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Bioeconomy Moves Forward: Perspectives on Wood Product

INFLUENCE OF TOOL HOLDER DESIGN ON ROUGHNESS OF THE MILLED PLYWOOD SURFACE

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INTRODUCTION

- The design and construction of a tool holder for CNC machines are important for the stability of the wood milling process and thus for the quality of milled surfaces
- Various types of tool holders and elastic collets are used to fix tools on CNC machines (mechanical clamping, thermal clamping, hidro, clamping,...)
- The aim of developing a new tool holder is to ensure the accuracy of tool positioning in the chuck, i.e., the goal is to achieve ideal centering of the tool axis in relation to the chuck axis, in order to increase processing accuracy, reduce vibrations and achieve the highest quality processing.

MATERIALS AND METHODS

Table 1: Tool holders and used collet, and mounting moment

Label	Producer	Collet	Moment (Nm)
AKE32	Ake Knebel (Germany)	ER32	180
TER	Leuco Ledermann (Germany)	n/a	n/a
MEW40	Metal world (Italy)	ER40	196
HID	Leuco Ledermann (Germany)	n/a	n/a
SEM40	Semar (Italy)	ER40	196
LDU32	Leuco Ledermann (Germany)	ER32	130
LKR32	Leuco Ledermann (Germany)	ER32	130
KLE32	Klein tools (Italy)	ER32	130

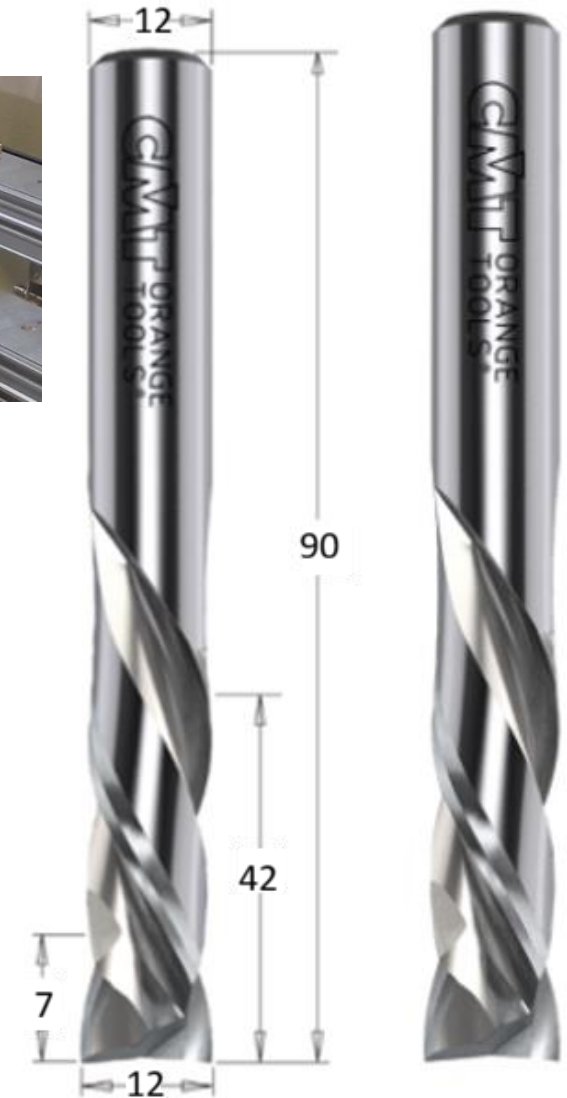
MATERIALS AND METHODS

1. AKE32
2. TERMO
3. MEW40
4. HID
5. SEM40
6. LDU32
7. LKR32
8. KLE32



MATERIALS AND METHODS

- Nine-layer plywood (Birch - *Betula pendula*) 12 mm
- CNC machine HOMAG VENTURE 316 M
- Tool-CMT Utensili S.p.A (Z2+2)
- Rotational frequency 18.000 rpm
- Feed rate 7 m/min
- Depth of cut 3 and 6 mm



MATERIALS AND METHODS

- Surface roughness tester
- R_a (arithmetical mean deviation of profile)
- R_z (maximum height of the profile)



