Diyala Journal of Engineering Sciences

ISSN 1999-8716
Printed in Iraq

Second Engineering Scientific Conference
College of Engineering –University of Diyala
16-17 December. 2015, pp. 686-691

IMPROVEMENT HARDNESS AND MICROHARDNESS OF LOW ALLOY STELL BY USING MOLTEN METAL

Ali adwon H.
Material department/ College of engineering / Diyala University

ABSTRACT: - We examined and study the characteristics properties of bainitic low alloy steel (30crmov9) obtained by used molten copper Instead what is customary in this process using molten salts .X-ray diffractometry (XRD)and optical microscopy (OM)were used to characterized their crystal structures ,microstructure and micro hardness.
Keywords: low alloy steel, hardness, micro hardness

INTRODUCTION

The use of molten metal's as quenching media decreased greatly in recent years, largely due to the availability of salts, which are cheaper and provide more flexibility as quenching agents .molting lead is still used to a limited extent, but in the zone very limited in addition to the risk of toxicity resulting from emissions from furnaces to humans make of this heat treatment is very limited.(1) Molten lead often has been used as quenching for patenting, as a mill process for heat treating steel wire .lead also has been used to some extent for austempering, where its working range is compatible with the specific steel being processed. Austempering is a process wherein the steel is austenitized ,then quenched to some temperature below the nose of the TTT curve ,buy above the M_s temperature ,and allowed to transform isothermally to bainite over a period of time .The time and temperature depend on the transformation characteristics of the steel being processed .Low alloy (20x1МΦА)steel is well suited to austempering ,as indicated by the TTT curve shown in the fig.1.Selection of steel for austempering must be based on transformation characteristics as indicated in time-temperature-transformation diagrams .

Three important consideration are (a) the location of the nose of the TTT curve and the time available for bypassing it,(b) the time required for complete transformation of austenite to bainite at the austempering temperature ,and (c) the location of the M_S point.

MATERIALS AND EXPERIMENTAL PROCEDURES

Annealed Low alloy steel (30crmov9) sample with a (10x10x50) $_{mm}$ were used in this study chemical composition as shown in table 1.

Sample of low alloy steel has been putting in a small container with powder of pure zinc 99.99% in a vacuum furnace to temperature 1200_c for 1.5 hours and cooled slowly to 1000_c in 0,5 hour and quenched in air rapidly. After reached at room temperature we were don the second step of heat treatment (austempering), by heated the sample at austenitic temperature 890_c for 30 min and quenched at the second furnace at 600_c for 1.5 hour then cooled at the room temperature. Cutting the sample 2 half to inspection the surface after cleaned it.

4. RESULTS AND DISCUSSION

Hardness and micro hardness

1-We examined hardness and micro hardness of the part which copper rounded and the part without zinc to compare the difference between them. The results shown in table 2.

The effect of cooling rate and zinc used in this new austempering on the microstructure

obtained show clearly in the figures
2-Micro hardness results shown in Table3.

5. CONCLUSIONS

This research was a first attempt to study and Knowledge the changes and improvement of the mechanical properties of low alloy steel which is used as small parts in sensitive field requiring very high hardness and homogeneity to get to the better performance. Results that have been mentioned previously give a clear vision about the importance of zinc in improving properties of bainite compared with the classic way by used salt furnace. So zinc diffusion in the steel with high temperature give good element to obtained constant temperature and homogeneity of bainite with high tensile strength and hardness and high grid of elongation.

REFERENCES:

