ANNALS of the ORADEA UNIVERSITY.

Fascicle of Management and Technological Engineering, Volume VI (XVI), 2007

STATISTIC PROCESSING OF THE EXPERIMENTAL DATA OBTAINED AFTER BAR STRIP SHEET COOL HARDENING DURING TECHNOLOGICAL AND BLANKING OPERATIONS

Alin STĂNCIOIU*
Gheorghe GÎRNICEANU**
Gheorghe POPESCU***
** Lect. dr. eng. U.C.B, Tg-Jiu, e-mail* alin@utgjiu.ro
*** Prof. dr. eng. U.C.B,Tg-Jiu, e-mail* girniceanu@utgjiu.ro
**** Prof. dr. eng. U.C.B,Tg-Jiu, e-mail* gepo@utgjiu.ro

Keywords: tensions, deformations, hardness, statistic.

Abstract: By statistically processing the experimental research results, mathematic patterns have been obtained with cool hardening dependences in comparison with the active tools penetration into the sheet material, through which tension and deformations states can be appreciated. Besides the mathematic expression there was also obtained a graphic representation of the hardness increase dependence in report with the independent variable. The mathematic modeling allowed also to obtain some results and displays a concluding image upon the phenomenon's evolution way.

1.Introduction.

The hardness analysis method is based on the fact that, in cold plastic deformation, the metallic shape modification is accompanied by some modifications of the physical-mechanic properties, mainly the material hardness, especially when being deformed the material is more powerfully cool hardened.

On the basis of the dependences between hardness and deformations intensity or between hardness and tensions intensity, generally expressed under the form of graphics drawn as a results of some tests series made for some materials, the tensions and deformations states that appear in a deformed body through a certain procedure may be immediately appreciated, by measuring the hardness from the places that interest us in the respective body. For example, figure 1 displays the hardness graphics regarding the deformations intensity and the tensions intensity for proof samples from steel similar to OLC 20.

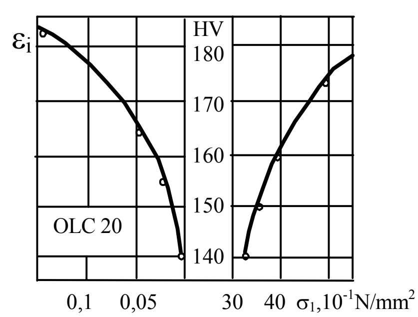

Fig. 1 Hardness variation graphic regarding tensions intensity and deformations intensity

The method of deformation degree and tension state analysis by analyzing the hardness of the deformed material is simple, but rather approximate.

2. The influence of the tool wear on cool hardening of the bar strip material

Tool wear may be directly monitored through the cool hardening effect upon the processed bar strip. For this purpose, it has been determined the Vickers hardness 0,5daN of the pressed material with cool hardening effect from the force plug and the matrix. The hardness measurement has been done as in figure 2.

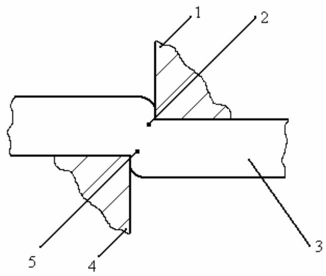

Fig.2 force plug, 2 and 5 – the places where hardness was measured, 3 – bar strip, 4- matrix.

On the basis of the dependences between hardness and active tool penetration into the bar strip sheet, expressed by algebraic relations and graphics compared to experimental results, we can appreciate the tensions and deformation states, by measuring the hardness in the material cool hardened areas.

In table nr.1 we display the values of the Vickers hardness 0,5daN of the strip bars deformed by force plugs obtained in the research.

