Flow Rate, Application and Maintenance of Metal Working Fluids

Once the choice of a coolant for the operation has been made, three related areas contribute to grinding efficiently. They are: fluid delivery, cleanliness and concentration, viscosity of the fluid, and the fluids bulk temperature. The fluid delivery system comprises of sump pump, the tank design, piping and hoses, valves and nozzles. Coolant maintenance deals with the make-up and filtration of the fluid. Bulk temperature is the operating temperature of the coolant and how well controlled that is. All of these areas govern the real value achieved from the coolant.

Fluid Flow Rated and Sump Capacities

Recommended flow rates for conventional grinding may be established using 2.5 GPM per 1 HP of wheel motor employed (1 2 L/min. per KW consumed). Based on "contact width" of the grinding wheel to the part, use a factor of 1 GPM per 0.150" of wheel contact (10 L/min. per 10mm of wheel contact), whichever method is greater.

Sump tank capacity for heat dissipation and settling time is dependent on such factors as the number of pumps used and their sizes, filtration quality, any other motors adding heat into the reservoir, the size and layout of the piping, and whether a chiller or heat exchanger is on line. Minimum size requirement of sump tanks for conventional grinding is three times the flow rate (GPM) required for intermittent work and five to six times the flow rate for continuous use. This sizing affords time to cool, filter and reduces the work stress on the fluid's components.

Keep the coolant sump full to the correct level for the greatest heat dissipation and filtration quality. Properly size and minimize the length of the fluid supply pipes to accept the full pump capacity without pressure build-up, allowing generous delivery of fluid to the coolant nozzle.

Grinding machines should have adequate splash guards or enclosures, where necessary to accept maximum fluid flow rate available. If these guards/enclosures are not practical, the operator may be encouraged to cut back the coolant flow valve, thus reducing the coolants effectiveness.

Coolant Applications

For a grinding fluid to be useful as a lubricant and coolant, it must be delivered in sufficient quantity to the grinding zone. Most conventional grinders are equipped with low pressure (flood) systems using nozzles for coolant application. To ensure maximum coverage of the wheel face/form the nozzle should be at least the same width as the wheel.

The main obstacle to overcome is ensuring that the fluid is applied to the point of contact between the grinding wheel and the part. This maximizes heat transfer and lubricity and flushes the wheel surface and surrounding areas of debris. Past methods of applying coolant remove little cutting heat until after it has dissipated into the mass of the work piece. Even fluid applied to the part in the vicinity of the grinding wheel is unable to reach the cutting zone. This is due to the grinding wheel, when rotating at 6000 SFPM or more, picks up a film of air which encloses the wheel surface and excludes the coolant. Because of this air barrier, the fluid may look like its being property applied, but it is not getting to the wheel/part interface, where it is needed the most

Aside from using higher pressures involving pump replacement, one simple solution to this problem is to break up the air film. By positioning an air baffle close to the wheel surface at a

location just ahead of the point where the fluid meets the wheel, the air baffle or scraper creates a vacuum and the coolant fills it and is then carried into the grinding zone.(See diagram Fig. 1 on next page) Another approach is to use a "shoe vessel" rather than a nozzle, which is closely fitted to the wheel peripheral surface and sides allowing the fluid to be dragged into the wheel/part interface.

