A Review of Optimization of Fluid Flow Through Grinding Zone

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***Abstract-* High temperatures in grinding can causes thermal damage to the work piece. This paper addresses the quantity of fluid required for grinding and overview of quantitative method of to calculate the grinding temperature and energy partition to the work piece. A parameter that often use the assessment of cooling efficiency in the amount of fluid flows through the grinding zone.it is observed that ample of fluid travel through grinding zone. Waste occurs because supply flow fails to become useful flow reaches inside the grinding contact. Therefore it must be necessary to obtain useful flow through the grinding zone.The increase of flow rate of coolant through the grinding zone. The grinding zone,therefore, has become extremely essential.**

Keyword : Useful flow,Grindingzone ,Cutting fluid

INTRODUCTION

Grinding fluids are used to cool the work pieces & the grinding wheels, to transport debris away from the grinding zone, and to provide lubrication contact between the wheel and the work piece often,there is either large undersupply or large over supply coolant in industrial operations. Adequate flow rate through grinding contact is needed in order to achieve high process performance at minimal cost there is therefore a need of accurate prediction. The flowrate is termed useful flow rate since a large proportion of the flowrate may bypass the grinding contact & is therefore regarded as non-useful.

Various researches found that the useful flow rate depends on nozzle position, jet speed & wheel porosity, nozzle design(11)

In 1979 ,Powell (1)developed a model for determining depth of fluid penetration into a porous wheel from a shoe nozzle. The same method could be applied for calculating useful flowrate. Radial pressure inside the shoes was the main parameter assumed toinfluence depth of penetration, since pressure forces the fluid into the pores of the wheel. Wheel speed, radius, porosity & permeability was determined by measuring pressure drop across a small stationary specimen of the grinding wheel with fluid passing through it.Depth ofpenetration is usually small, compared with wheel grain size,which means that the fluid is kept mainly on the wheel surface & does notflow deep into the porous medium

. In 1984 (2/3)Akiyama ,Assessed the presence of coolant in the grinding wheel-workpiece interface by measuring the electrical resistanceof the fluid passing through the contact zone. Heestimated fluid film thickness from a calibration curve obtained with a device simulating the gap of thecontact area.

In1992, Engineer at al,(5) found that useful flowrate for a low wheel speed of 30m/s & for a low delivery flowrate of 75m1/2 in conventional grinding is 5 to 20% of jet flow. In 1992, Guo,〔5〕analysed fluid flow through the grinding zone & it was concluded that the useful flowrate could be calculated in terms of depth of penetration, wheels width, wheel porosity and wheels peripheral velocity.This model was claimed to predict useful flowrate accurately if the depth of penetration is know.

Wbster et al,1995(6),Another problem is the air-barrier ,most commonly overcome by matching the wheel speed & the coolant jet speed. Poor nozzle design& pluming problems lead to a dispersed jet change in pipe diameter, elbows & edges also cause turbulence preventing the conditioning to a coherent jet. A shoe type nozzle is good at overcoming theseproblem with the large contact area. It creates difficulties with the small gap needed.Shoes nozzle are also considered to be too bulky for general purpose grinding.

Ebbrellet.al (2000)(7), Studied through modeling & experiments, the effects of air boundary layer on cutting fluid applications. By measuring the velocity of air boundary layer around the grinding wheels they reported a reversed airflow against the direction of rotating boundary layer. The most severe flow reversal occurs just surface. Theytherefore proposed an intermediate nozzle position for most effective cutting fluid application. This is contrary to the common method of applying fluid jet, as tangential to the grindingwheel periphery 7 parallel to the work-piece surface as possible,inanticipation that the rotating wheel will aid in driving the fluid through grinding zone.

