WHITEPAPER

Oscillation-assisted turning with VibroCut oscillate

Chip flow problems in turning processes

In turning, the chip breaking problem has not yet been solved reliably. When machining materials with ductile material behavior, this leads to the formation of long helical and tangled chips. Insufficient chip breaking causes process uncertainties along the chip flow – this results in damaged surfaces, tool breakage (**1**) and clamping errors (**2**). In addition, chip packings form in the work area, causing a risk of collision (**3**) and restricting removal from the lathe by chip conveyors and thus automation (**4**). As a result, process stops for manual chip removal are necessary, which reduce machine availability and lead to a risk of injury for the machine operator.

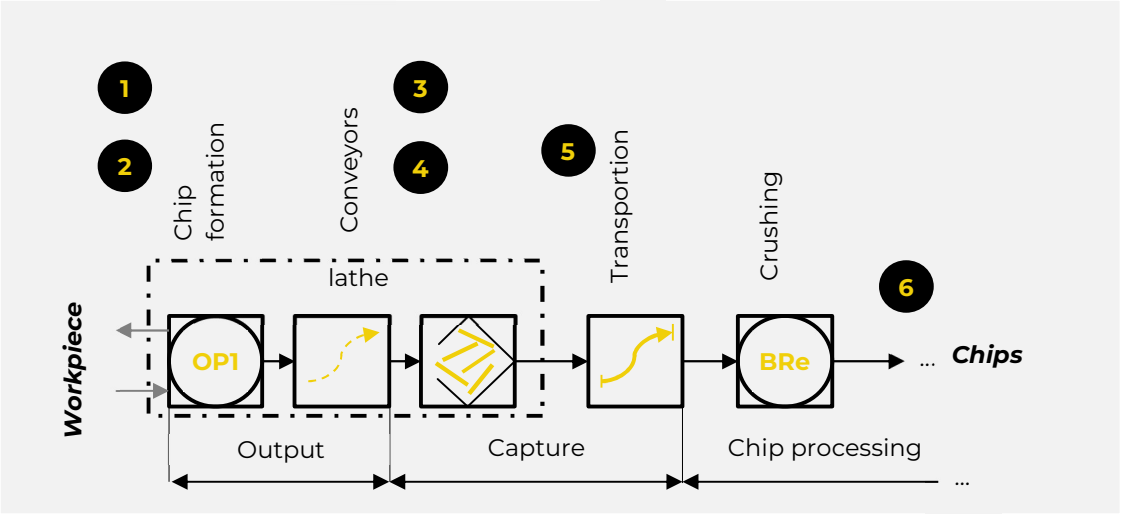

Figure 1: Chip flow and chip breaking cycles

In addition, the low chip volume results in additional effort during transportation (**5**). The result is inefficient chip processing (**6**).

Use of VibroCut *oscillate* for internal and external turning of steel

A VibroCut *oscillate* tool holder was used to investigate chip formation and the influence on chip lengths during internal and external turning on a tempered steel made of C45 (1.0503). For this purpose, VibroCut *oscillate* was integrated into a turret lathe with a driven tool location (VDI 40). An insert (DNMG 150616) was used for this. The test setup shows the basic principle of oscillation-assisted turning with VibroCut *oscillate* and the setting options for the chip shapes using a simple machining example. A defined oscillation is generated in feed direction by the tool holder, thus generating predetermined breaking points in the chip. The tool holder is driven by the tool shaft of the turret. Oscillation assistance in the test

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setup was provided in feed direction with amplitudes of 0.08-0.11 mm in a frequency range of 13-65 Hz. The VibroCut *oscillate* system was operated via the NC control system.

