AN INFLUENCE OF THE SURFACE ROLLING ON MECHANICAL PROPERTIES OF THE BAND SAW BLADES

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Abstract

The article present the experiment focused on the band saw blade surface mechanical properties analysis after plastic deformation process. The deformation of the band saw blade is caused by rootling in order to increase operating reliability. Mechanical properties were evaluated by hardness measurement and by microstructure analysis.

Keywords: *Degradation of material properties, tools reliability, rolling of the band saw blade surface, micro hardness, microstructure.*

1. Introduction

For increasing of the life time and operating safety of band saw blades, rolling of the blade surface was made. This technological operation is integrated after welding of blade, with aim to cause plastic deformation of the surface. The blade is enfolded better around the wheels and secured against slip down during the cutting process. In this experiment, influence of rolling on mechanical properties and microstructure of the surface layer was analysed. Further some possible changes of mechanical properties were discovered.

2. Toughening by plastic deformation.

Effect of the rolling is adaptation of transverse bending of band saw blade to incurving of flywheel by prolongation of determined width zone for front - back purpose keeping. Modulation of the internal tension consists of the whole series of the operations (combination of working procedures), which are made on rolling machines (Barcík, 2000, Siklienka, 2002). Making of the plastic deformation in the middle part of blade is aim of the rolling. At the plastic deformation by means of press rollers on band saw blade, changes of substructure in micro bulb exist. These relate to dislocation moving (line failure of crystal lattice) in the skid places of elementary crystal lattices.

Increasing of concentration of dislocations and their bracing appears as a consequence of plastic deformation. It will cause increasing of internal tension in material (Skočovský, 2001). Toughening and increasing of hardness of the blade surface layers at plastic deformation are expected.

2.1. Procedure of rolling

Rolling is started in the middle of blade (Fig.1) with the highest pressure, and then is rolled right side and left side from the middle line of blade with gradual decreasing of pressure.

Distance between rolling prints depends on width of blade (from 10 to 20 mm). Marking of rolling prints by chalk is beneficial. Extent of deformation is checked by try rule (Fig. 2), (Barcík, 2002).

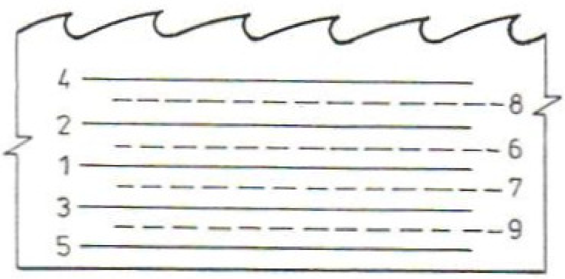

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Fig. 1. Principle of symmetric rolling
Fig. 2. Check of the blade distortion

3. Experimental materials

Blade from steel of the Swedish firm Sandwik (carbon tool steel) was used for experiment. Pressure 5 MPa was applicated. The length of sample was approximately 1m (Fig. 3).

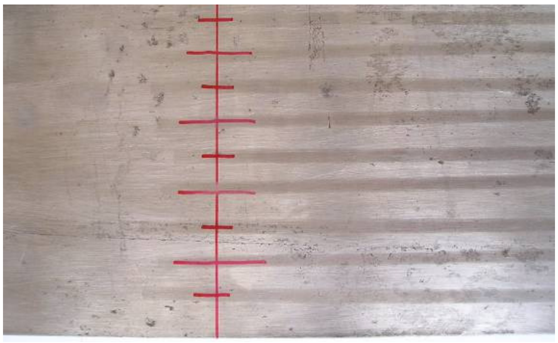

Fig. 3. Sample of blade after rolling

4. Method of properties evaluation

1) Changes of mechanical properties were detected by comparison of properties of rolled and non-rolled parts of blades. The samples chosen from these parts were submitted:
   a) static tensile tests,
   b) hardness and micro hardness measurement by methods HV5 and HV0,050.
2) Microstructures of cross-section of the rolled and non-rolled parts of blade were evaluated and compared by metallographic optic microscope Neophot 2.

5. Description of achieved results

5.1. Static tensile test

Basic mechanical properties were tested on 6 samples. Three samples were made from rolled and three from non-rolled blade parts. These tests should determine possible changes of tensile strength. Results are presented in Table 1.

Tab. 1

Results of the tensile test

	Non-rolled part	Rolled part
Maximal force F(N)	21 900	22 000
	22 000	22 100
	22 000	22 100
Tensil strength R_m (MPa)	1 460	1 467
	1 467	1 473
	1 467	1 473
Ductility %	2,42	2,42
	2,42	2,42
	2,42	2,42

Comparing of maximal tensile forces from tested areas shows that rolling operation has a little impact on mechanical properties in macro content band saw blade. Tensile strength is increased minimal only, strengthened layer is very thin. Moreover, limit tension of sliding up by samples chosen from rolled areas, on the tensile graphs was a slightly pointed.

5.2. Hardness measurement

Hardness measurement was made on surface of blade by method HV5 (Fig. 4). Graphic illustration of results is in Fig. 5.

