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CONTROL EFFECTS BY SHOT PEENING WITH APPLICATION OF THE EDDY CURRENT METHOD

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ABSTRACT

In the paper some information about application of the eddy current method in evaluation of shot peening effects in the ferromagnetic materials.

The method allows to estimate quantity as well as depth deposition of strsses, which are in the volume under a probe.

The estimation of depth deposition of stresses is made by change of magnetic current fraquances, which decide on depth of eddy current penetration.

KEY WORDS

eddy current, non - destructive testing, shot peening, stresses monitoring,

1. INTRODUCTION

By estimation of stresses induced as a result of shot peening it is possible to estimate the real degree of fastening of the surface. This method will allow to check if shot peening process was done properly and to estimate degree of fastening and in this way safe exploitation of responsible parts will be guaranted.

Measurement of the shot-peening intensity by use of Almen plates is only indirect stage of process. Stress control by use of X-ray method is proper but too expensive. The eddy current method is simple in service and enables to estimate stresses in the elements of every shape by comparing with samples (pattern elements).

2. STATE OF PROBLEM

The important effect of shot peening is distribution of own stresses, which plays important role in increasment of endurance of elements of machines and constructions. There is a demand for devices allowing to non – destructive estimation of stresses in every place of shot peened surface.

Such method hasn't been used in Poland so far. But it is heard that abroad some researches on this method have been conducted. In the Advanced Manufacturing Center of Cleveland /1/ such researches were undertaken. The target was to estimate possibility of estimation of own stresses in titanium and Al. 7075 samples.

The standard non-destructive control device was used. With computer register of result to adjust this unit for measurement stresses after shot peening. The parameter which has to be specially adjusted is little change of conductivity after shot peening. Adjustment has been achieved by increasment of signal amplification with simultaneous decreasment of drift indication.

Reduction of drift has been achieved as a result of low temperature in which measurements were conducted. The intensive cooling allowed to tell little indications coming from own stresses from drifts of indications of devices. The titan samples were tested. The shot-peened samples were : 100-100x12,5 mm (40x40x0,5 inch) and the following intensivities were used : 003C, 006C, 009C (in Almen scale) and M330 was used.

Inside the shot peened sample Almen plates were placed in order to evaluate intensity of shot peening. Unpeened part of sample under the Almen plate was used to set the probe at the initial position. Researches were undertaken in various frequnces. For titanium sample frequency ranges from 7.031 MHz to 7.382 MHz and the step was 40 KHz and for Al. 7075 sample frequency ranges from 73.24 KHz to 152 KHz, the step was 3 KHz.

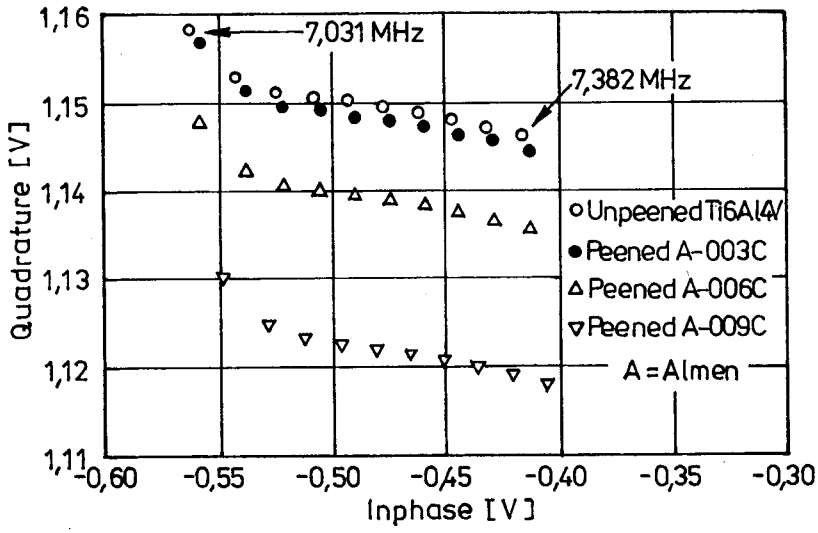

Fig.1. Change of eddy current devices resistance in the function of shot peening intensity for Ti 6Al4V

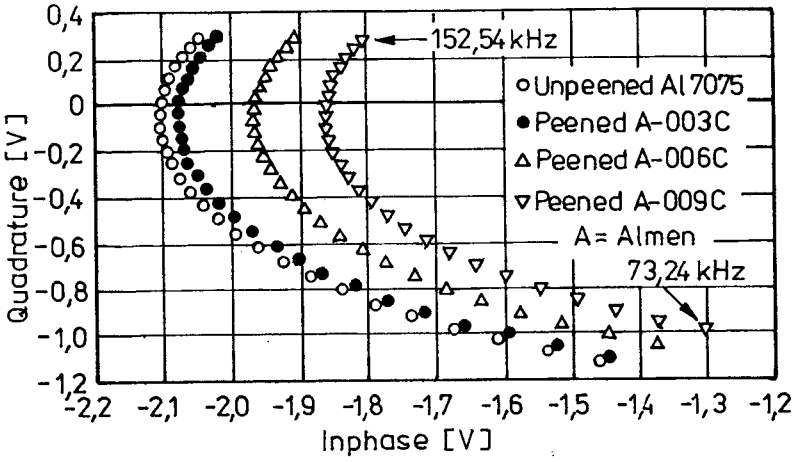

Fig.2. Change of eddy current devices resistance in the function of shot peening intensity for Al. 7075

