

Development trends of saw chains and analysis of the forces acting on the saw chain tooth



Chain saw, kinematic and dynamic parameters, planing chain link, sharpening angle

1 Goal of the project

The project focuses on comparing two types of saw chains – 3/8" Rapid Super chain with standard geometry and the new STIHL Hexa cutting system, which consists of a 3/8" Hexa saw chain and a Hexa file. The quality of the cutting process is directly related to the geometry of the cutting elements of the saw chain, which is why choosing the right one and taking care of it is one of the key requirements. During operation, the chain gradually becomes dull, which reduces the quality of the cut and increases the difficulty of operating the chainsaw.

2 Theoretical background and methods

Stihl has launched the new STIHL Hexa cutting system, which consists of a 3/8" Hexa saw chain and a Hexa file. The manufacturer claims that the cutting performance of the new chain is up to 10 percent higher than the 3/8" Rapid Super chain with standard geometry. This is an unusual innovation compared to the traditional round shape of the saw tooth blade.

Materials for saw chains: The steels used for the production of saw chains require a combination of high strength, toughness and wear resistance. This can be achieved by proper heat treatment of iron alloys containing silicon, which is able to form microstructures containing austenite with the required hardness. The cutting surface of the saw teeth is coated with a hard layer of chromium. For special types of chains that are intended for recovery work and cutting e.g. car bodies, the cutting links are supplemented with diamond blades. However, these chains are not used in the woodworking industry, here chains with carbide edges are used for use in more demanding conditions.

In the first part of the project, operational measurements were carried out in the terrain, where both chains processed the same amount of wood and their gradual dulling was monitored under a microscope. The main cutting edge of the saw chain was examined on a Keyence VHX-5000 digital microscope. The raw material processed was Norway spruce (*Picea abies*) and Scotch pine (*Pinus sylvestris*) with bark in 1 m lengths, which were cut into thirds. For each cut, the diameter at the cut points was measured with a forestry caliper and then cut into thirds with a chainsaw. The measurements were taken after consuming 1 tank, which corresponds to 1 hour of work and a cut area of 2.5 m². Dulling was measured on 12 cutting links (6 left and 6 right links) selected from the entire length of the chain (every third link in the row). A total of 5 pcs of 3/8" Hexa saw chain and 5 pcs of 3/8" Rapid Super chain were tested.

Parameters:	Hexa	Rapid Super
Chain pitch	3/8"	3/8"
Guide groove width	.063"/1.6 mm	.063"/1.6 mm
Number of guide links	72	72
Tooth profile	edgy	edgy
Tooth sharpening angle	25°	30°
File type	Hexa – hexagen	Round ø 5.2 mm
For guide bar length	20"/50 cm	20"/50 cm

3 Result and discussion

The results of increased operational wear show an average of 21% lower values for the Hexa chain compared to the Rapid Super chain. A closer analysis reveals a difference in the median for the left and right links of the Rapid Super saw chain. The left links of this chain show a 38% increase in dullness, while the right links show only a 28% increase compared to the Hexa chain links. In the Hexa chain, the dullness of the left and right links is uniform (average 7.23 µm and median 6.82 µm).

The lower increase in dullness in the Hexa saw chain links may be due to the different sharpening angle of this chain (25°) compared to the Rapid Super chain. The cleanliness of the processed material is decisive for chain dulling, which could also have caused the higher wear measured on the Rapid Super chain, but given that the same operator worked with the saw under the same conditions and processed the same raw material, this factor can be disregarded. In addition to the factors mentioned above, the cutting performance is also determined by the reduction of the limiting foot, the available power of the saw motor, the chain speed, and the type of wood being processed. (Neruda, Nevrkla, Cach, 2013).

LITERATURE:
NERUDA, Jindřich; NEVRKLA, Pavel; CACH, Adam. 2013. Práce s motorovou pilou a křovinořezem: učební text pro předmět Práce s motorovou pilou. V Brně: Mendelova univerzita. ISBN 978-80-7375-841-7.