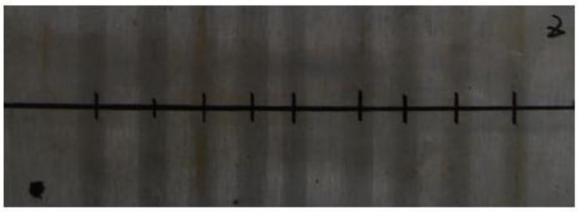

Fig. 4. Areas of hardness measurement by HV 5

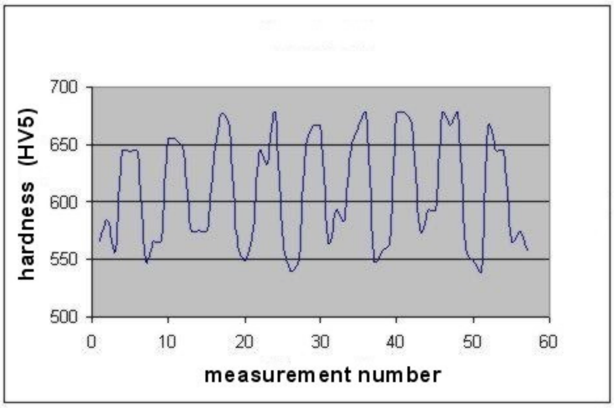

Fig. 5. Graphic illustration of results hardness measurement

From Fig. 5 it is evident, that values of hardness in rolled parts of blade are increased about 100HV.

5.3. Micro hardness measurement on cross-section of band saw blade

According to Fig. 6 on the metallographic sample, micro hardness by HV 0,050 method was measured. The results are showed in Tab. 3 and Tab. 4.

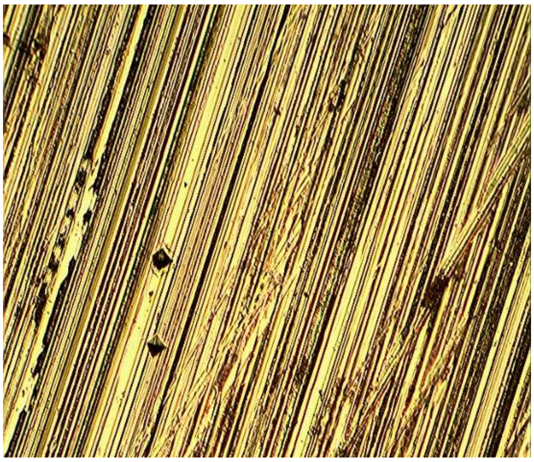

Fig. 6. Method of measurement (cross-section)

Tab. 3

Result of hardness measurement on cross-section of non-rolled blade

Sample non-rolled	1	2	3	4
HV 0,05	499	499	499	499

Tab. 4

Result of hardness measurement on cross-section rolled blade

Sample rolled	1	2	3	4
HV 0,05	499	499	499	499

Under the surface of cross-section, changes of hardness were not established.

5.4. Hardness measurement on the surface of blade

Because the changes of hardness in the cross-section area of the blade were not established, measurement was realized on the surface in the rolled and non-rolled part of the blade (Fig. 7, 8). Here were confirmed the changes of hardness (Tab. 5 and 6).

Fig. 7. Rolled part of blade

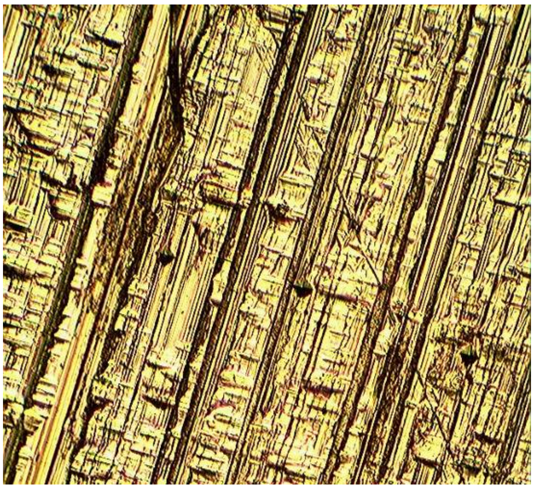

Fig. 8. Non-rolled part of blade

Tab. 5

Result of hardness measurement of rolled surface

Rolled part	1	2	3
HV 0,05	633	549	584

Tab. 6

Result of hardness measurement of non-rolled surface

6. Microstructure evaluation

The no noticeable microstructure deformations on the samples of the rolled part of blade were observed. The microstructure of material after heat treatment is homogeneous, fine-grained, formed by tempered martensite with globular carbides (Fig. 9).

Fig. 9. Microstructure of material

7. Conclusions

Result of performed experiment confirmed the changes of mechanical properties of materials band saw blade. Increasing values of hardness was established on the rolled parts of band saw blade. The toughening from plastic deformation was not noticeable presented values of the tensile strength were not increased. Structure deformation on the cross-section of sample was not visible. It was not measured, because deformation layer after rolling was very thin.

Acknowledgement

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References

[1] Barcík, Š.: Analysis of factors by sawing on vertical band saw blade. TU Zvolen 2000, ISBN 80-228-0909-8.

[2] Barcík, Š.: Maintenance about operation of the band saw blades. In: Wood cutting tools, 2002. TU Zvolen 2002, ISBN 80-228-1199-8.

[3] Skočovský et al.: Material science for machine branches, EDIS – Publisher ŽU, Žilina 2001, ISBN 80-7100-831-1.

Non-rolled part	1	2	3
HV 0,05	435	435	412