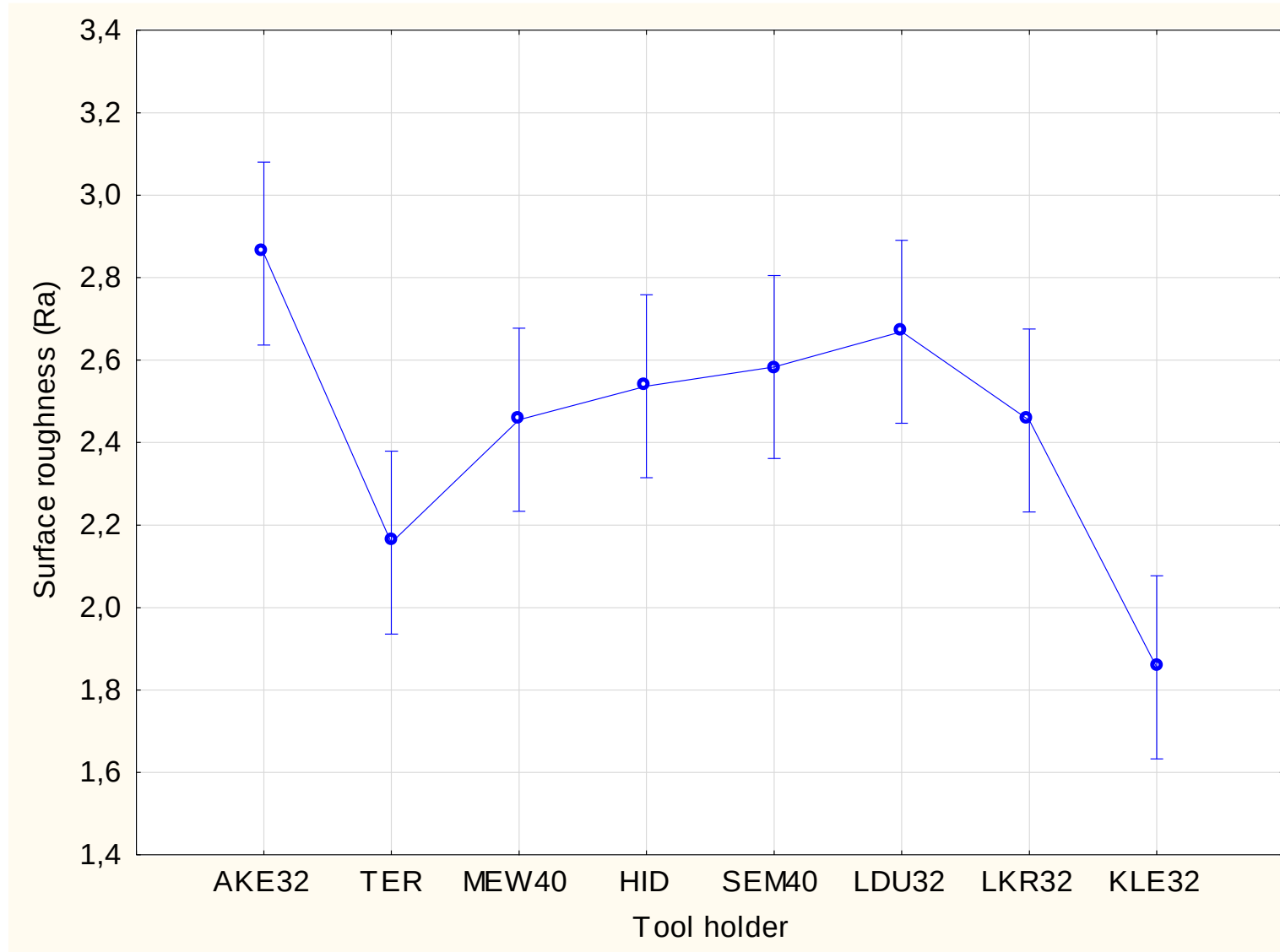
RESULT AND DISCUSSION

Table 2. Values of surface roughness R_a depending of tool holder and depth of milling

Effect	SS	Degr.of freedom	MS	F	P	Tukey test (Tool holders)
Intercept	1914.81	1	1914.81	3761.85	0.000	(1,3,4,5,6,7) (2,3,4,5,7,8) (3,4,5,6,7)
Tool holder	27.17	7	3.88	7.63	0.000	
Depth of milling	1.87	1	1.87	3.67	0.056	
Tool holder × depth of milling	7.92	7	1.13	2.22	0.032	
Error	154.74	304	0.51			

