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MECHANICAL PROPERTIES OF BRASS SHEETS

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Preliminary Note – Prethodno priopćenje

Brass is widely used in the machine industry, automotive, shipbuilding, construction, metalworking industries, as well as in the production of fittings. Certain types of brass, despite the almost identical chemical composition and the same form resulting from the standards, e.g. sheets of a certain thickness, often differ in performance, e.g. mechanical properties. The presented work compares selected mechanical properties of CuZn39Pb2 brass sheets from different manufacturers.

Keywords: brass, sheets, tensile strength, strain / deformation point, Yang's modulus

INTRODUCTION

Static tensile tests were carried out at room temperature on the MTS-Landmark 100 kN servohydraulic testing machine (Figure 1) using the TestSuite software. 7 mm thick brass sheets produced by hot and cold rolling were used in the tests [1, 2]. The tests were carried out under uniaxial stretching conditions with a displacement speed of the working head of 4 mm/min. Flat samples with a rectangular cross-section of 7x12 mm and a measuring base length of 50 mm were used. A brass sheet sample from the manufacturer No. 1 (marking I), recognised as the model, was cut in the direction of rolling. Comparative samples from manufacturer No. 2 were cut in the direction of rolling (marking II / 1) and perpendicularly to the direction of rolling (marking II / 2). The strain was measured using an MTS-632-11c-20 extensometer. During the tests, data was recorded from active control channels: displacement, force, deformation.

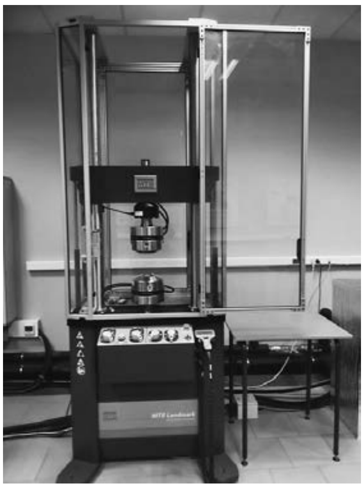

Figure1 MTS-Landmark testing machine

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RESEARCH RESULTS

The results obtained in the course of the conducted research allowed for the development of static tensile characteristics, which are summarised in Figure 2.

The recorded measurement signals were converted into the relationship: strain - actual deformation. The obtained dependencies are shown in Figure 3.

From the dependence, the values of the narrowing of the sample after fracture were determined:

$$Z = \frac{S_o - S_u}{S_o} 100 \qquad (1)$$

where:
So- initial cross-section of the sample,
Su - cross-section after fracture of the sample

In the static tensile test the following were determined: the conventional yield point $R_{p0,2}$, the tensile strength R_m, elongation *A50*, necking down *Z* and Young's modulus *E* in accordance with PN-EN ISO 6892-1 norm as well as the hardening exponent n and the strength coefficient *C* (equation constant) for the Hollomo's dependency in accordance with PN-ISO 10275:1996 norm.

$$\sigma = C\varepsilon^n \qquad (2)$$

where:
s – strain,
ε – deformation.

In order to determine the directional coefficients of the Hollomon function (2), equation (2) was logarithm on both sides. The following was obtained:

$$ln\sigma = lnC + nln(\varepsilon) \qquad (3)$$

After approximation of the equation (3) by the linear regression method, the strengthening exponent n and the strength coefficient C (equation constant) were de-

