Low-noise circular saw blades

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Introduction

Sound pressure levels generated by circular saws usually exceed 85 dB(A) at many workplaces in all kinds of industries. Because the main noise is radiated from the saw blade, it can be assumed that noise levels will be effectively reduced if so-called low-noise saw blades are used. Although such saw blades have been available on the market for several years, they have been used relatively infrequently to date. This is probably because low-noise saw blades and corresponding noise reduction are not sufficiently known about. The *Berufsgenossenschaftliches Institut für Arbeitsschutz* (Institute for Occupational Safety and Health – BIA) therefore conducted tests of various low-noise saw blades in comparison to conventional saw blades and determined the attainable noise reduction. This paper presents the results of the investigation.

Description of circular saw blades

During the first measurements that were carried out in the BIA laboratory, carbide-tipped saw blades with a diameter of 250 mm and 60 or 80 teeth were used. The following types of saw blade were tested:

A. Conventional saw blade with fine radial expansion slots on the outer edge (No. 1-4)
B. Low-noise saw blade with additional fine laser cuts in the middle region (No. 5-8)
(these laser cuts shall prevent the development of natural oscillations and attenuate vibrations by friction within laser cuts)
C. Low-noise saw blade with muffling layer – sandwich construction (No. 9)
(attenuation by visco-elastic docked cover plate).

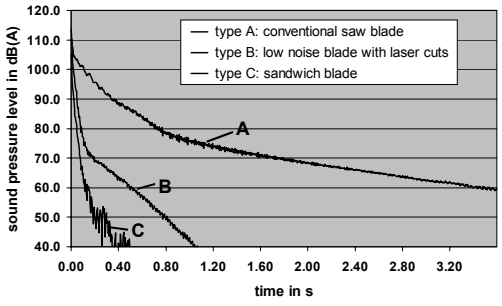

Figure 1: Noise decay curves of different types of circular saw blades after stimulation by a plastic hammer

To describe the damping effect of the various saw blades, the blades were struck with a plastic hammer and the noise decay curves recorded by sound measurements at short distance. In Figure 1, the A-weighted sound pressure level of the noise decay process is shown for three selected saw blades. Curve A shows the noise decay curve of a conventional saw blade. By comparison, curve B for a saw blade equipped with laser cuts (design B) drops much more quickly after stimulation. Curve C representing a sandwich blade (design C) shows particularly high damping effects.

The following measurements show how the saw blades' different damping characteristic affects the noise emission when the blades are in use.

Implementation of measurements

Measurement conditions

This section presents the first results of the project that were obtained during the sawing of wood. Nine circular saw blades were tested:

- 4 conventional saw blades without damping (type A)
- 4 saw blades with damping by laser cuts (type B),
- 1 saw blade as a sandwich construction (type C)

The materials used included various types of wood, e.g. particle boards, blockboards and squared beech beams.

The results presented in this report were obtained in a semi anechoic room at the BIA with the following circular saw:

Manufacturer: Metabo
Type: TKU 1693 W
Performance: 2100 W
RPM: 4220 min^{-1}

As measured values, the A-weighted sound pressure level L_{Aeq} and third octaveband spectra were recorded simultaneously at the following two measuring points:

1. Defined workplace according to DIN 45635 Part 1651 (corresponds to a distance from the saw blade of approx. 0.75 m)
2. Reference measuring point at 3 m distance.

Measurement results

In Figure 2, the A-weighted sound pressure levels L_{Aeq} recorded during the sawing of particle boards (19 mm thick) and beams (beech, 60 x 60 mm²) are compared (chart speed approx. 0.15 m/s).

