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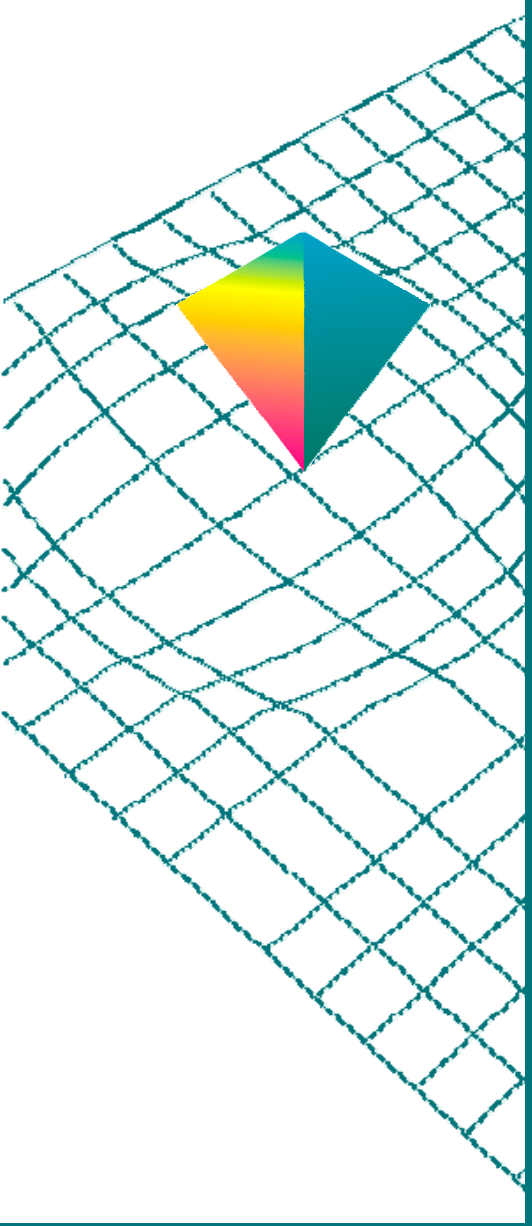

# Maschinenbau von Makro bis Nano / Mechanical Engineering from Macro to Nano

## Proceedings

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50. Internationales Wissenschaftliches Kolloquium
Technische Universität Ilmenau
19.-23. September 2005