Table nr.1 with HV 0,5 in daN/mm^2 hardness made by force plugs on bar strips

Nr. crt.	Penetration [0,01 mm]	Covered sparks OSC10 die [HV]	Chromate OSC10 die [HV]	Improved 205Cr115 die [HV]	Nitride OSC10 die [HV]	Improved OSC10 die [HV]
1.	33	117	123	129	134	164
2.	66	138	140	143	147	187
3.	99	145	146	152	157	193
4.	132	156	162	170	178	200
5.	165	168	169	179	181	210
6.	198	174	180	189	197	225
7.	231	180	188	195	210	241
8.	240					260

3. Statistic processing of experimental data

By statistically processing the experimental research results, mathematic patterns have been obtained with cool hardening dependences in comparison with the active tools penetration into the sheet material. Besides the mathematic expression there was also obtained a graphic representation of the hardness increase dependence in report with the independent variable.

The mathematic modeling allowed also to obtain some results and displays a concluding image upon the phenomenon's evolution way. The dependence between y hardness and x penetration for force plugs is displayed in the algebraic expressions from table nr.2, and the graphic response in the figures 3-7 for the polynomial mathematic patterns.

The mathematic patterns graphics are represented by red continuous curves, and the experimental graphics values are represented by blue discontinuous lines.

Table nr.2 Algebraic expressions

Covered sparks OSC10 die	y = 26+4.77475*x-0.08035*x^2+6.62038e-4*x^3-2.52968e-6*x^4+3.61991e-9*x^5+eps
	y = 116.227*exp(0.002*x)+eps
	y = 1.946+74.266*log10(x)+eps

Chromate OSC10 die	y = 68.28571+2.79431*x-0.0453*x^2+2.88647e-4*x^3-1.46926e-6*x^4+2.12936e-9*x^5+eps
	y = 119.149*exp(0.002*x)+eps
	y = 2.556+76.061*log10(x)+eps
Improved 205Cr115 die	y = 92.286+1.87406*x-0.03126*x^2+2.88647e-4*x^3-1.19776e-6*x^4+1.80996e-9*x^5+eps
	y = 123.675*exp(0.002*x)+eps
	y = -0.374+80.911*log10(x)+eps
Nitride OSC10 die	y = 138-0.52681*x+0.01599*x^2-1.17841e-4*x^3+3.76897e-7*x^4-4.25872e-10*x^5+eps
	y = 126.461*exp(0.002*x)+eps
	y = -8.499+88.159*log10(x)+eps
Improved OSC10 die	y = 49.26744+6.04555*x-0.10203*x^2+8.27814e-4*x^3-3.1513e-6*x^4+4.57966e-9*x^5+eps
	y = 157.842*exp(0.002*x)+eps
	y = 10.625+95.439*log10(x)+eps

By accomplishing the graphic processing of the experimental research results we may observe the evolution of the bar strip material hardness increase and the eventual optimum technologies of active tools accomplishment for which the hardness value is minimum. With the help of these mathematic patterns we may obtain a clear image of the independent variable influence upon the response value (cool hardening).

Polynomial mathematic patterns graphics for approximating the force plugs hardness evolution

