Abstract

Cryogenic treatment (CT) is the supplementary process to conventional heat treatment process in steels, by deep-freezing materials at cryogenic temperatures to enhance the mechanical and physical properties of materials being treated. Cryogenic treatment (CT) of materials has shown significant improvement in their properties. Various advantages like increase in hardness, increase in wear resistance, reduced residual stresses, fatigue Resistance, increased dimensional stability, increased thermal conductivity, toughness, by transformation of retained austenite to martensite, the metallurgical aspects of eta-carbide formation, precipitation of ultra fine carbides, and homogeneous crystal structure. Different approaches have been applied for CT to study the effect on different types of steels and other materials.
This paper aims at the comprehensive analysis of strategies followed in CTs and their effects on properties of different types of steels by application of appropriate types of CTs from cryogenic conditioning of the process. The conclusion of the paper discusses the development and outlines the trends for the research in this field.

References

- Dr. R. G. Tated, Dr. S. R. Kajale, Dr. Kumar Iyer, Improvement in tool life of cutting tool by application of deep cryogenic treatment, 7th International tooling conference held at Politecnico di Torino, Italy on 2-5 May 2006, pp. 135-141
- Timmerhaus, K.D.; Reed, R.P. Cryogenic Engineering; Springer: New York, USA, 2007; 3.27.
- Baldissera, P.; Delprete, C. Effects of deep cryogenic treatment on static mechanical properties of 18NiCrMo5 carburized steel. Materials and Design 2009, 30, 1435.1440.
- Mazur, J. Investigation of austenite and martensite subjected to very low temperatures. Cryogenics 1964, 4, 36.
Comparison of Effects of Cryogenic Treatment on Different Types of Steels: A Review

240.252.
- Popandopulo, N.; Zhukova, L.T. Transformation in high speed steels during cold
Comparison of Effects of Cryogenic Treatment on Different Types of Steels: A Review


Babu, P.S.; Rajendran, P.; Rao, K.N. Cryogenic treatment of M1, EN19 and H13 tool steels to improve wear resistance. Institute of Engineers (India) Journal-MM 2005, 86 (10), 64.66.


Pen-Li Yen, as reported in his thesis "Effect of Cryogenic Treatment on the Wear Resistance of Tool Steel," submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at The Pennsylvania State University

Podgornik, V. Leskovsek, and J. Vizintin Influence of Deep-Cryogenic Treatment on Tribological Properties of P/M High-Speed Steel Materials and Manufacturing Processes, 24: 734.738, 2009

A. Akhbarizadeh, A. Shafyei, M.A. Golozar Effects of cryogenic treatment on wear behavior of D6 tool steel, Materials and Design 30 (2009) 3259.3264


Debdulal Das, Rajdeep Sarkar, Apurba Kishore Dutta, Kalyan Kumar Ray; Influence of sub-zero treatments on fracture toughness of AISI D2 steel; Materials Science and Engineering A 528 (2010) 589. 603

Phillip Nash Rajendra M. Kelkar Study on Effect of Cryogenic Treatment on Properties and Mechanism of M2 Tool Steel in their research project


- Baldissera, P. Fatigue scatter reduction through deep cryogenic treatment on the 18NiCrMo5 carburized steel. Materials and Design, 2009, 30, 3636.3642.
- Shaohong Li, Yinzi Xie, Xiaochun Hardness and toughness investigations of deep cryogenic treated cold work die steel Cryogenics 50 (2010) 89.92
Comparison of Effects of Cryogenic Treatment on Different Types of Steels - A Review

- Paul Stratton, Michael Graf The effect of deep cold induced nano-carbides on the wear of case hardened components Cryogenics 49 (2009) 346.349.
- P. Paulin, Gear Technology, March/April 1993, p.23
- P Sekhar Babu, P Rajendran, Dr K N Rao; Cryogenic Treatment of M1, EN19 and H13 Tool Steels to Improve Wear Resistance, IE(I) Journal-MM Vol 86, October 2005.
- Hoque, M., Ford, R. and Roth, J., 2005, Automated Image Analysis of Microstructure Changes in Metal Alloys, Submitted to the Transactions of the North America Manufacturing Research Institute of the Society of Manufacturing Engineer


C.H. Surberg, P. Stratton, Klaus Lingenhole, Cryogenics 48 (2008) 42.47.


**Index Terms**

- Computer Science
- Computational Intelligence

**Keywords**

- Austenite
- Cryogenic Treatment
- Carbide formation
- Cooling rate
- Dimensional stability
- Deep-freezing
- Martensite
- Soaking
- temperature
- Wear resistance