COMPARISON INFLUENCE OF THE ALTERNATING MAGNETIC FIELD AND THE STEADY MAGNETIC FIELD ON FLOW STRESS CURVE DURING COLD COMPRESS TEST

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SROVNÁNÍ VLIVU STŘÍDAVÉHO MAGNETICKÉHO POLE A STEJNOSMĚRNÉHO MAGNETICKÉHO POLE NA PRACOVNÍ DIAGRAM TLAKOVÉ ZKOUŠKY ZA STUDENA

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Abstrakt

V tomto příspěvku je srovnáván vliv stejnosměrného a střídavého magnetického pole na hodnotu přetvárného odporu při tlakové zkoušce. Experimenty se stejnosměrným magnetickým polem byly provedeny ve dvou částech. V první vektor magnetického toku směřoval proti směru pohybu dolního nástroje, v druhé části pak byl orientován ve shodném směru. Experimenty prokázaly, že stejnosměrné magnetické pole způsobuje nárůst přetvárného odporu ve srovnání se střídavým magnetickým polem, které mělo podobnou hodnotu magnetické intenzity.

Abstract

In this paper is comparison influence steady magnetic field and alternating magnetic field on value flow stress at compression test. The experiments with the steady magnetic field were make in two parts. The first part was done with magnetic flux, which was opposite direction with direction of motion down tool. The second part was done with magnetic flux, which was identical direction with direction of motion down tool. The experiments show, that the steady magnetic field makes hardening. Whereas alternating magnetic field makes softening. The alternating magnetic field was a similar beginning value of magnetic intensity as alternating magnetic field. In during compress test value of magnetic intensity alternating magnetic field decreasing.

Key words: flow stress, strain, steady magnetic field, alternating magnetic field, magnetic intensity

Introduction

The above mentioned changes in material behaviour during cold plastic deformation are caused by changes in types of energies related to changes in magnetic structure, and processes occurring in the cation electron shell – change in electron spin states and in the cation core (core spin moments).

Alternating magnetic field causes processes occurring in the electron gas as a reaction to changes magnetic flux in the time and oscillation is a product of magnetostriction in condition magnetic intensity as function time.Interaction of the process in the cation electron shell and cation core, together with processes occurring in the electron gas, also leads to changes in plasticity.

Experiment

Experiment was making with steel 23MnB4. Conditions of strain rate and magnetic intensities are on Fig.1. Magnetic intensity alternating magnetic field was marked H_1. Magnetic intensity of the steady magnetic field with magnetic flux, which was opposite direction with direction of motion down tool was marked H_2. Magnetic intensity of the steady magnetic field with magnetic flux which was identical direction with direction of motion down tool was marked H_3. There is yet another curve of the magnetic intensity with marking H_4. H_4 is magnetic intensity of the alternating magnetic field, which caused very similar hardening as steady magnetic field [1]. Samples and solenoid were continually cold transformer oil during compress test. Temperature and magnetic intensities were measured with multimeter **M–3850D** connecting with RS–232C on computer. Every flow stress curve is average from twenty measured samples.

Table 1 Chemical structure of the steel 23MnB4

% C	% Mn	% Si	% P	% S	% Al_{cel}	% B	% Cr	N2	% Cu
0,25	0,90	0,08	0,009	0,011	0,015	0,004	0,32	0,007	0,05

