrites form from the coolest areas first. Typically, these are the surfaces and edges. This irregular freezing results in natural stress lines where the dendrites collide or along the boundaries of the remaining liquid (molten) metal and the solid metal. After the metal is cast in it’s raw stock form, it is heat treated to normalize the material and modify its properties. Once the raw stock is further modified, additional stresses

International Journal of Engineering Technology Science and Research
IJETSR
www.ijetsr.com
ISSN 2394 – 3386
Volume 4, Issue 5
May 2017

are added by the manufacturing process. When combined, all of these stresses form weak areas that are prone to fail through propagation of the stress lines into cracks. These are often characterized as fatigue failures or more simply "metal fatigue". By attacking the root cause – the residual stresses – cryogenic treatment greatly reduces or eliminates fatigue failures or cracks in metal components.

JOB MACHINING DIAGRAM



In this first operation we selected the machining material as En8 and performed the machining by reducing the material for various diameters of the desired length. The material is removed by turning operation performed in the lathe for a constant speed and feed. The depth of cut is given as 3mm for the metal removal for various diameters. In this shaft of 100mm length, the first 40mm is used for holding the shaft in the lathe.

Table 1: EN8 Machined with Untreated HSS tool

Dia. Of Shaft (mm)	Tool Travel length (mm)	Tool Wt.		M.R.R (g)	M/C time (sec)
		Initial	Final		
38-32	35	49.26	49.25	98.2	143.23
32-26	35	49.25	49.23	87.47	130.07
26-20	30	49.23	49.21	46.48	61.91

Table 2: EN8 Machined with Treated HSS tool

Dia. Of Shaft (mm)	Tool Travel length (mm)	Tool Wt.		M.R.R (g)	M/C time (sec)
		Initial	Final		
38-32	35	55.27	55.27	156.1	89
32-26	35	55.27	55.27	106.12	84.01
26-20	30	55.27	55.27	83.31	59.71

Properties ofCarbon steel EN8

TYPICAL ANALYSIS				
C.	Si.	Mn.	S.	P.
0.40%	0.25%	0.80%	0.015%	0.015%

Hardening:

Heat uniformly to 830/860C until heated through. Quench in oil or water. Can also be induction or flame hardened.

Tempering:

Heat uniformly and thoroughly at the selected tempering temperatures, between 550C to 660C and hold at heat for one hour per inch of total thickness.

Normalising:

Normalise at 830-860C, and cool in air.

Available sections of EN8

Properties ofCarbon steel EN19

EN19 is a high quality, high tensile alloy steel usually supplied readily machine able in 'T' condition, giving good ductility and shock resisting properties combined with resistance to wear.

Properties of EN19

TYPICAL ANALYSIS				
C.	**Si.**	**Mn.**	**Cr.**	**Mo.**
0.40%	**0.25%**	**0.70%**	**1.20%**	**0.30%**

Hardening:

Heat uniformly to 820/840°C until heated through. Quench in oil.

Tempering:

Heat uniformly and thoroughly at the selected tempering temperature, and hold at heat for one hour per inch of total thickness.

Available sections of EN19

Experiment details

Sample material

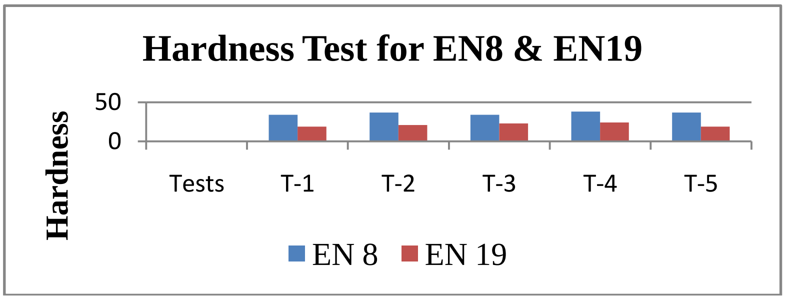
There are different types of materials are used for machining purposes due to the requirements. We have selected the hardened steels for machining. They are EN8 and EN19.

For these two sample work pieces the hardness test is performed at various sections using Rockwell Hardness testing machine. Therefore the test readings are tabulated and it is shown.

Rockwell Hardness Test for EN8 and EN19 Steel

TESTS	EN8	EN19
T-1	34	19
T-2	37	21
T-3	34	23
T-4	38	24
T-5	37	19

Rockwell Hardness:



Preparation of tool

Although we have selected the normal high speed steel tool for machining, it is not possible to machine the hardened materials. Due to this drawback we prepared to dip the tool in the cryogenic solution for certain minutes. The hardness is tested for the tool before dipping and after dipping it in the solution.

The hardness tests is done for a untreated single point cutting tool at various sections are: 64.1,64,64.4. The average is 64.2 HRC.