The fig.1 shows the result of indications : change of resistance in the function of phase, 10 steps of frequency changes were used 40 KHz for Ti6Al4V, the shot peening intensity ranges from 0 to 009C. The fig.2 shows the result of indications : change of resistance in the function of phase, 26 steps of frequency changes were used 40 KHz for Al. 7075, the shot peening intensity ranges from 0 to 009C.

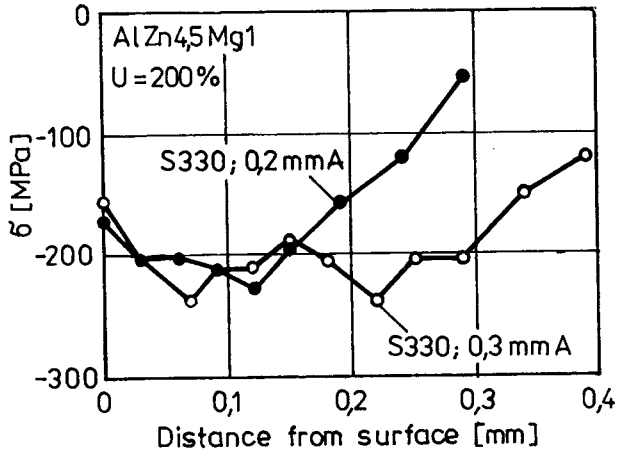

Fig.3 Distribution of compressive strsses after shot peening evaluated with the use of X-ray method

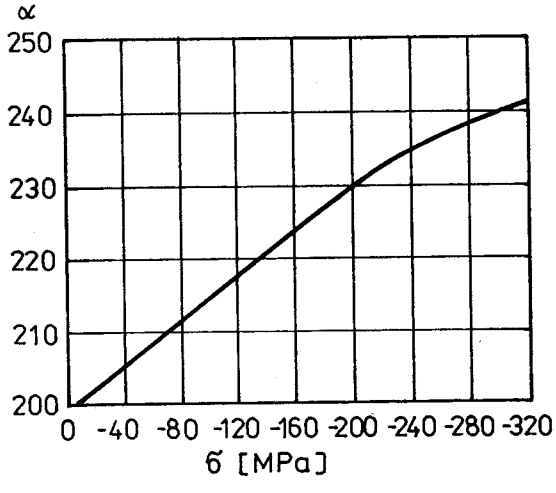

Fig.4 Indications of Wirotest in the function of compressive stresses in cylinder Φ28 after hardening and tempering in 350°C

Fig.3 shows stresses in the function of distance from surface. The curves show a little selectivity of evaluation when Almen plates were used. During the shot peening of AlZn4,5Mg sample two types of shot were used (Φ0,58 and Φ 0,84) the rest of parameters were taken in such a way that deflection was 0,2 mm of plate A.

As a result of shot peening various depths of compressive stresses were achieved in case of the shot of bigger granulation the strata of stresses was about 25 deeper. The Almen plates are used to control constancy of established parameters of shot peening.

3. EVALUATION OF SHOT PEENING EFFECTS BY USE OF EDDY CURRENT METHOD

Magnetic induction in form of eddy current is sensitive on changes of electric conductivity and magnetic permeability of controled metal. Defects in structure in form of dislocation which are generated during plastic strain cause a change of electric conductivity and magnetic permeability.

The scale of plastic and elastic strain after shot peening is estimated by evaluation of changes of electric conductivity and magnetic permeability. The depth of stresses is estimated by use of various frenquences of magnetic current.

Researches conducted in the Institute of Precision Mechanics aimed to estimated stresses after shot peening with the following shots : S170, 230, 280 and 330, the cylinders were Φ28x48 and made of steel ŁH-15 after hardening and tempering in 650, 550, 450, 350°C.

Fig.4 shows curve indications of Wirotest during compressing the cylinder Φ28 made of steel ŁH-15 after tempering in 350°C. Similar curves were made with reference to other temperatures of tempering. Deviation from propotional indications apears when 210 MPa is exceeded with reference to cylinders tempered in 350°C.

In temperatures over 350°C.the deviation decreases and in temperature of 650°C indications are 130 Mpa (Fig.5).