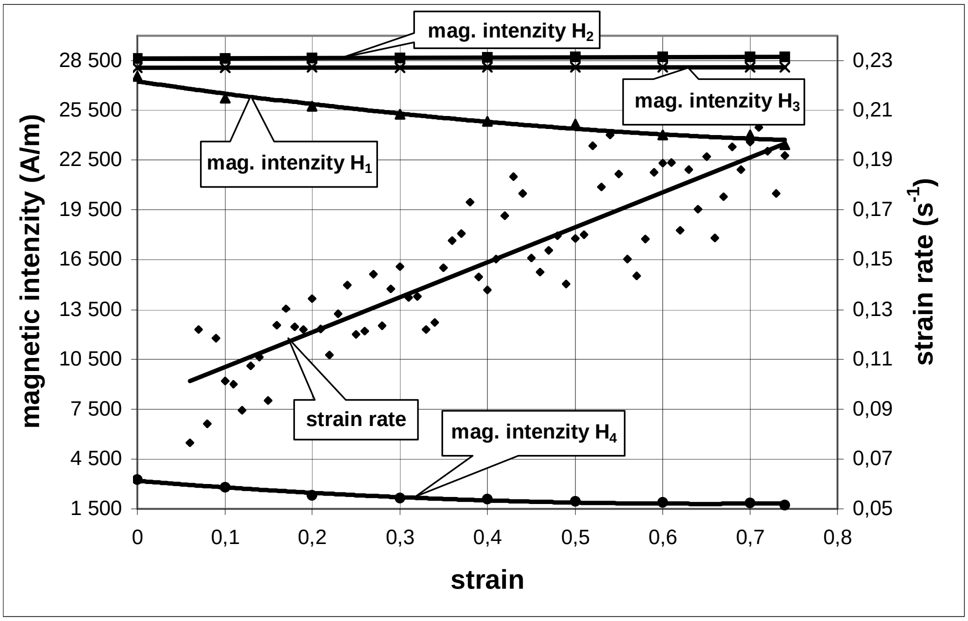

Fig.1 Development of the strain rate and magnetic intensities as function strain

Barrelling coefficient is defined as:

$$B_s = \frac{\pi \cdot h_f \cdot d_f^2 \cdot \frac{1}{4}}{\pi \cdot h_0 \cdot d_0^2 \cdot \frac{1}{4}} = \frac{h_f \cdot d_f^2}{h_0 \cdot d_0^2}$$

there are h_0 initial height and d_0 initial diameter, h_f final height and d_f final diameter. If Barrelling coefficient is greater than 1,1 the test is invalid [2]. Barrelling is caused by friction at the interface contact surface of the sample and tool.

True stress:

$$\sigma_i = \frac{4 \cdot F_i}{\pi \cdot d_i^2}$$

there is F_i actual compressive force, and d_i is actual diameter, which is determined from actual height $(h_0-\Delta h)$ on the assumption that cubic volume of the sample is during compress test constant.

$$d_i = d_0 \cdot \sqrt{\frac{h_0}{(h_0 - \Delta h)}}$$

Strain:

$$\varepsilon_i = \ln\left(\frac{h_i}{h_0}\right)$$

Results

Alternating magnetic field caused decreasing of the flow stress. Steady magnetic feld caused hardening.

Only little change were observed between steady magnetic field with magnetic flux, which was opposite direction with direction of motion down tool and steady magnetic field with magnetic flux, which was identical direction with direction of motion down tool.

Comparisons are illustrated on Fig.2. On Fig.3 there are curved differences between curved of flow stress, and they are in percentage average value set with absence external magnetic field. Curve A views development influence alternating magnetic field with magnetic intensity H_1 as function strain. Alternating magnetic field with magnetic intensity H_1 caused softening of the testing material. Curves B, C view development influence steady magnetic fields with magnetic intensities H_2, H_3, which are differential in direction magnetic flux. The steady magnetic fields caused hardening of the testing material.

On Fig.4 there are comparisons of the barrelling coefficient. Alternating magnetic field caused increase barrelling coefficient. Steady magnetic fields caused decrease barrelling coefficient. Barrelling coefficient describes friction ratio at the interface of the contact surface of the sample and tool. However we can not say that alternating magnetic field increases external friction between sample and tool. Because distribution magnetic flow during sample is among others functions radius. Influence alternating magnetic field on plastic forming is function value of the magnetic intensity. It is possible that alternating magnetic field prefers (for some value of the magnetic intensity) plastic flow on surface layer. From experiments is evidently if the magnetic field increases the flow stress then barrelling coefficient decreases.