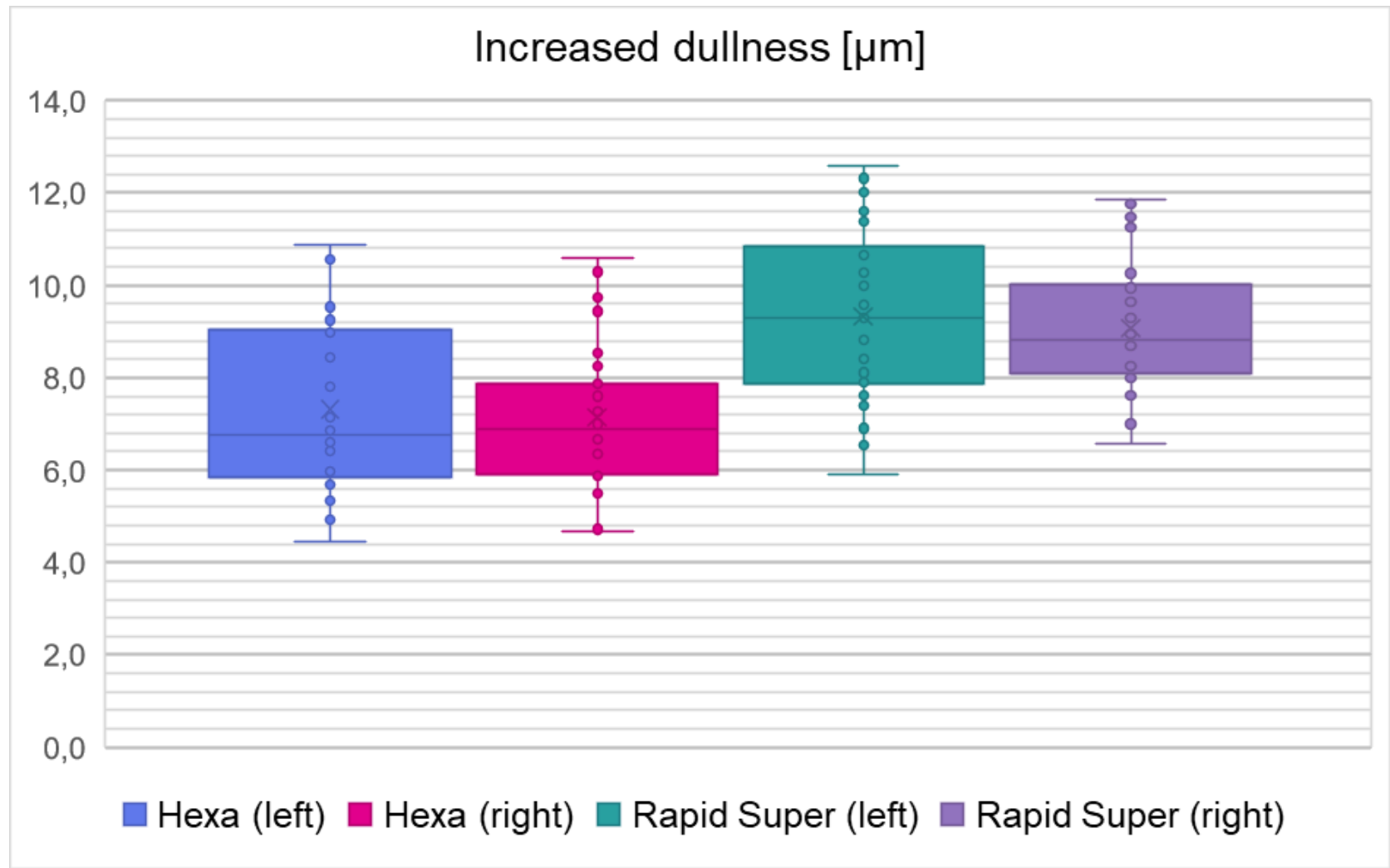
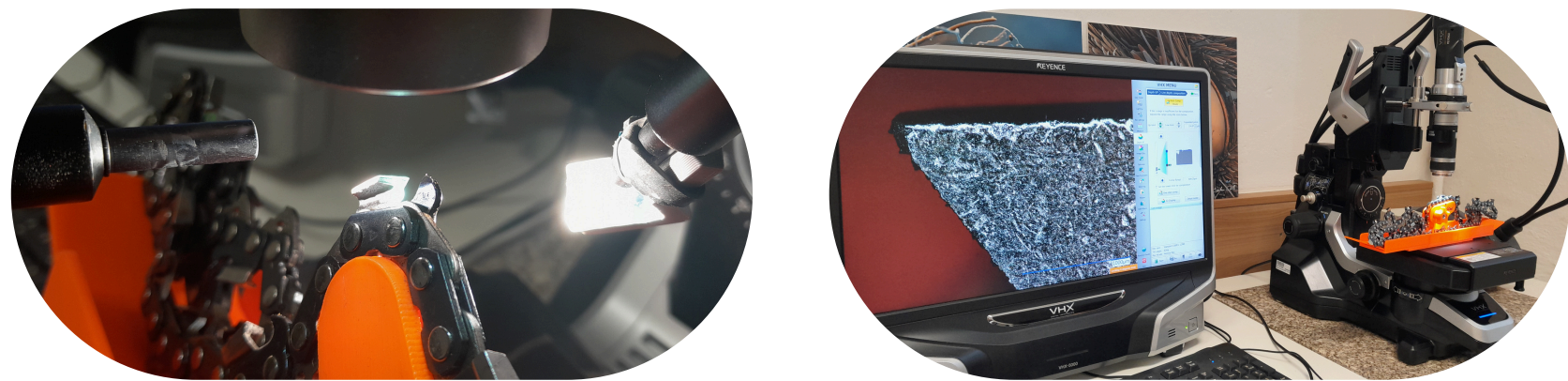


Fig. 1: Increased dullness of the main cutting edge

4 Conclusion

The material being processed, the properties of the saw chains, and the skill of the operator will have a particular impact on dullness. Lower dullness increase in Sithl Hexa chains leads to longer cutting performance and thus safer and higher-quality working conditions with lower physical demands on the chainsaw operator.