1- Y.U.M.Lakhtin, ENGINEERING physical metallurgy & heat treatment, English translation , Mirpublishers, 1983 .
2- Karl-ERIL.THELNING,steel and its heat Treatment, Mackays of chatham Ltd, kent, 1984.
3- V. Raghavan, Materials Science and Engineering, PHI, NEW Delhi, 1982.
4- D.D. AGARWALL, S.S. ARORA, Engineering Materials and Technology, Simla, delhi, 1989 .
5- R.S. Khurmi & R.R.Sedha, Material Science, S. Chand & Company LTD, NEW delhi, 1989.
6- Philip cary , Quenching and control of distortion , ASM international , Metals park ohio , 1988 .
7- ANNUAL Book of ASTM standards, part 1 Amercan society for testing & Materials, 1979.
8- Gustav Niemann, Machine design K. LAK SHNIN ARAYANA & G.V.N Ruyudn, 1979.
9- JIS Handbook , Ferrous Materials and Metallurgy , 1989 .
10- INDIAN standards institutron, INDIAN standards code for unfired pressure vessels, New delhi, 1971.
11- Philip G. Hill & Carl R. Peterson Mechanics and Thermodynamics of Propulsion, addism - weseley publishing company, 1970.
12- Robert L. Norton, Machine design , Prentic Hall. 1998.
13- Stuart W. Gibson, ADVANCED WELDING - MACMILLAN PRESS LTD, 1997 .
14- EARL R. Parker, Materials for Missiles & space craft, MC Graw - hill Book company 1963.
15- George P. Sutton, Elements the engineering of rockets. John Wiley Sons 1986.
16- INTERNATIONAL INSTITUTE OF WELDING stresess Releiving heat treatments of welded steel constructions, pergaman PRESS, 1987
17- Y. ANDO AND SUZUKI, Development of Rocket motor case in Japan paper, 1970.
18- NIPPON STEEL CORPORATION, MARKET TRENDS AND NIPPON STEELS ACTIVITIES IN THE FIELD OF PRESSURE VELLELS, SEP, 1986.
19- J.F. Lancaster" Metallurgy of welding" George allen and unwin Ltd.London 1980.
20- A.C Davies "The science and practice of welding" Volume 1,cambridg university press, 1989 - England.

Table1.Composition of low alloy steel (30crmov9)(wt.%).

C	Cr	Mo	V	Mn	Si	Ni	Ca	Al	N_2	P	S
0.2	1.3	0.41	0.081	0.58	0.25	0.1	0.0026	0.026	0.162	0.008	0.003

Table2.hardness test HRC. Steel in molten zn and without zinc.

St .+zn	St. without zn
37.5	22.5
38	23
40.2	24
38	22
45	26
38	24

St. + zn	St. without zn
405	291.5
461	358.8
430.5	334.2
462.6	299.8
441.5	3.5.5
439.3	289.9

Table3.mico hardness test HV. Steel in molten Zn and without Zn.
Processing option: All elements analyzed (Normalized)

Spectrum	In stats.	Si	V	Cr	Mn	Fe	Cu	Mo	Total	
Spectrum 1	Yes		0.00	0.00	0.00	3.83	96.17	0.00	100.00	
Spectrum 2	Yes		0.27	1.04	0.00	51.67	45.37	1.66	100.00	
Spectrum 3	Yes	0.00	0.30	1.80	0.61	96.74	0.00	0.55	100.00	
Spectrum 4	Yes	0.31	0.00	1.67	0.53	97.50	0.00	0.00	100.00	
Spectrum 5	Yes	0.27	0.00	1.80	0.67	97.26	0.00	0.00	100.00	
Max.		0.31	0.30	1.80	0.67	97.50	96.17	1.66		
Min.		0.00	0.00	0.00	0.00	3.83	0.00	0.00		