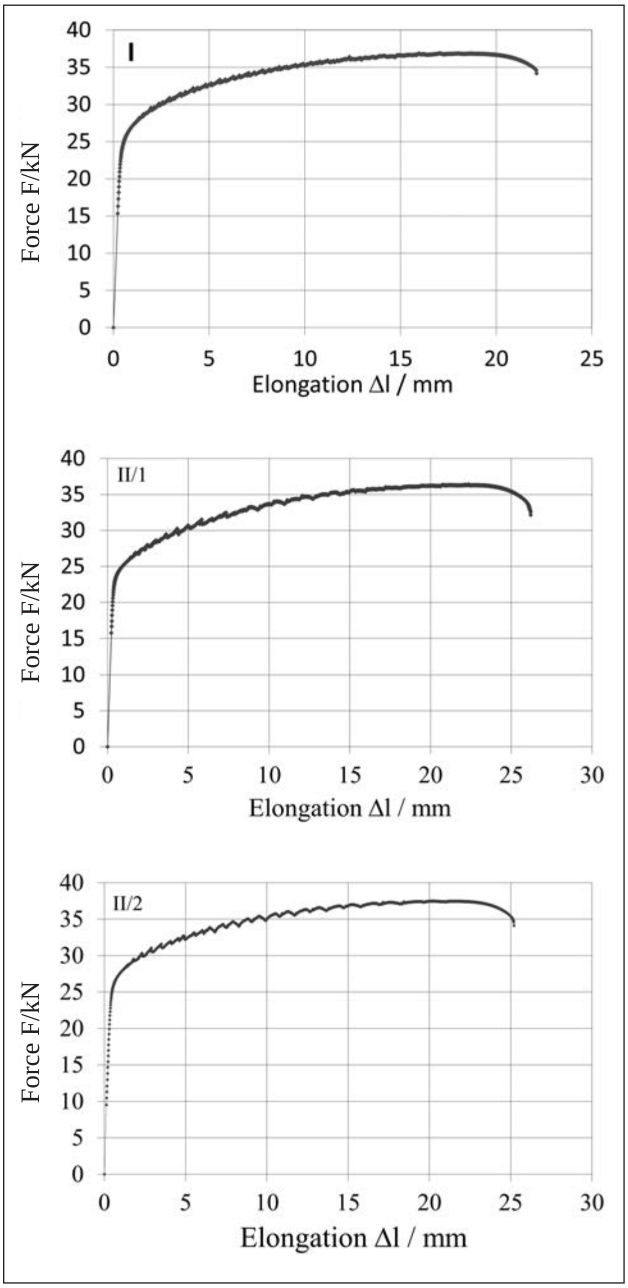

Figure 2 The dependence of force on elongation

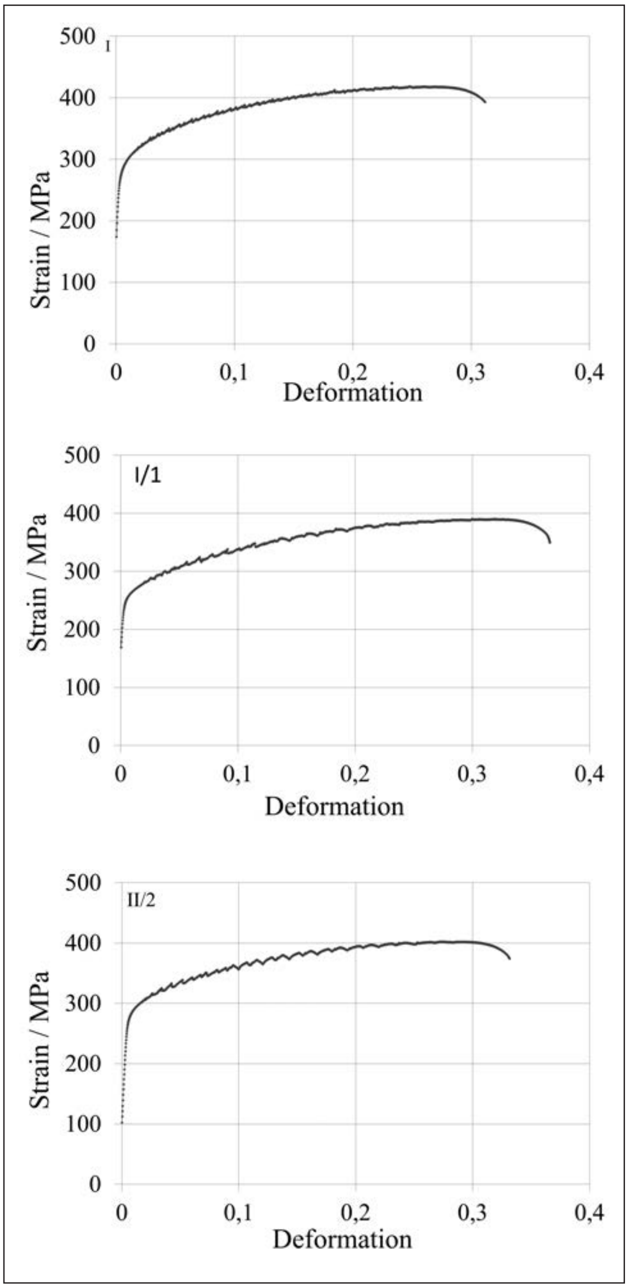

Figure 3 The relationship between strain and deformation

Tabele 1. **Mechanical properties of tested materials**

Sample	R_m / MPa	$R_{0,2}$ / MPa	Z / %	A_{50} / %	E / GPa
Sample I	418	279	37,5	37,2	103,5
Sample II/1	398	254	49,2	44,8	97,2
Sample II/2	402	275	49,2	42,0	103,4

Tabele 2 **The strengthening exponent n and the strength factor C**

Sample	C / MPa	n
Sample I	481,19	0,104
Sample II/1	444,20	0,116
Sample II/2	470,83	0,118

termined for the dependence (2). The method of determining Young's modulus is shown in Figure 4.

The obtained results of the research are summarised in Tables 1 and 2 and Figure 5.

SUMMARY

The mechanical properties of both types of sheets are different from each other. There is also a slight anisotropy of the properties obtained after the rolling process. The strain strength values for the sheets from the first manufacturer, amounting to 398 MPa for the rolling direction (sample II / 1} and 402 MPa for the direction perpendicular to the rolling direction (sample II / 2), are clearly lower compared to the alloy considered as the reference alloy for which the obtained *Rm* value was 418 MPa. At the same time, the plastic properties, i.e. elongation and necking down, are clearly greater. For a sample cut in the direction of rolling, the narrowing value is 49,2 %, elongation is 44,8%, and for a sample cut per-