The hardness tests is done for a treated single point cutting tool at various sections are: 65.5,65.3,66.1. The average is 65.63 HRC

Therefore the hardness is increased by 1.43 HRC than the untreated tool.

Rockwell Hardness Test for Treated and Untreated Tool

TESTS	Untreated HSS tool	Treated HSS tool
T-1	64.1	65.5
T-2	64.0	65.3
T-3	64.4	66.1

International Journal of Engineering Technology Science and Research
IJETSR
www.ijetsr.com
ISSN 2394 – 3386
Volume 4, Issue 5
May 2017

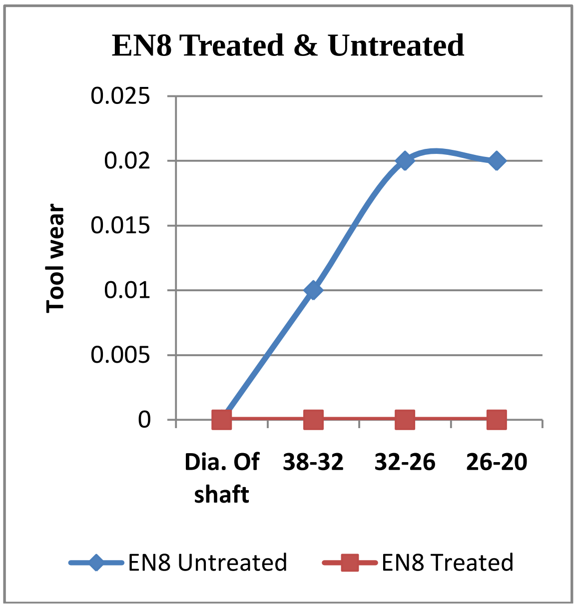
CONCLUSION:

It will be evident experimental details there is 34.17 seconds decreases in machining time and there is no tool wear when machining EN8 and when machining EN 19 there is 22.04 seconds decrease in machining time and 0.03g increase in tool wear resistance.

Deep cryogenic treatment has shown to result in significant increase in the wear resistance and correspondingly reduces machining time of steels such as EN8 and EN19. The basic mechanisms at work during the cryogenic process helps to control wear by producing a tough surface, which helps to prevent particles from tearing out of the material and resist penetration of the surface by other particles.

This concept can be extended to machine various work pieces of different material.

Fig 1: Difference in Tool wear



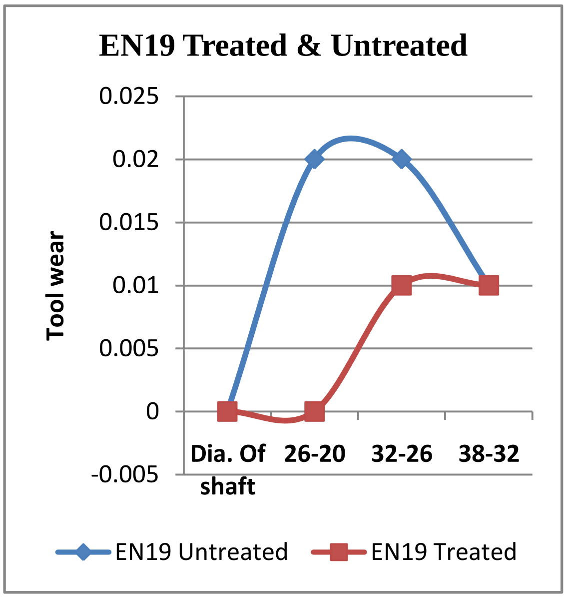
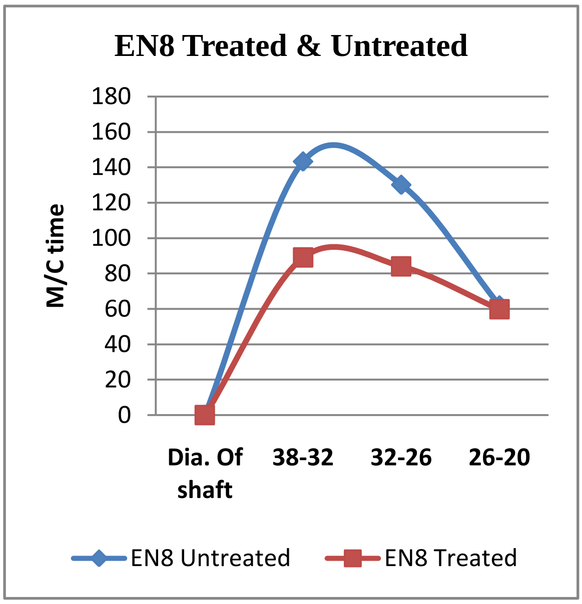
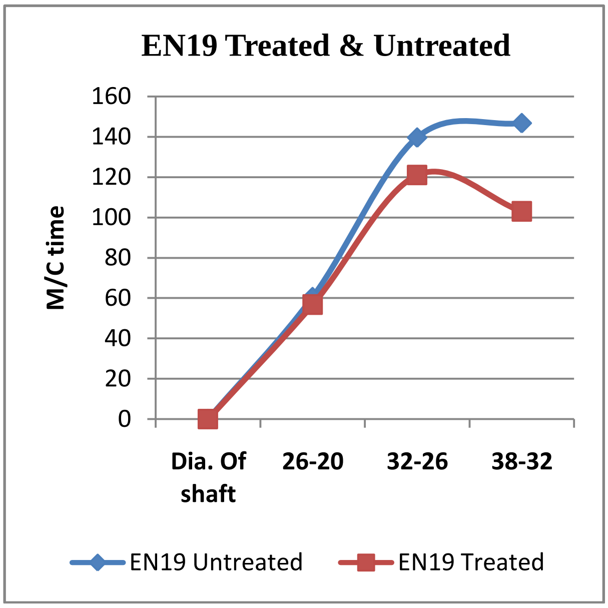