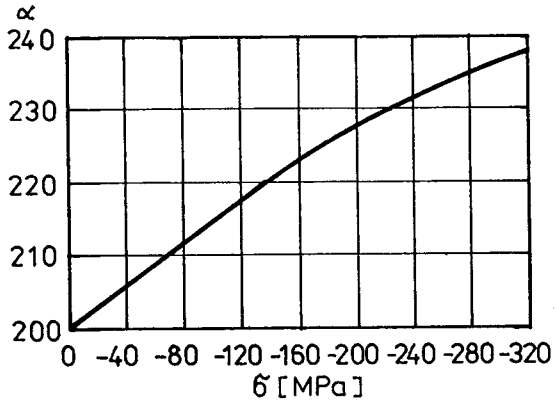

Fig.5. Indications of Wirotest in the function of compressive stresses for cylinder Φ28 after hardening and tempering in 650°C

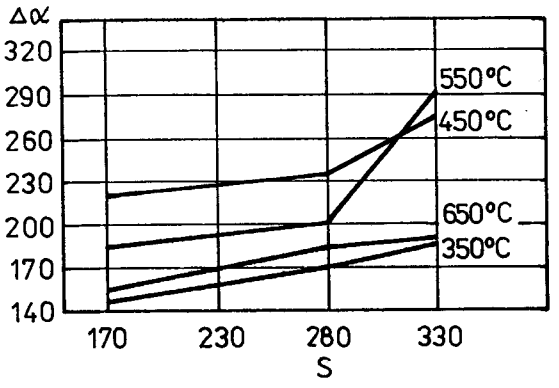

Fig.6. Indications of Wirotest in the function of granulation of shot for cylinders tempered in various temperatures

Figure 6 shows dependence of indications of Wirotest on shot granulation shot. The increasement of shot diameter causes considerable increasement of indications in the case of materials tempered in 450°C and 550°C .

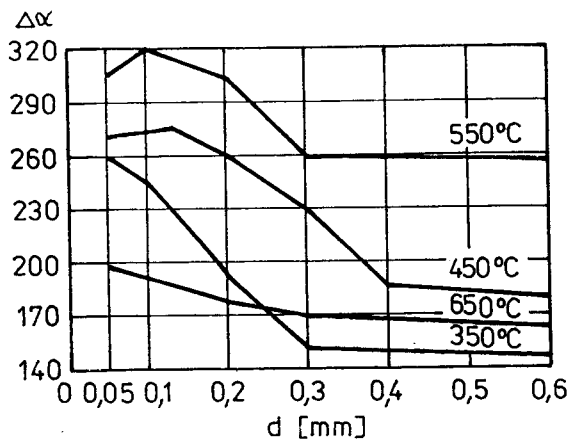

Fig.7. Indications of Wirotest in the function of depth of eddy current penetration (S 330)

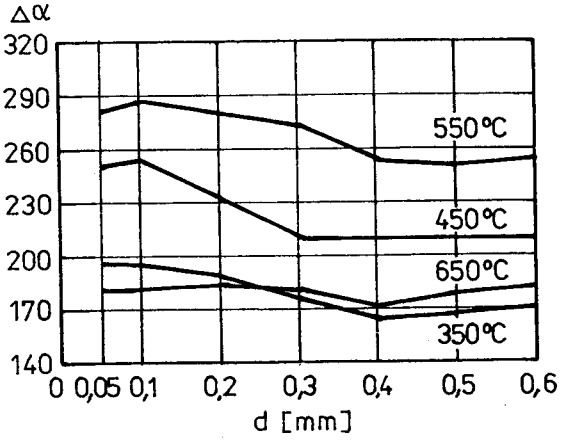

Fig.8. Indications of Wirotest in the function of eddy current penetration (S 280)

Fig.7 shows a curve of Wirotest indications in the function magnetic current frequency in case of shot peening with shot of granulaton S330, where depth stresses is signaled by change of curve inclination.

Fig.8 shows a curve of Wirotest indications in the function magnetic current frequency in case of shot peening with shot of granulaton S280, where depth stresses is signaled by change of curve inclination.

4. CONCLUSIONS

The result of tests indicate that eddy current method is useful in the control of shot peening process.

REFERENCES

1. Hond Chang; Fred C.Schoenig; Ir.And Jack A.Soules NoN-Destructive Residual, Stress Measurement Using Eddy Current, Advanced Manufacturing Center 1751 East 23rd Street Cleveland OH 44114,

2. R.Herzog; W.Zinn, B.Scholtes, H.Wohlfahrt Zur Aussagefahigkeit der Almeninlensitet als Konwert bei der gezielten Eigenspannungserzeugung durch Kugelstrahlen – VCH Verlagsgeselschaft Wernhem 1996,

3. Czesław Dybiec – Nieniszczaca kontrola naprężeń metodą prądów wirowych – Dozór Techniczny Nr.1 1997.