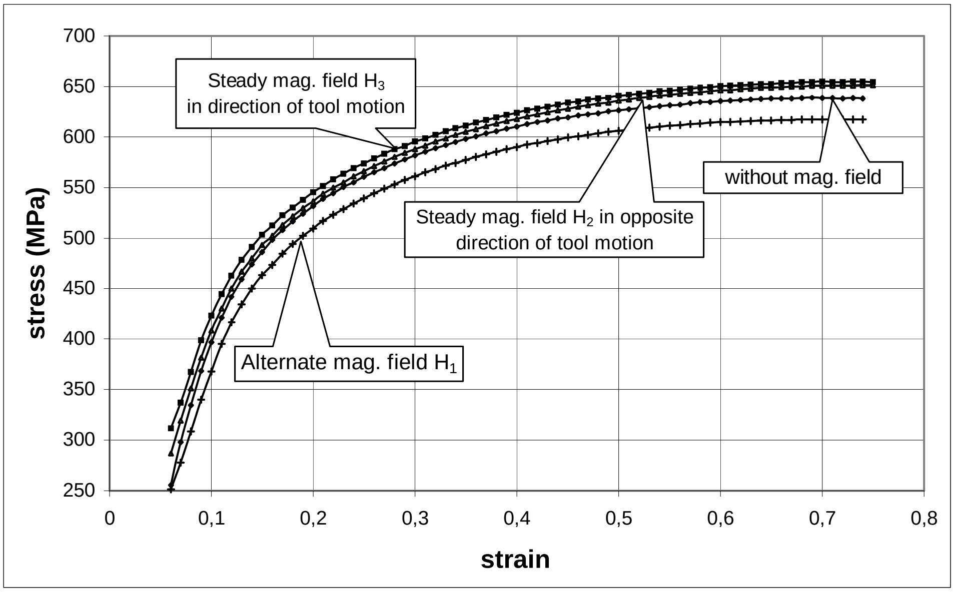

Fig.2 Comparison the flow stress curves as function strain

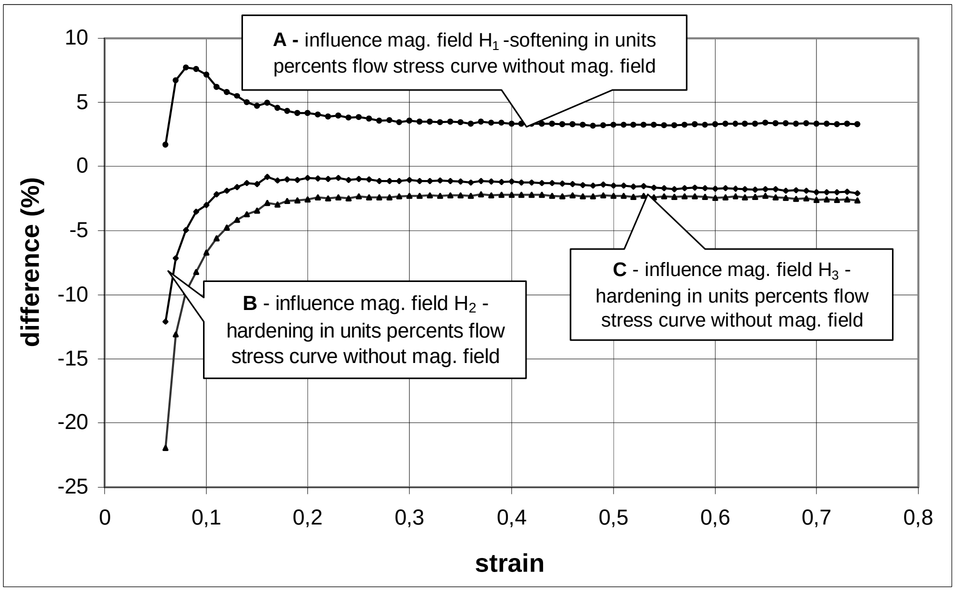

Fig.3 Influence of magnetic filed on flow stress as function strain

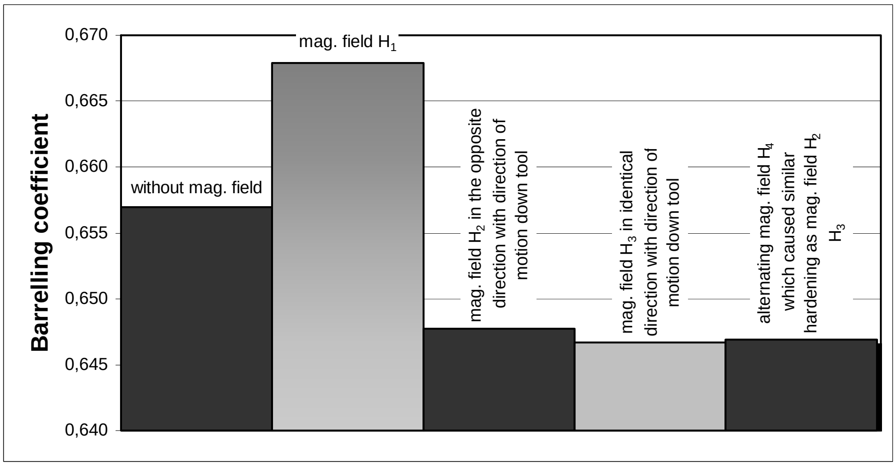

Fig.4 Comparison of the barrelling coefficient

Conclusion

In conclusion can it to be, that magnetic field influences flow stress and barrelling coefficient. This very depends on size magnetic intensity.

The experiments show, that the steady magnetic field makes hardening. Whereas alternating magnetic field makes softening. The alternating magnetic field was a similar beginning value of magnetic intensity as alternating magnetic field.

Only little change were observed between steady magnetic field with magnetic flux, which was opposite direction with direction of motion down tool and steady magnetic field with magnetic flux, which was identical direction with direction of motion down tool.

Acknowledgement

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