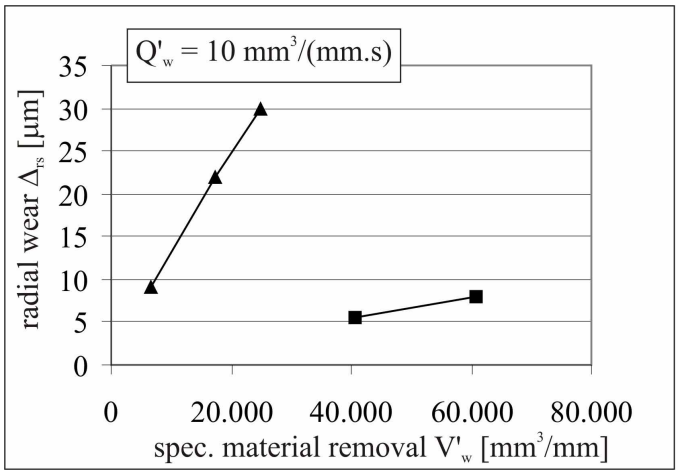
W. L. Weingaertner / E. Weingärtner

# The Influence of Oil Emulsion Application on Grinding Ductil Cast Iron with CBN Grinding Wheels

The application of high speed grinding and the utilization of CBN grinding wheels are trends in the machining universe. The grinding process is associated to high generation of heat due to plastic deformation and friction with a temperature increases proportional to the grinding speed. The produced heat during grinding process flows to the workpiece, abrasive grain, grinding wheel bond and environment. This can lead to thermal damage to the workpiece as well as to an excessive wear of the grinding wheel. In this context cooling and lubrication play a decisive role during the abrasive process. The efficiency of the cutting fluid application depends not only on coolant type and composition but also on the supply pressure and flow rate, nozzle design and the velocity of delivery at the outlet of the nozzles. In the grinding process, due to the high surface speeds of the wheel, a boundary layer of air forms around the wheel periphery. This boundary layer restricts the access of cutting fluid to the grinding zone. Conventional methods of delivering the cutting fluid do not fully penetrate this boundary layer and thus, the majority of the cutting fluid is deflected away from the grinding zone. In order to improve grinding results, it is important that the coolant is forced into the contact zone between wheel and workpiece. In this context several nozzles have been developed for different grinding applications. In the industrial practice free jet nozzles are often used for supplying the grinding fluid. To achieve a penetration of the boundary layer of air, high coolant pressure and resulting high jet velocity have to be guaranteed, but normally this is not foreseen on the industrial equipment. An efficient alternative, even for lower grinding fluid flow rates, are shoe nozzles. The use of a shoe nozzle leads to wetting of the grinding wheel directly in front of the contact zone. Furthermore the shoe nozzle works as a ”scrapper”, reducing the effects of the boundary layer of air.

In order to investigate the influence of the cutting fluid application methods on the grinding process, a free jet nozzle and a shoe nozzle were used to allow the comparison of different delivery conditions. Experiments of external cylindrical plunge grinding have been carried out. As cutting tools two types of CBN grinding wheels were used: a resin bonded and a vitrified bonded. As work

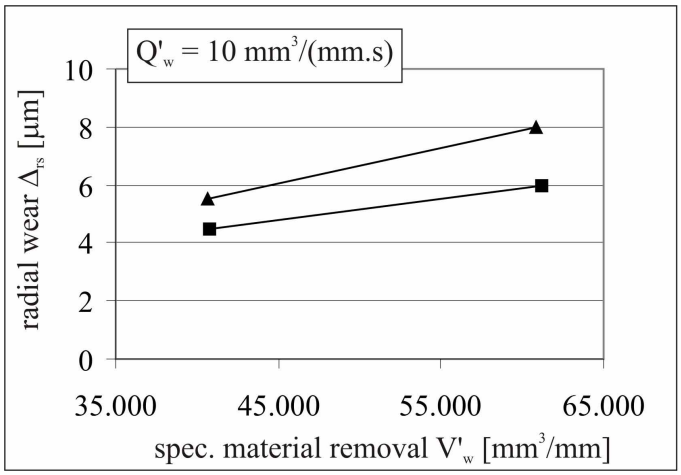
material a DIN GGG70 nodular cast iron was used in all experimental investigations. As a cutting fluid a 5% oil-in-water emulsion was used. Some results obtained in this work are illustrated in Figures 1 and 2.




Experiment parameters

| | ▲ | ■ |
|---|---|---|
| $v_s$ [m/s] | 60 | 60 |
| $P_{CL}$ [bar] | 2 | 2 |
| $Q_{CL}$ [l/min] | 48 | 30 |
| Nozzle | Free Jet | Shoe |
| G-ratio | 658 | 6.057 |

Figure 1: Reduction of the grinding wheel radial wear by using the shoe nozzle.




Experiment parameters

| | ▲ | ■ |
|---|---|---|
| $v_s$ [m/s] | 60 | 60 |
| $P_{CL}$ [bar] | 2 | 2 |
| $Q_{CL}$ [l/min] | 30 | 39 |
| Nozzle | Shoe | Shoe |
| G-ratio | 6.057 | 8.117 |

Figure 2: Reduction of the grinding wheel radial wear by increasing cutting speed.

The results showed, that in comparison to the conventional method of delivering cutting fluids with a free jet nozzle, the utilization of a shoe nozzle has lead to a lower tool wear and better workpiece quality at a even lower coolant flow rate. The best results have been obtained by employing the vitrified bonded grinding wheel at a cutting speed of 80 m/s. The advantages of the vitrified CBN grinding tool are in the structure, which is more open (higher porosity) and propitiates a more favorable condition to carry the coolant to the grinding zone.

**References:**

Weingärtner, E., 2005, Influência do Sistema de Alimentação de Fluido Lubri-refrigerante na Retificação com Rebolos de CBN, MSc. Thesis at Federal Univesity of Santa Catarina, UFSC.