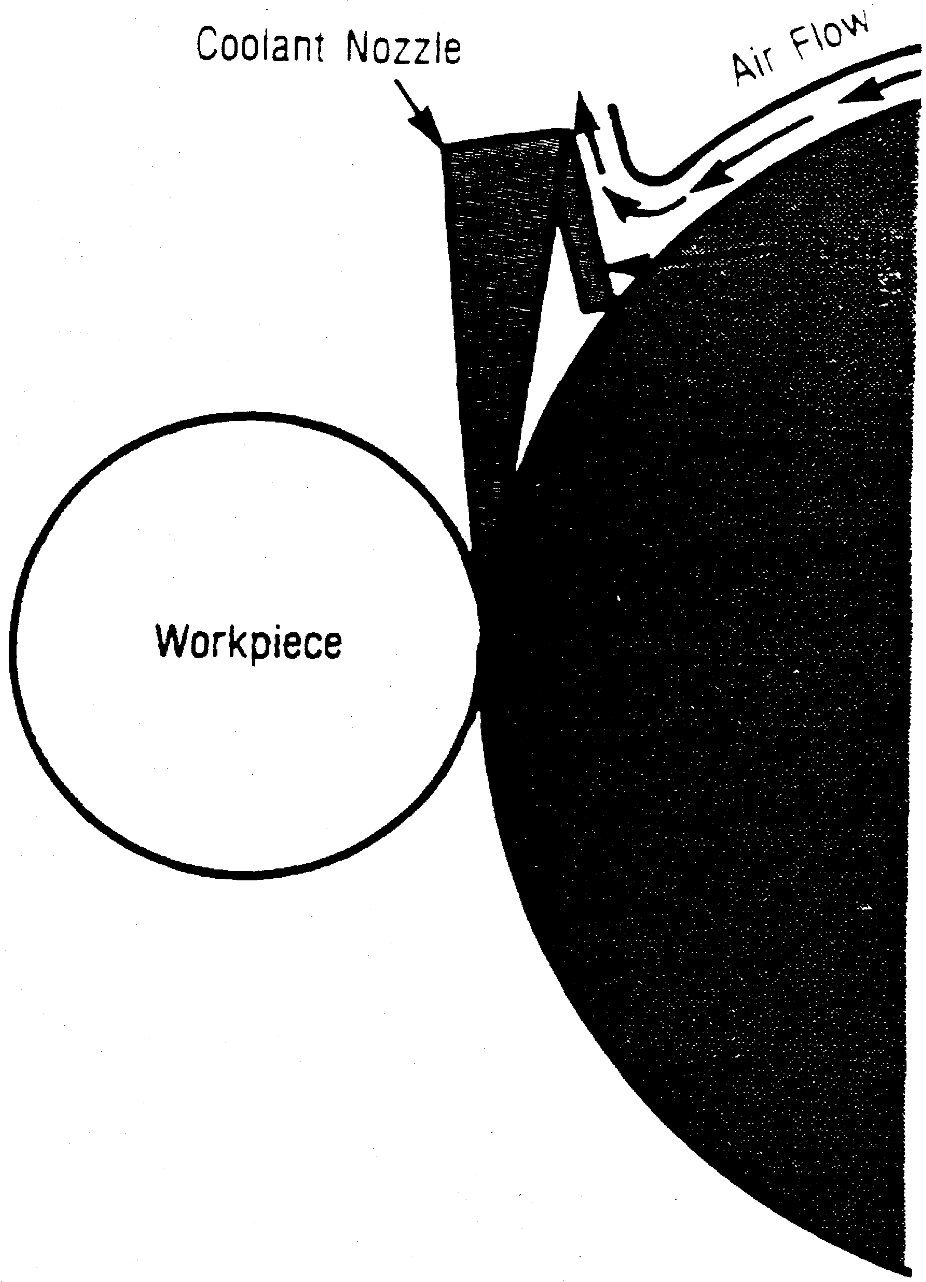

Fig.1 - An air baffle can be used to break up the air film around the grinding wheel, thus allowing a better application of coolant.

Maintenance and Recycling of Metal Working Fluids

To Maximize the value of a metal working fluid, attention to proper filtration and temperature control must be observed. The retention of hard particle manufacturing swarf (wheel bond, wheel grit, and metal chips), tramp oil, and dirt dispersed throughout the fluid in a very finely divided state, is a contradiction when posed against the tight tolerance and accuracy standards required of grinding machines. It is most often left to the machine owner to analyze and improve the elementary filtering unit provided with most production grinders.

Due to the Wide variety of operating Conditions and peculiarities of each operation, a filtration quality and bulk temperature increase study is advised. Monitoring devices are available that can check coolant concentration, flow rates, pump pressure, temperature and particulate counts. A daily coolant report of this information Will quickly show trends that Will help spot trouble before it happens and point out the weaknesses of your coolant system.

Proven filtration equipment available for grinding includes; simple gravity settling tanks, with drag out conveyors, magnetic separators/filters, centrifuges or hydrocyclones, gravity or vacuum media band filters, and bag or cartridge filters. Filtration systems should be sized to handle a flow rate of 30% greater than the maximum nozzle flow rate. Any one of these types of filter may be combined with another to facilitate a “rock catcher/polishing filter” arrangement, securing a filtering efficiency of better than 120 micron absolute.

Recycling of the coolant can be done at the machine site or at a central in-plant unit, or transferred to a processing company’s facility. The procedure usually includes straining, tramp oil removal, finish filtration, and fluid concentration make-up.

Importance of Filtration of Metal Working Fluids

1/ Surface finishes are maintained Within tolerances - no damage from returning grind swarf.

2/ Reduction in part scrap - from stable coolant quality.

3/ Increase production rates - no need for shut-down to clean or reset machine.

4/ increase coolant life - reduction in disposal costs.

5/ Removal of major breeding site for microbial growth - source of skin rash eliminated.

6/ Machine surfaces remain clean - less wear compensation required.

7/ Parts per dress increase - lower grinding @ and dresser costs.

Temperature Control

The power generated in the grinding zone can be in the order of a few horsepower. When used in continuous production, the coolant temperature can rise substantially. If this heat is dissipated using large sump volumes, heat exchangers or a refrigeration unit, then the production rate, part geometry and quality Will remain in control. Increased wheel and dresser life, and significant extension of the service life and quality of the coolant Will also occur. During continuous grinding operations, a maximum of 40°F bulk coolant temperature rise is advised, to prevent unstable and nonproductive fluid breakdown, For precise grinding operations, the coolant should be held to one or two degrees below ambient air temperature, to overcome thermal expansion.