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Procedia Engineering 150 (2016) 1073 – 1080

Procedia Engineering

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International Conference on Industrial Engineering, ICIE 2016

Ways to Enhance Environmental Flat Grinding by Improving the Technology of the Coolant Supply

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Abstract

The present article includes the analysis of coolant supplying for flat grinding with the grinding wheel face; we discuss questions, related to development of combined methods of coolant supplying. Article presents the method and theoretical justification of forming the coolant bath in the working area of the flat grinding machine. Article also includes justification of the new coolant function – recovering. This function involves grinding waste neutralizing in the cutting area, and is evaluated by limiting concentration of the harmful substances in the machine working area.

Peer-review under responsibility of the organizing committee of ICIE 2016

Keywords: surface grinding; combined coolant supply; shade coolant; capturing waste; ecological machining.

1. Introduction

The increasing environmental safety requirements force enterprises to take measures to reduce the level of harmful emissions into the environment. The main source of contamination during surface grinding of waste is the torch of the driving of the cutting area, but because of the specifics of the treatment process, hindered the effective application of traditional cleaning agents, such as traps or exhausts, so requires the use of specialized research-based technical solutions [1, 2].

Completely resolved and are still relevant issues related to the reduction of coolant loss, which is the main source of spatter and processing waste torch.

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Peer-review under responsibility of the organizing committee of ICIE 2016
doi:10.1016/j.proeng.2016.07.217

Presented in this article the technical solutions focused on design and technological modification of the existing fleet of surface grinding machines, ensuring, at the lowest cost for equipment, reducing costs and improving sustainability by improving processing techniques coolant [3-5].

Specificity of cutting fluid at abrasive processing pieces connected with the peculiarities of the structure of abrasive tools, grinding kinematics and processing modes. Particular difficulties arise on the grinding operations performed at speeds of 80 m/s or more: rotating at high angular velocity of the grinding wheel circumferential creates strong and face the air flow, preventing access of coolant into the treatment zone [6-9].

2. Features of aerodynamic processes in the work area for surface grinding machines.

On the amount of coolant passing through the cutting zone, wear and clogging of the grinding wheel, the temperature in the cutting area, and hence on the quality of the surface layer of the workpiece and its structure greatly affect aerohydrodynamic phenomena accompanying the polishing process [10, 11, 12, 13].

In Prioksky State University conducted a study which purpose was to study the wind conditions in the work area for surface grinding machines, for which the receiving space is bounded in the vertical plane of the protective casing of the parties, and in the horizontal plane - the machine table and the edge of the casing.

The study was conducted on the machine 3E711VF1 (analogue HFS E 50100 VC) with the terms of 250x32x76 38A60KVBE at a cutting speed of 35 m/s. The study was conducted with the use of differential pressure MP 200 and Pitot tube.

In conducting studies revealed three characteristic planes in which air flows are formed intense: table plane (A), the edge of the casing (C) and a plane passing through the machined surface of the workpiece (B) (Fig. 1.).

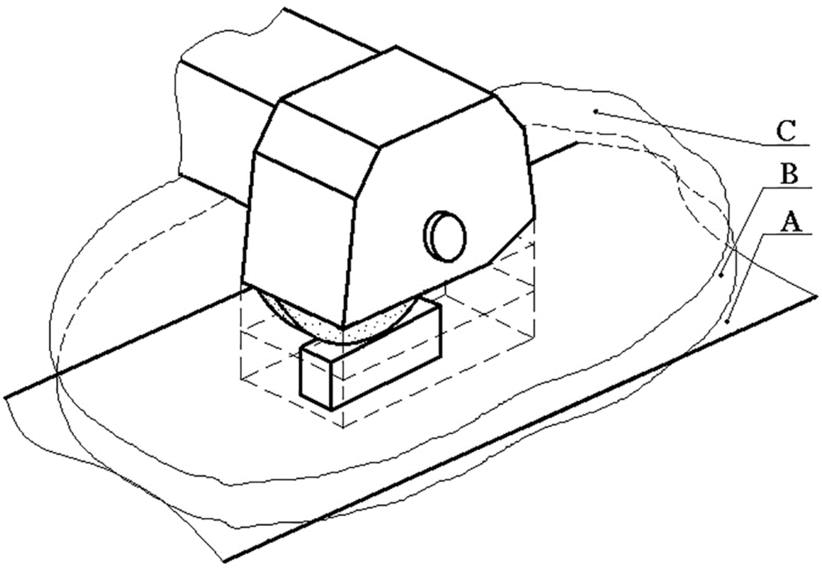

Fig. 1. General view of the test space

It is established that when the outlet air streams from the housing is formed **centre of boost**. The essence of this phenomenon consists in the fact that the direction of air flow in the plane A coincides with the direction of the rays emanating from the centre of pressurization. It is on the end of the projection range, at a distance of 10-15 mm from the peripheral surface of the projection range (Fig. 2).