2.CONVENTIONAL CUTTING FLUID APPLICATION

The significant parameters of the model are the wheel speed, radius, porosity & permeability compared to the grain size of the wheel, the depth of penetration is usually small. This result implies that the cutting fluid remains mainly on the surface of the wheel & does not flow deep into the pores of the wheel.(1)

3.EXPERIMENTAL SET-UP

ent where conduct an impervious aluminum disk(diameter 390mm, width 25mm and for a porous A6022VN)

Water base emulsion (hysol X, 10O% of oil) was used as a grinding fluid. Parameter considered for 0experimentare as follows

1. Wheel porosity
2. Wheel speed
3. Nozzle position
4. Nozzle design
5. Jet velocity

3.1 Wheel porosity

Achievable useful flowrate was estimated based on surface porosity. Achievable useful flow rate was estimated from

$$Q_{4}=f.h_{pores}.b.v_{s}.Ø$$

Where $h_{pores}$is mean pore depth roughly equal to mean grain size ,v_s is wheel speed,Ø the porosity is typically 0.5.It was found that actual useful flowrate is usually less than flowrate required to fill the surface pores.

3.2 Wheel speed

Useful Flow rate Varies Linearly with wheel speed. Figure 3 up to a speed exceeding jet speed. The linear portion under the best conditions represents achievable useful flowrate over the speed range. Further increase in useful flowrate requires a more porous wheel. Increasedenergy consumption(4)

Useful flow rate (%)

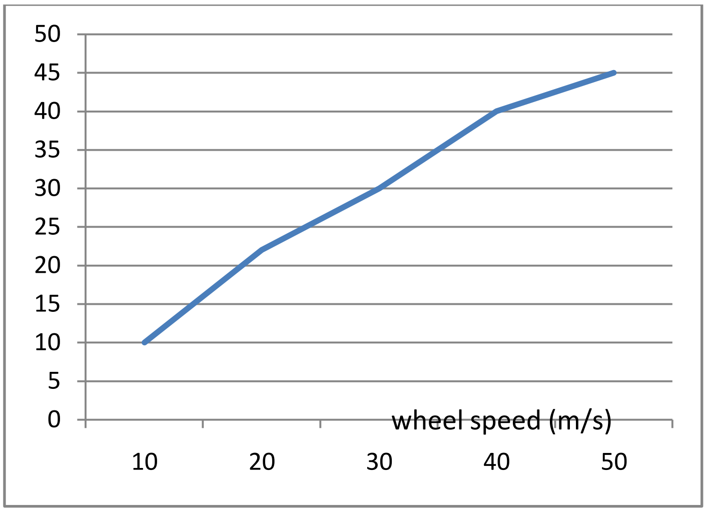
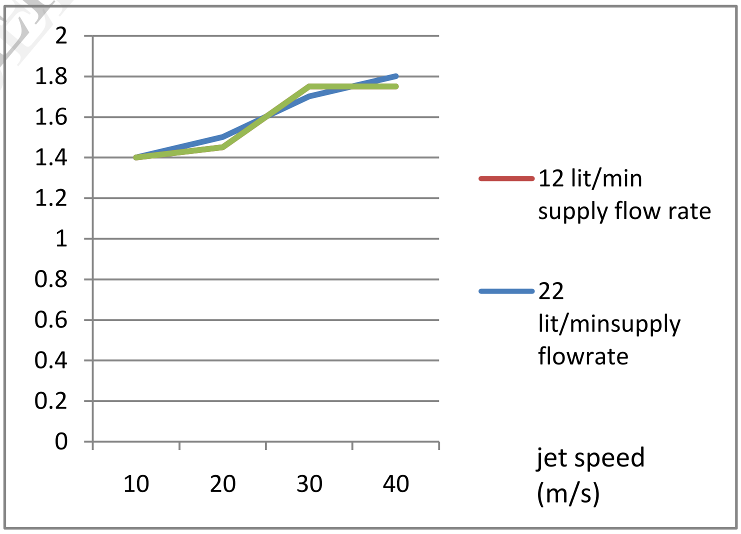


Figure no 3

Figure 4 shows that excessive jet supply flow rate reduces percent useful flow and increases rejected flow while useful flowrate slightly until wheel speed is reached.after this there is reduced benefit for the medium porosity wheel shows,maximum useful flow rate could be increased to a maximum of 50% These figure allow jet flowrate to be specified in terms of achievable useful flowrate . A suggested guideline is that

$$q_{jet}= 2.b.h_{pores}V_s$$



3.3 Effects of position and orientation of developed nozzle on effective flow rate.

In this study, location of the nozzle is varied in polar (r. Ɵ) co- ordinate at chosen values of r & Ɵ (fig.1). The angle of ipingment 'Ɵ' of the fluid jet is also varied. Effective flow rate, Q for different values of r, Ɵ, Q are than compared for finding out location & orientations of the nozzle for favorable fluid flow condition through grinding zone .Both the main and secondary fluid jets are wider than the wheel with and consequently prevent entry of air from sidewalls of the wheel in all the location & orientation of the developed nozzle.