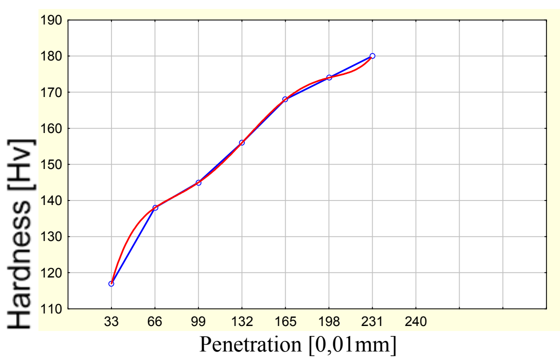

Fig.3 Covered sparks OSC10 die

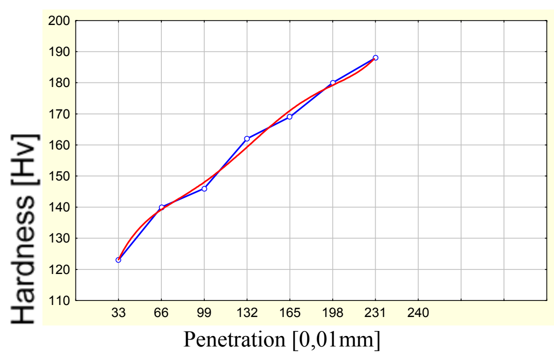

Fig.4 Chromate OSC10 die

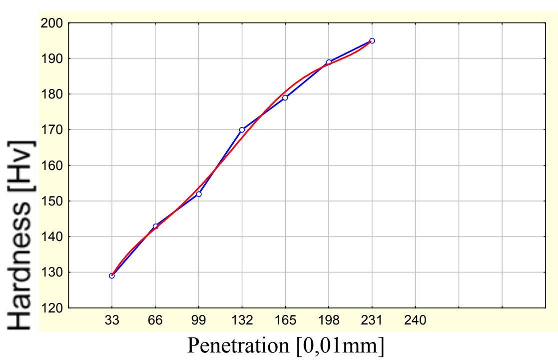

Fig.5 Improved 205Cr115 die

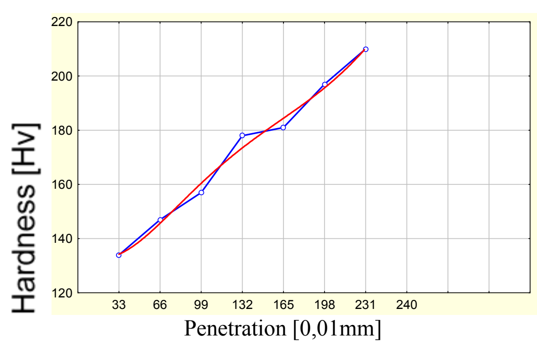

Fig.6 Nitride OSC10 die

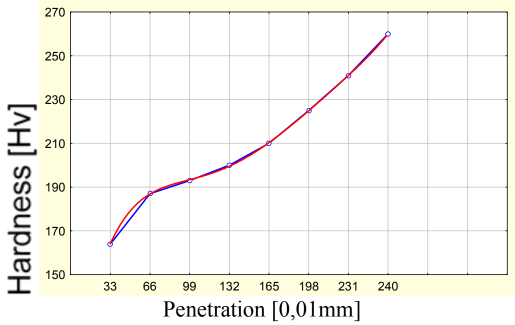

Fig.7 Improved OSC10 die

4. Conclusions

From the values obtained after the multiple regression analysis we observe that the mathematic patterns are adequate because the main established parameters are framed within the admissible values field.

Because the matrixes and force plugs edges are rounded due to wear, they have deformed the bar strip sheet causing cool hardening.

Every force plug has differently hardened the material, penetration function, due to the different edge wear of the active tools.

- We observe that the greatest value of the cool hardened material is when cutting with the OSC 10 improved force plug, and the least value with the OSC 10 force plug covered with sparks.
- The same behaviour is registered also for the deformations caused by the matrixes that worked together with the respective force plugs;
- The cool hardening caused by the matrixes effect is superior to that caused by the force plugs effect;
- The cool hardening maximum value caused by the chromed OSC 10 force plug is bigger than the one of the OSC 10 force plug covered with sparks, therefore having a lower hardness, but its behaviour in the cutting process is satisfactory;
- The nitrated OSC 10 force plugs and 295Cr115 improved force plug have durability between those mentioned before and the improved OSC 10 force plug.

BIBLIOGRAPHY:

[1] Stăncioiu Alin, *Cercetări cu privire la influența calității sculelor asupra proceselor tehnologice de tăiere,* Universitatea din Craiova, Teza de Doctorat, 2004

[2] Şontea, Sever., *Tratamente termice şi termochimice* , Editura Spirit Românesc, Craiova, 2001

[3] Şontea, Sever, *Calitatea acoperirilor prin cromare dură* , Revista Tratamente termice, Nr.5. 1993