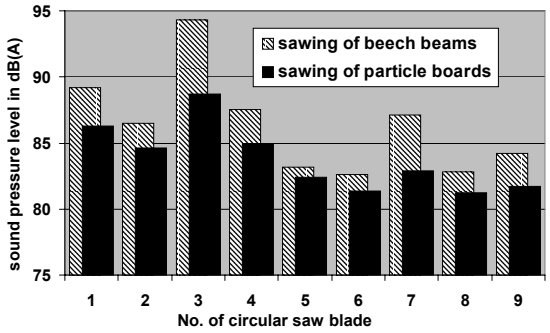

Figure 2: A-weighted sound pressure levels L_{Aeq} at the workplace when sawing wood
(No. 1-4: type A, No. 5-8: type B, No. 9: type C)

The sawing of the hard beech beams caused stronger stimulation of the blades and therefore higher sound pressure levels. Noise reductions of around 5 dB were recorded for the examined low-noise saw blades compared to the mean value of the four tested conventional saw blades. There are significant sound level differences within the group of conventional saw blades. Apart from the damping of the blade, other factors undoubtedly also play a role here, i.e. tooth geometry, number of teeth and the steel of the blade. The achieved noise reduction therefore depends significantly on the initial situation and the conventional saw blade used. Based on saw blade No. 2, noise reduction of approximately only 3 to 4 dB would be achieved with suitable low-noise saw blades. Based on saw blade No. 3, however, noise reduction of 6 dB can be recorded during the sawing of particle board and of 10 dB when timber beams are sawn. Figure 3 illustrates the appropriate noise reduction compared to saw blade No. 3. The measured noise attenuation of the examined low-noise saw blades are similar although blade No. 7 is less effective when sawing beech beams.

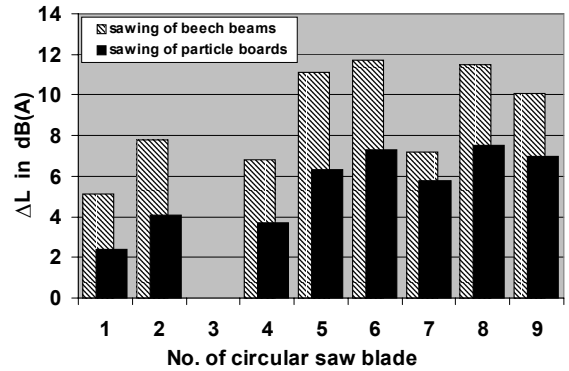

Figure 3: Noise attenuation ΔL in relation to the sound pressure level of saw blade No. 3
(No. 1-4: type A, No. 5-8: type B, No. 9: type C)

The noise reduction as a function of frequency is shown in Figure 4, where the one-third octave band spectra of a conventional saw blade (No. 3) and a low-noise saw blade (No. 9) are compared when sawing of particle board. One can observe an attenuation of the sound pressure levels at higher frequencies of 800 Hz and more, but a small increase of the levels at lower frequencies.

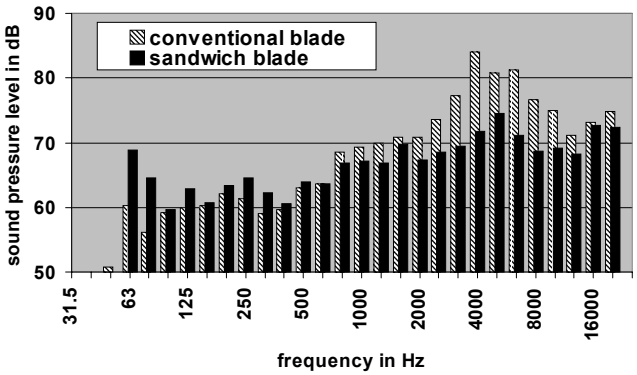

Figure 4: One-third octave band spectra of a conventional saw blade (No. 3) and a sandwich-blade (No. 9) when sawing particle boards

To verify the presented results, additional practical measurements were carried out in two timber workshops. Saw blades with diameters of up to 350 mm were used. Under the given conditions, noise reduction of approximately 5 to 8 dB(A) was achieved using low-noise saw blades.

Summary

In summary, it can be said that the noise exposure caused by circular saws at many workplaces can be significantly reduced using low-noise saw blades. Depending on initial situation (saw blade, operating condition), noise reduction of approximately 3 to 10 dB(A) can be expected when wood is being sawn. A pleasing aspect is that this measure can be implemented without any notable financial expense. The price of low-noise saw blades is comparable to that of conventional blades.