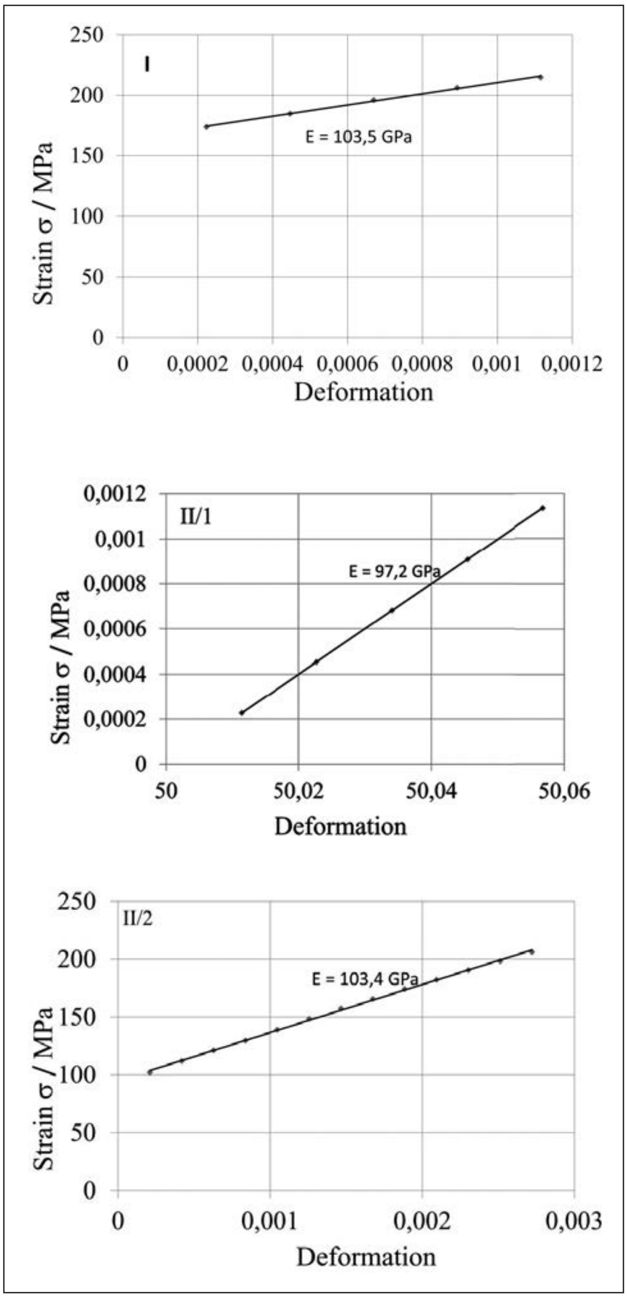

Figure 4 Young's modulus

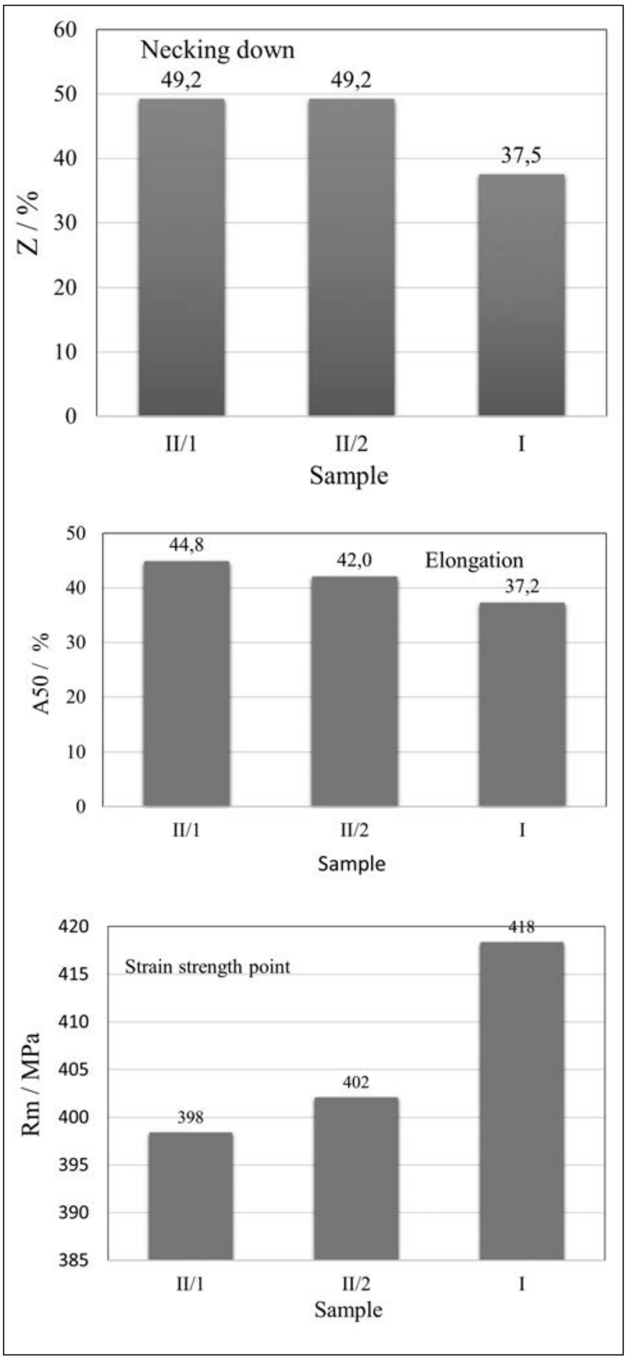

Figure 5 Comparison of mechanical properties of tested materials

pendicular to the rolling direction, 49,2 % and 42 % respectively. For the sample considered as the reference value, the necking down value is 37,5 %, and the elongation is 37,2 %. The values of the obtained Young's modulus do not differ from the literature data [3,4]. Differences in the properties of both tested sheets may result from different rolling technologies (e.g. the number of densities, different hot and cold rolling configuration) and a different setting and different parameters of the applied inter-operational and final heat treatment.

Acknowledgments

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Note: Nowak P. is responsible for English language, Katowice, Poland