All results in weight%

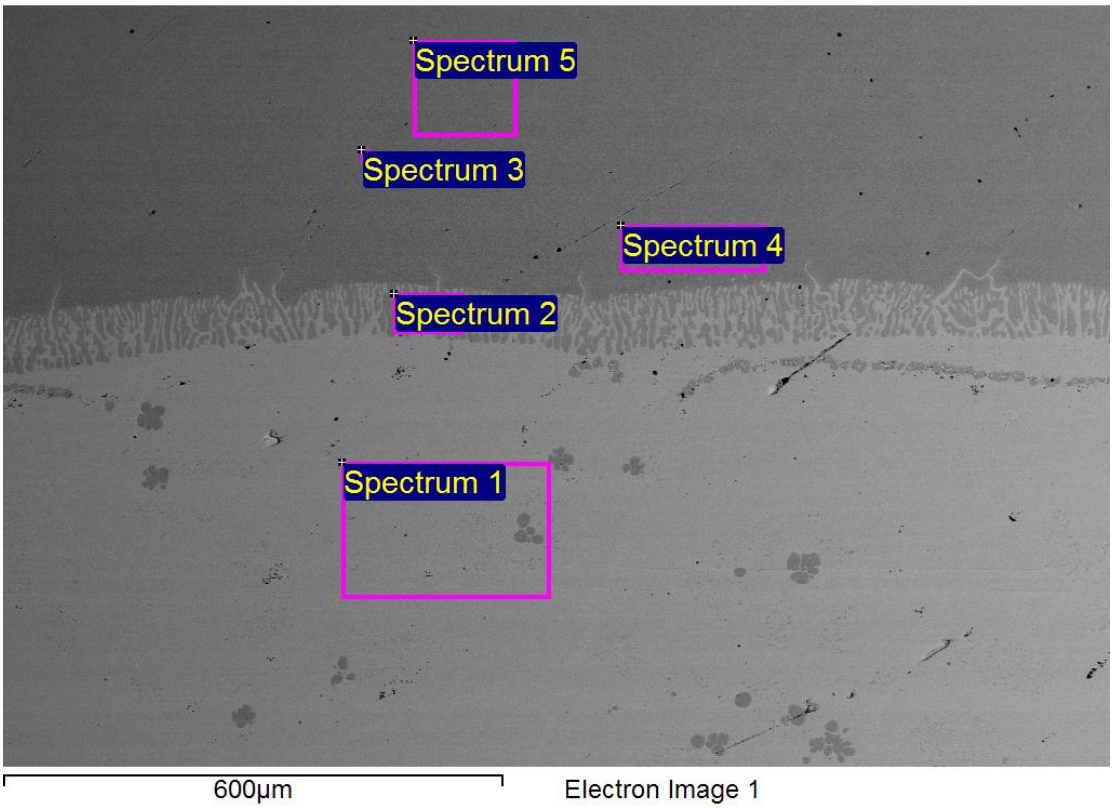
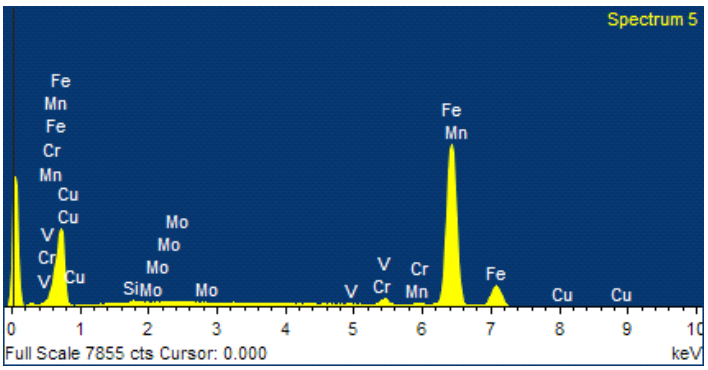
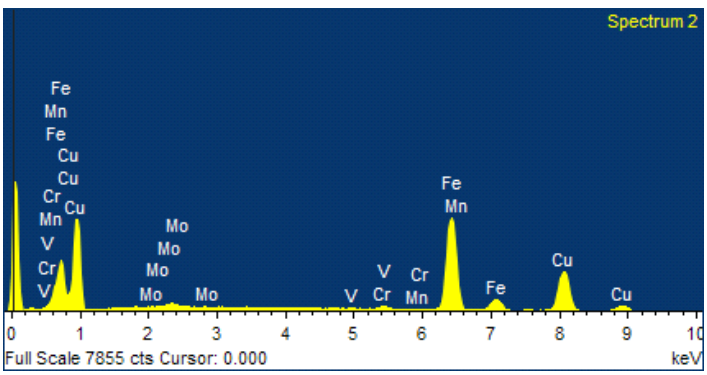