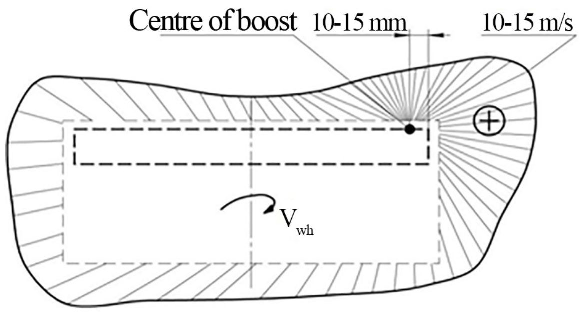

Fig. 2. The movement in the plane of the air streams A

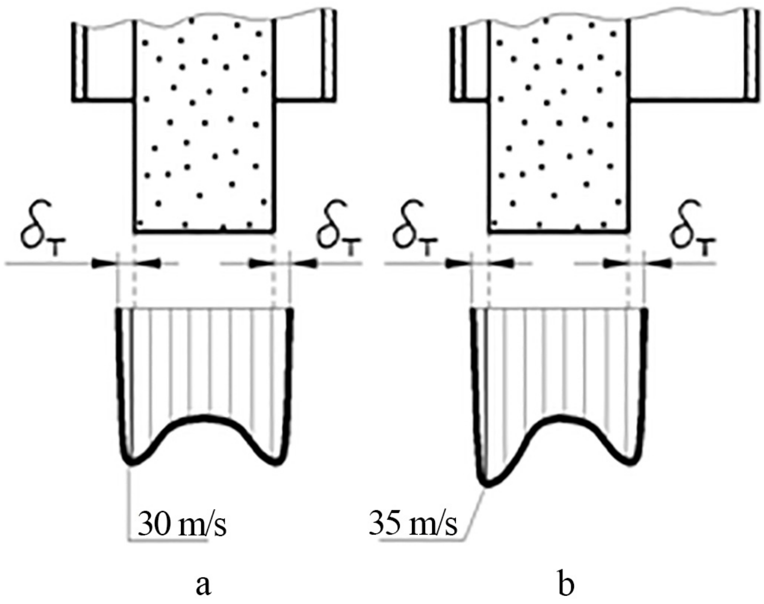

Fig. 3. Diagrams the velocities of air streams: (A) sharpener; (B) grinding machine

Formation of centre of boost is due to the design of the protective casing of the machine. It is known that in the range of its end faces capturing same air volume, the air flow creates mechanical δ_T thick. Known law of distribution of velocities of airflows in the periphery of the circle grinding machine (Fig. 3, a), at the surface grinding machines, due to the mechanical displacement of the abrasive wheel relative to the housing, the rate curve changes (Fig. 3, b). By housing the air flows in a small laminar gap move and reach the speed range. Therefore, when you exit out of the shell, these flows, having a maximum speed to dominate the motion along a plane A.

Due to the high flow velocity in part is reflected from the boost zone of the table surface (Fig. 4). Along the treated surface of the workpiece airflows moving the cutting zone is at an angle of 10-15° to the laminar range speeds up to 10 m/s, depending on the distance from the abrasive wheel. It is found that in the wide portion of the wedge formed by the workpiece and the grinding wheel, the turbulent motion is air, and the closer to the narrowest part of the wedge gets directed laminar flow.