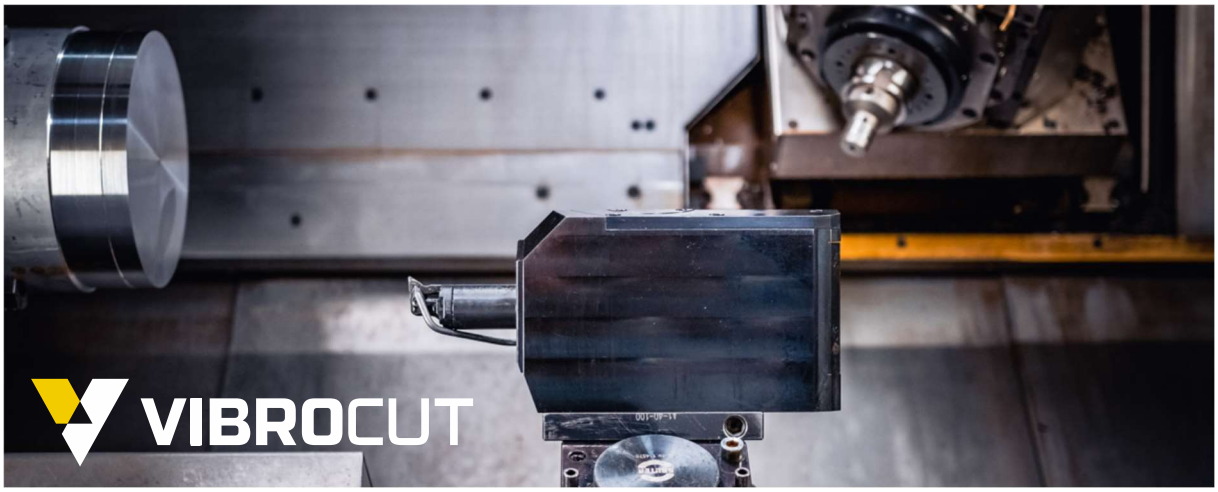

Figure 2: VibroCut oscillate with boring bar for internal machining

By using the VibroCut *oscillate* tool holder, chip formation can be specifically adjusted. If the amplitude is greater than the feed rate, interruptions of the cut occur which directly lead to an interruption in chip formation and therefore to short broken chips. The chips with an amplitude of 0.11 mm show correspondingly identical chip lengths, which become shorter at a higher frequency. Improved chip breaking behavior is also achieved if no interruptions of the cut are generated. The thickness of the chip is changed periodically to create predetermined breaking points in the chip. The test series without interruptions of the cut with an amplitude of 0.08 mm shows that the chips break primarily at the predetermined breaking points. The resulting chips therefore consist of one or two pieces of the periodic elements, the length of which can be shortened again using the frequency.

Figure 3: Influencing chip breaking with VibroCut oscillate (conventional chip shape - center)

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Customer benefits

The advantage for the user is a stable and economical chip breaking behavior, with a high robustness against influencing variables, e.g. tool wear or batch variations. Process reliability and machine availability during turning increase significantly. Since the conventional turning process is superimposed, the oscillation assistance is cycle time neutral. Machine downtimes caused by chip breaking have an impact on the economic efficiency of the turning process. By considering the loss of utilization, the potential savings of VibroCut *oscillate* can be calculated. Figure 4 shows that with machine downtimes of 4 min/h due to chip breaking, an annual saving of € 34,000 per equipped machine tool can be realized.

Cost savings with VibroCut *oscillate*

Calculation example internal turning

- Machine hour rate: 45 €/h
- Planned occupancy time: 6000 h/year (750 shifts/year)
- Downtime due to chip breaking: 2 – 6 min/h

Downtime due to chip breaking	Usage loss per year	Downtime costs per machine
2 min/h	200 h (3.3 %)	9,000 €/year
4 min/h	400 h (6.7 %)	18,000 €/year
6 min/h	600 h (10 %)	27,000 €/year

Figure 4: Example calculation for avoiding machine downtimes due to chip breaking

Another essential advantage of VibroCut *oscillate* is the increase in process reliability. In many applications, automation of the production process is not possible due to problematic chip breaking. By safely breaking chips, VibroCut *oscillate* enables automated and unmanned operation of the lathe. Figure 5 summarizes the advantages of using oscillation-assisted turning.

Figure 5: Advantages of oscillation-assisted turning

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Further information

VibroCut *oscillate* is a patented system developed by VibroCut GmbH. We are your partner for oscillation-assisted machining, offering both innovative product solutions and comprehensive integration and service support. Our oscillation systems are available as tool holders for retrofitting new and existing machines, enabling significant process optimization through precisely controlled oscillation of the cutting edge.

Figure 6: Tool holders L-Line and T-Line

The VibroCut *oscillate* tool holder sets new standards in oscillation machining: By generating a defined movement along the feed axis, chip breaking is significantly improved, enhancing both process stability and efficiency. The system utilizes the driven tool station on the turret to generate movement, with the oscillation frequency directly programmable via spindle speed in the NC code. For specific applications, autonomous drive solutions can also be implemented. Thanks to its robust and adaptable design, VibroCut oscillate ensures optimal performance even under demanding conditions.
A unique feature of the system is its flexible drive concepts: The T-Line and L-Line offer oscillation either transverse or longitudinal to the tool axis, allowing all major turning operations – from longitudinal and face turning to grooving and even center drilling – to be enhanced with superimposed oscillation. Standardized tool holder interfaces such as VDI or BMT enable seamless integration into machines of various sizes, making it easy to upgrade both new and existing manufacturing processes with this cutting-edge technology.
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