Fig.1: 5 point takes by XRD on the zinc zone and steel austemperd





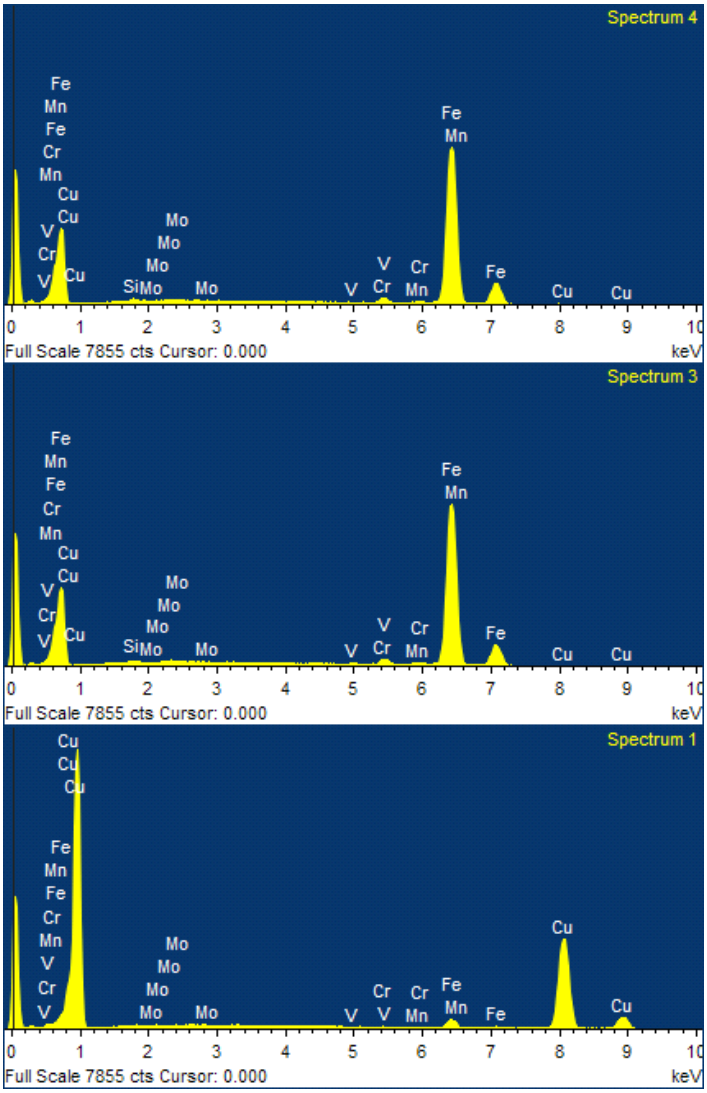
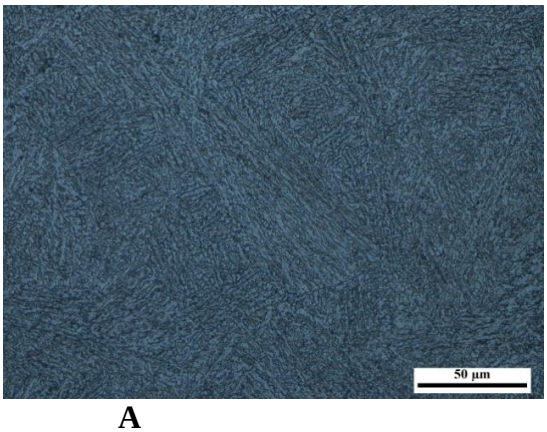
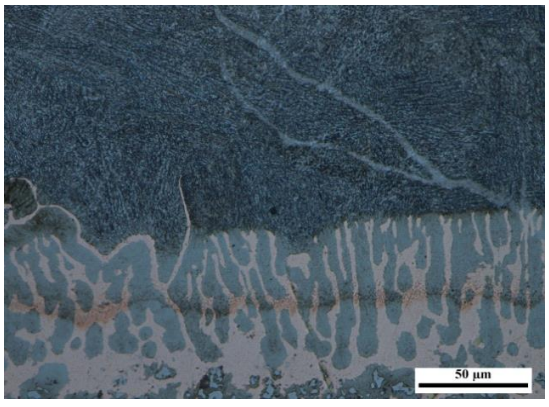


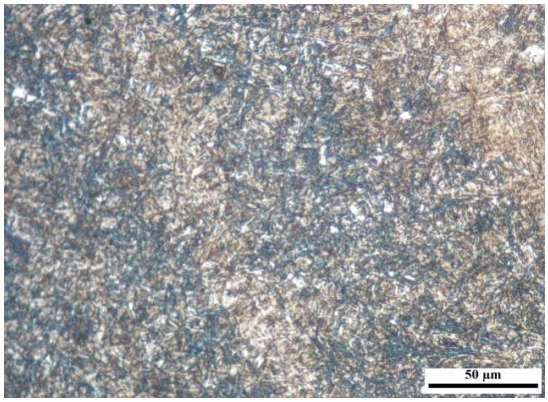
Fig.2 chemical composition of points 1,2,3,4,5 .by XRD.



A



B



C

Fig.3 Microstructure of sample, **A-**bainite with molten zn,**B-**Homogeneous bainite,**C-** Inhomogeneous bainite by