Effect of Nozzle position on useful flow rate

nozzle position	% useful flow rate		
5 cm	23	22.5	24
10 cm	21	21.5	22.2
15 cm	19.3	20	19.9
20 cm	17.4	17.3	18.3
25 cm	14	13.5	13.75
30 cm	11	11.30	10

Grinding wheel- A6022VN
Grinding wheel speed- 1800 RPM
Feed rate- 0.05 m/s
Depth of cut- 5µm
Flow rate- 7 lit/min, 8 lit /min, 9 lit /min

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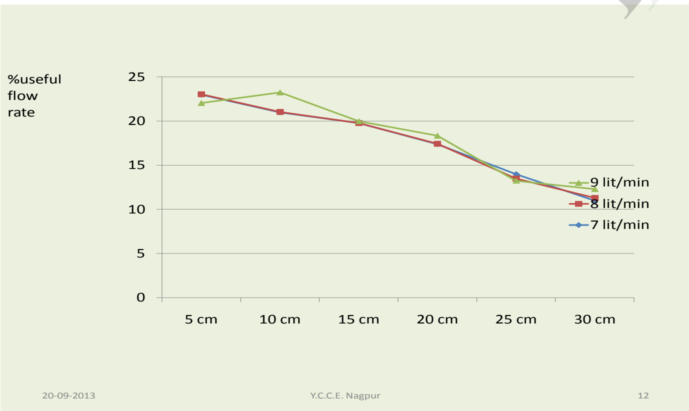

Figure no 4

3.4 Nozzle Design

There work was pooled from non grinding operations to develop the grinding operation. Using this information based Webster et al. Develop a new nozzle for grinding application. From this work on coherent jets several guidelines for their constructions and use have been put fourth. [7]

- The nozzle surface finished should be smooth and concave
- The nozzle should have sharp exit edges
- The nozzle should have a high concentration ratio from inlet to exit
- Elbows and changes plumbing diameter should be avoided
- Performance is not very sensitive to the nozzle angle as long as the flow is directed into the grinding zone
- There may be no need for profiled nozzles or since a large single round coherent nozzle or several smaller round coherent jets can be utilized. If expensive rectangular nozzles must be used, an aspect ratio of 5-8 is recommended.
- There should be low – pressure fluid flow on the back edge of the workpiece to prevent burn
- A straight pipe placed between a flow conditioner and nozzle is needed to encourage a uniform-velocity flow condition
- The lower the Reynolds number, the more coherent the jet
- With high porosity wheels, water-based fluids can have higher removal rates when compared to straight oils; however, for dense wheels, the oppositeappears to be true. Bo-Yi has also confirmed this last point for creep-feed grinding of metal with a shoe nozzle**.**

4. CONCLUSIONS

Both literature review and industrial experiment shows the need for research into new development that leads to he reduction and even complete elimination of cutting fluids in machining operation. In this work research experiences aim o improve useful flow rate through the grinding zone have been presented from the work carried out they Following conclusion may be drawn from the experimental investigation carried out a grinding wheel & review paper.

1) Nozzle should be place closer to the grinding wheel to the grinding wheel for achieving better effective flow rate through the grinding zone.

2) Maximum air layer pressure is found to occur at a distance from the centre of the wheel periphery on both the sides that may be due to penetration of air through suction effect.

3) The maximum effects of pneumatic barrier is found out at a polar angle,Ɵ=30, & swivel angle, œ= 50, at all the pneumatic barrier pressure employed.

4) Useful flow usually occupies less than the pore space at the wheel surface. Achievable useful flow can be estimate as approximately 50% of the surface pore space. High porosity wheels tend to allow higher percentage useful flowrate than low porosity wheels. The jet flow rate needs to be of the order of 4 times larger than achievable useful flowrate. Itwas confirmed that jet speed should be

approximately 80% -100% of wheel speed to match achievable useful flowrate.

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