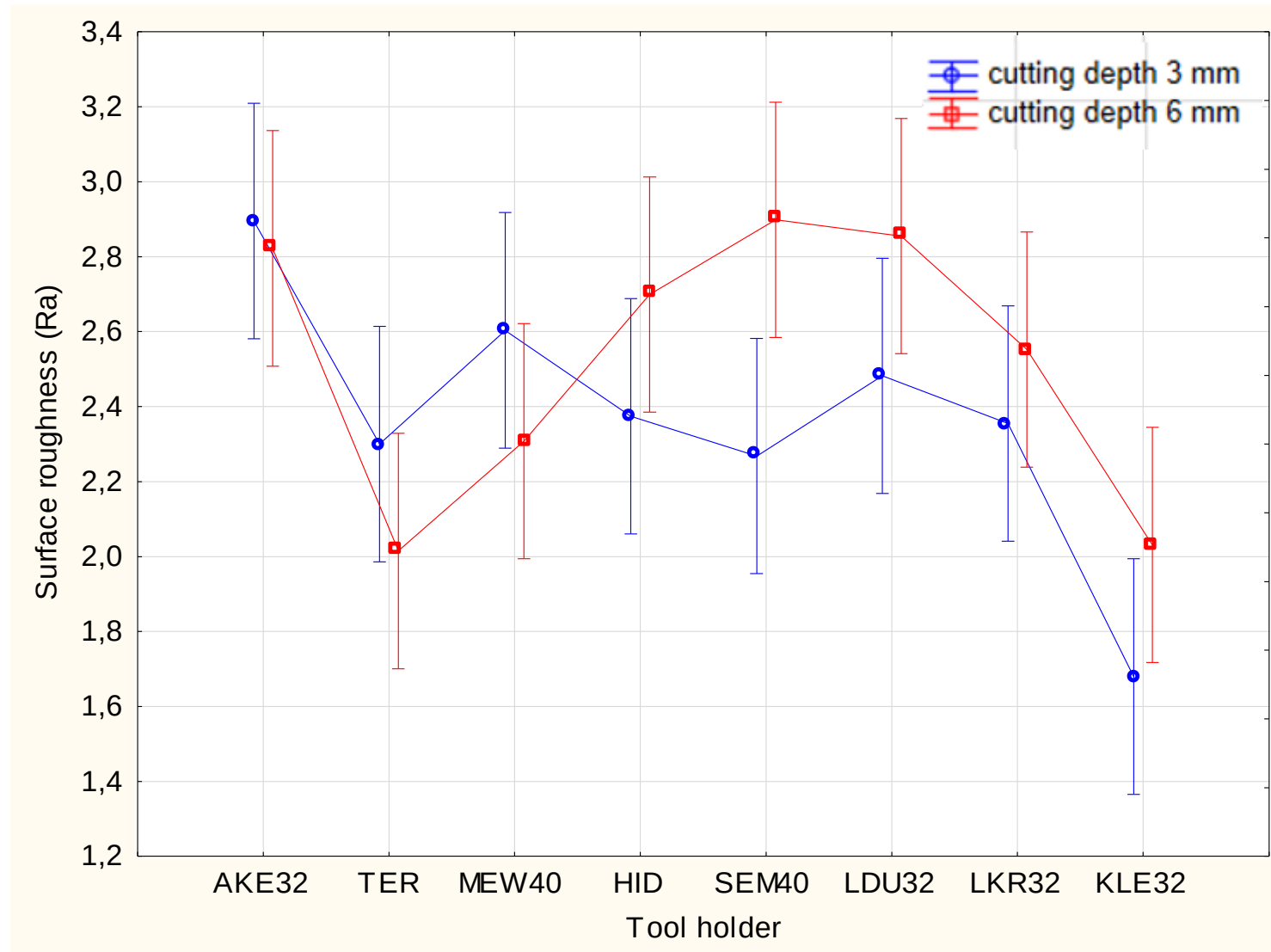
Marked values are significant at $p < 0.05$

RESULT AND DISCUSSION



Arithmetic means and 95% confidence intervals of values R_a depending on the type of tool holder