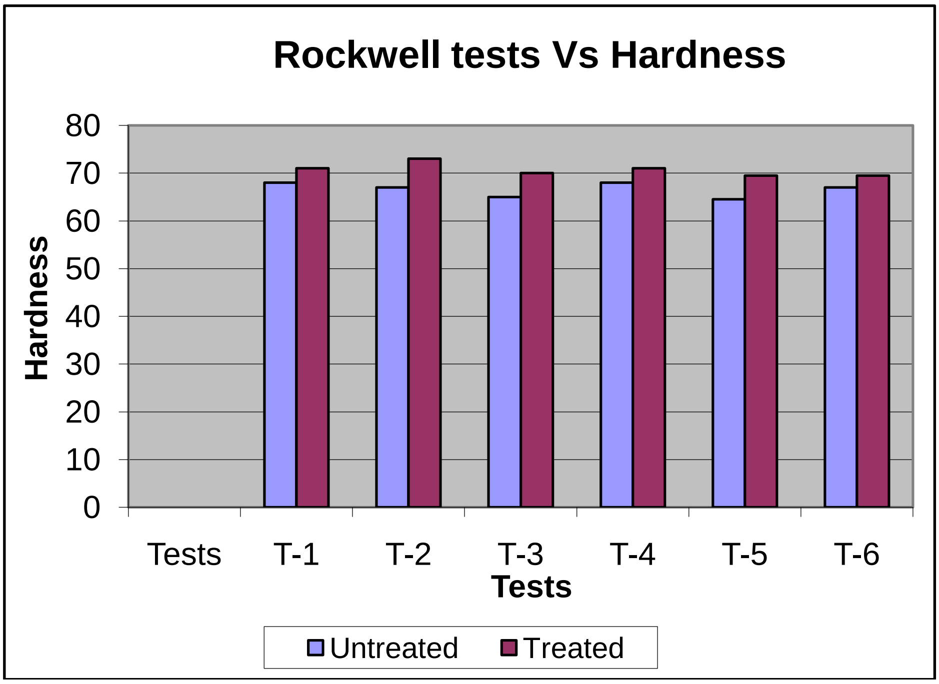
Fig 2: Difference in Machining Time





International Journal of Engineering Technology Science and Research
IJETSR
www.ijetsr.com
ISSN 2394 – 3386
Volume 4, Issue 5
May 2017

Fig 3: Work piece after machinig



REFERENCES

[1] Astakhov, Viktor P. and J. Paulo Davim, 2008. Machining Fundamentals and Recent Advances, Springer, Portugal, 2008, p.48-52

[2] Blackley W.S., Scattergood R.O., 1991. Ductile Regime Model for Diamond Turning of Brittle Material. Precision Engineering 13(2). pp. 95-102

[3] BouzidSa¨I, 2005. An Investigation of Tool Wear in High-Speed Turning of AISI 4340 Steel, International Journal Advance of Manufacturing Technology 26. Pp. 330–334

[4] Fang F.Z., Venkatesh V.C., 1998. Diamond cutting of Silicon with Nanometric Finish. Annual CIRP 47(1) pp. 45-49

[5] Feng, C., 2001. An Experimental Study of the Impact of Turning Parameters on Surface Roughness. Proceedings of the 2001 Industrial Engineering Research Conference. Institute of Industrial Engineers.

[6] Ghani A. K., Choudhury, Husni., 2001. Study of Tool Life, Surface Roughness and Vibration in Machining Nodular Cast Iron with Ceramic Tool, Journal of Materials Processing Technology 127 (2002) pp. 17-22