COOLANT DELIVERY

FOR

SUPERABRASIVES

(CBN & DIAMOND)

Why the best grinding process
can be improved with coolant optimization
when CBN or Diamond is employed

CBN Coolant Application Requirements

Optimization of the Coolant Supply System

As higher stock removal rates, superior quality, and longer wheel life are sought, fluid application for CBN is becoming very important. The role of the coolant system is to effectively supply metal working fluid to:

1/ Minimize frictional and contact forces - reduce energy conversion.

2/ Remove heat from the work piece and wheel surface - by convection.

3/ Flush chips away from working zone - at the rate they are produced.

4/ Prevent wheel loading - clean material particles from the wheel surface.

In conventional grinding operations coolant is, for the most part, "flooded" over the wheel face and work piece surface. Although this method is acceptable, it does not transfer well to CBN applications for these reasons;
A) higher wheel peripheral speeds, **B)** greater lengths of wheel surface to part contact, due, to larger depth of cut, and **C)** the shorter grinding times involved.

The primary drawback to flood coolant is its poor penetration of the grinding zone. Experience has shown that a focused, pressurized coolant stream traveling at or above the wheel's velocity can greatly improve CBN grinding performance, in terms of Grinding Ratio (G) and process stability and energy economy.

Frictional heat will increase as wheel speeds increase. Within the speed range of 8,000 SFPM (40 m/s) to 24,000 SFPM (120 m/s) burn damage may increase or decrease depending on the type and method of application of coolant. It is therefore necessary to have a very efficient means of applying coolant to the wheel, to stabilize the contributing value of the type of coolant selected. By lubricating the zone more effectively, the specific energy generated is lowered, resulting in less heat for the fluid to take away. Production CBN grinding requires two coolant systems, one primary supply to the wheel/work piece interface, and the other to clean and cool the wheel surface.

Primary Coolant Supply

The coolant must be delivered to the grinding zone by a suitable pump, piping and nozzle. This system may need to deliver as much as 25 GPM per 1" of wheel contact width, at a minimum of 100 psi, depending on wheel speed and depth of cut per resolution. This flow can be 10 times the volume and pressure of that employed for conventional grinding. When strategically directed into the grinding zone, fluid horsepower is generated, reducing the high-friction mechanical forces present in CBN grinding operations. The nozzle must be aimed to power the fluid directly through the grinding zone, to maximize stock removal rates. Primary coolant nozzles are specially designed and positioned for specific wheel geometry, as CBN wheel diameters change little during their wear life, thus eliminating the need for constant adjustments.

Continuous High Pressure Wheel Cleaning and Cooling

For optimum CBN grinding, effective removal of chips lodged in the wheel's surface is essential, as the chip-forming process is hampered if the chip-spaces between each grit become loaded. Furthermore, wheel loading causes higher grinding forces, increased power consumption, a rougher finish, and increased wheel wear. since CBN constantly transfers heat away from the surface being ground, into the body of the wheel All these factors have adverse effects on the expected results.

The flow rate required for wheel cleaning systems is a minimum of 1 GPM per 1" of wheel contact width, at 300 to 1000 psi, depending on wheel speed. The high impact fluid is forced directly into the wheel surface radially, immediately after the wheel passes through the grinding zone. Using a flat, thin stream of coolant, the embedded material is blasted out of the porous wheel surface, and the coolant penetrates the wheel structure and cools it.

Turbulent Air Deflection

With the higher speeds involved for CBN grinding, the available fluid velocity may need an assist to penetrate and replace the turbulent layer of air traveling around the wheels peripheral surface. One solution is an air scraper, either in the form of a metal plate, or flat-fan curtain of coolant. It is positioned radially, close to the wheel surface at a location just ahead of where the fluid hits the grinding wheel. To be effective, the air scraper plate must be set as close to zero clearance from the wheel surface as possible. Once set, it may only need a weekly or monthly adjustment due to the small amount of CBN wheel wear. The fluid curtain requires sufficient pressure (+150psi) to disrupt the air layer, but can be one or two inches away from the wheel surface. Side plates in this area will intensify the performance of the air scraper.

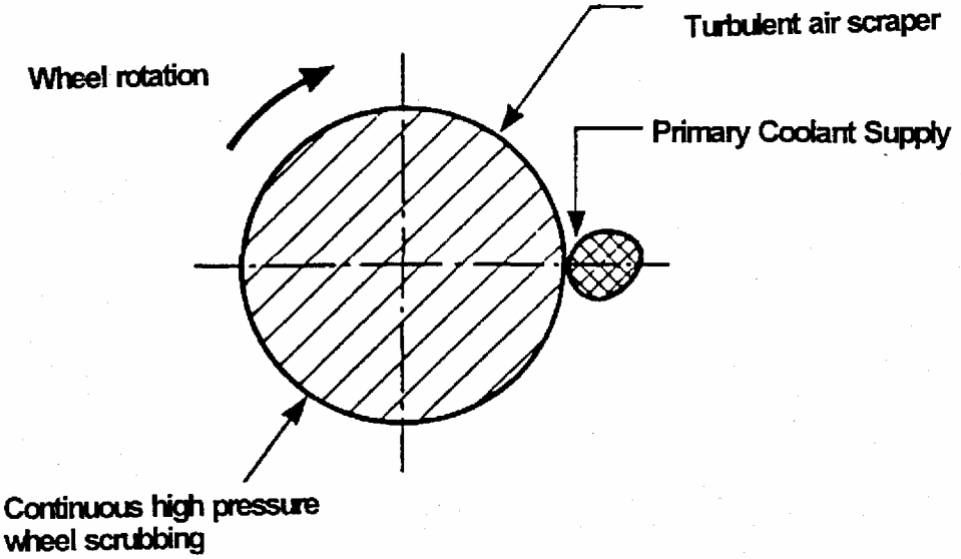

Fig 1. **Positive performance coolant application**