RESULT AND DISCUSSION

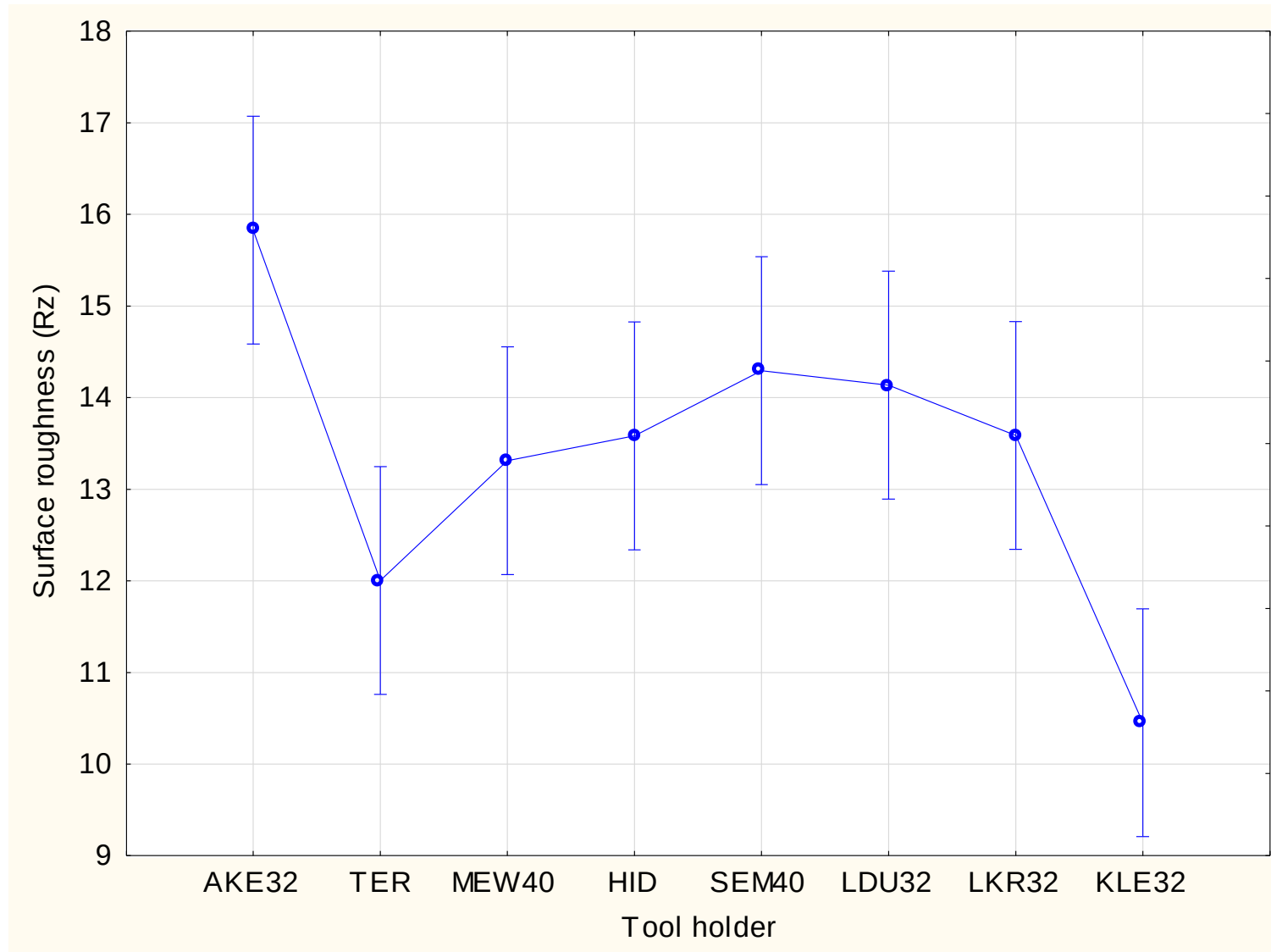


RESULT AND DISCUSSION

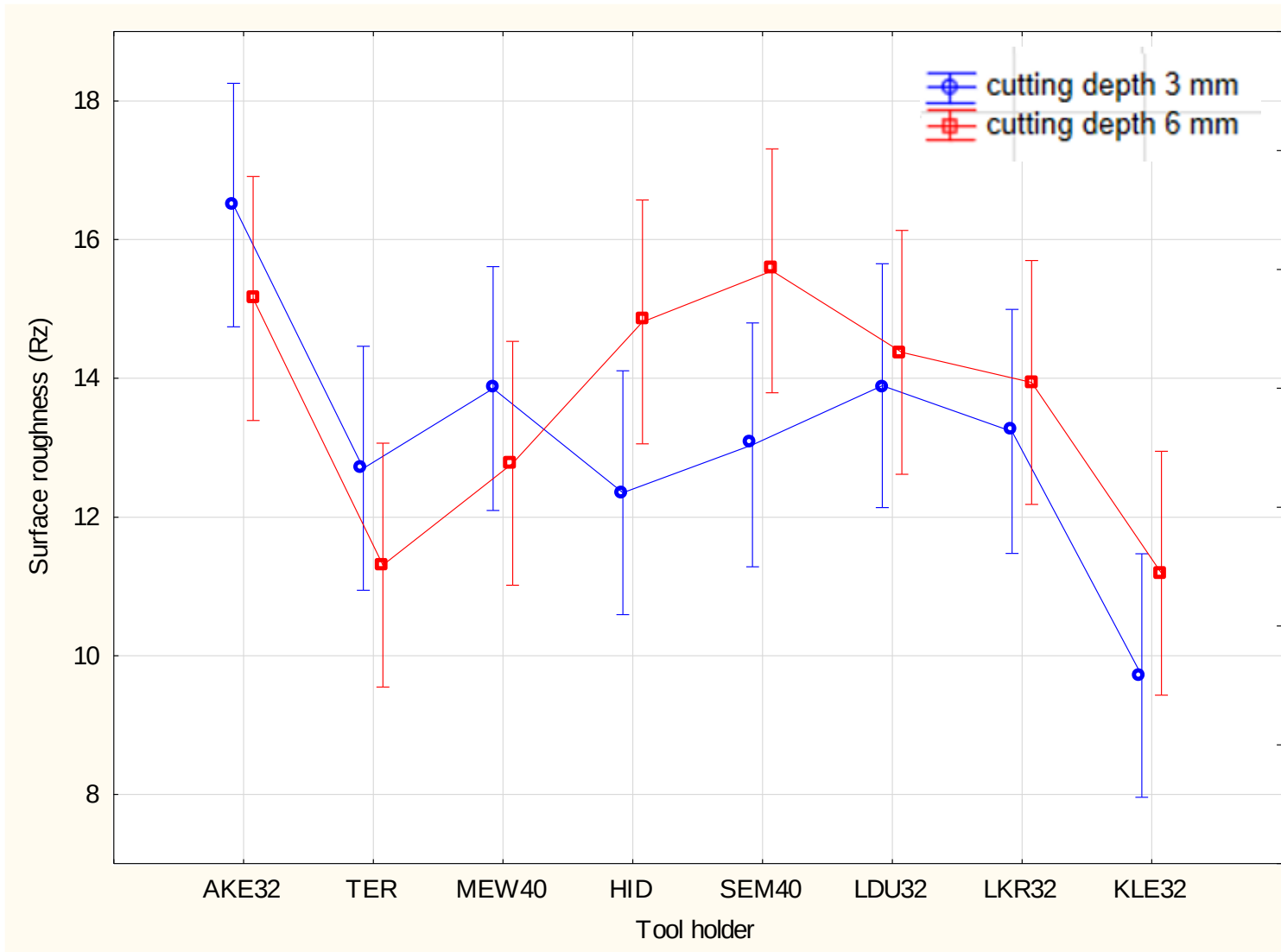
Table 3. Values of surface roughness R_z depending of tool holder and depth of milling

Effect	SS	Degr.of freedom	MS	F	p	Tukey test (Tool holders)
Intercept	57457.57	1	57457.57	3598.89	0.000	(1,3,4,5,6,7) (2,3,4,5,6,7,8)
Tool holder	717.60	7	102.51	6.45	0.000	
Depth of milling	18.22	1	18.22	1.14	0.286	
Tool holder × depth of milling	184.07	7	26.30	1.65	0.122	
Error	4853.47	304	15.97			
Marked values are significant at p<0.05						

RESULT AND DISCUSSION



RESULT AND DISCUSSION



Arithmetic means and 95% confidence intervals of values R_z depending on the depth of milling and tool holder **12**

CONCLUSION

- Tool holders affect the change in surface quality of plywood.
- Tool holder produced by KLEIN and tool holder with termo couple produced by LEUCO achieve lower surface roughness.
- The samples milled using the KLEIN and TERMO tool holders achieved 15–30% better surface roughness results compared to those milled using the other tool holders.
- The axial depth of cutting did not influence statistically significant differences in surface roughness.



Thank you for your attention!

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