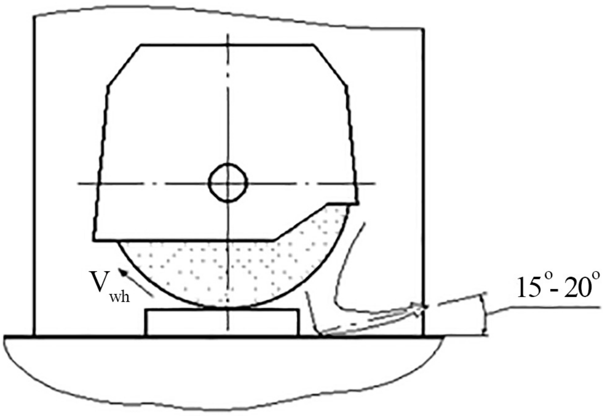

Fig. 4. Reflection of air flow

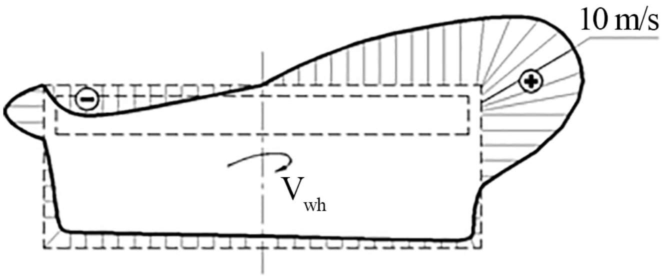

Fig. 5. The diagram of the air flow rate in the plane C

The diagram of the direction and velocity of air flow in the plane C shown in Figure 5. It is of interest in the presence of an excess-pressure zone for the air suction hood. This is a small gap between the abrasive wheel and protective cover. Thus, based on these results, we can make the following conclusions:

1. For flat grinding the periphery of the circle in the plane of the table formed by the boost facility, determining the direction of air flow in the desktop machine plane.
2. Mechanical displacement of the grinding wheel with respect to the enclosure causes a change in the diagrams of aerodynamic pressure on the periphery of the circle.
3. At the boundary of the casing in the zone of discharge there is excessive pressure zone, leading to countercurrent air flow and blowing them out of the casing.
4. Knowledge of the wind conditions in the work area allows you to choose the design of nozzles for coolant.

Theoretical and experimental studies of wind conditions around the cutting zone of grinding and grinding machines served as the basis for creating a barrier method of coolant. The essence of this method lies in the fact that the coolant-lubricant is supplied in the form of one or more water curtains of continuous work area at some distance from it.

The processing of grinding waste (swarf and abrasive particles), the moving is directed from the cutting zone (Fig. 6), meeting and interacting with a liquid curtain, lose kinetic energy of translational movement and are washed away in a cleaning system of the machine (Fig. 7). The result is significantly improved environmental treatment.

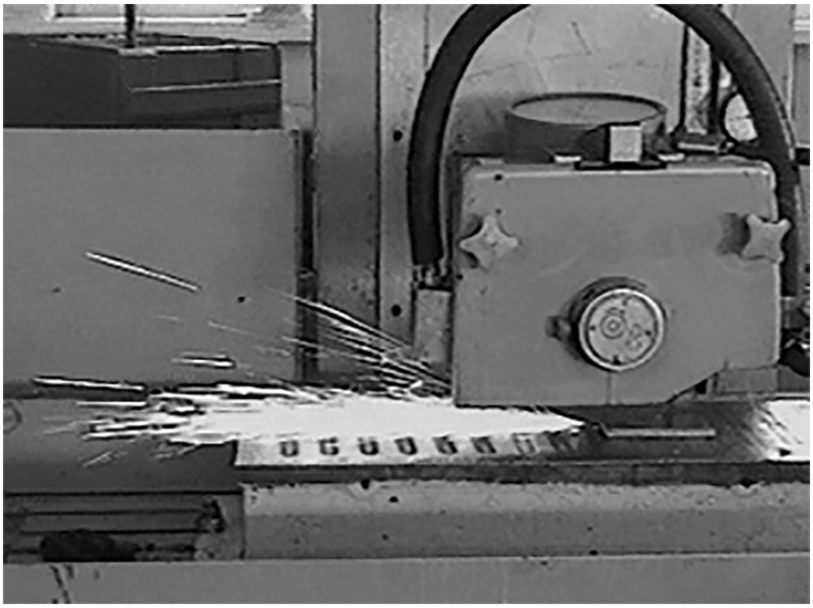

Fig. 6. Directional flow of slurry (Torch), formed by flat grinding

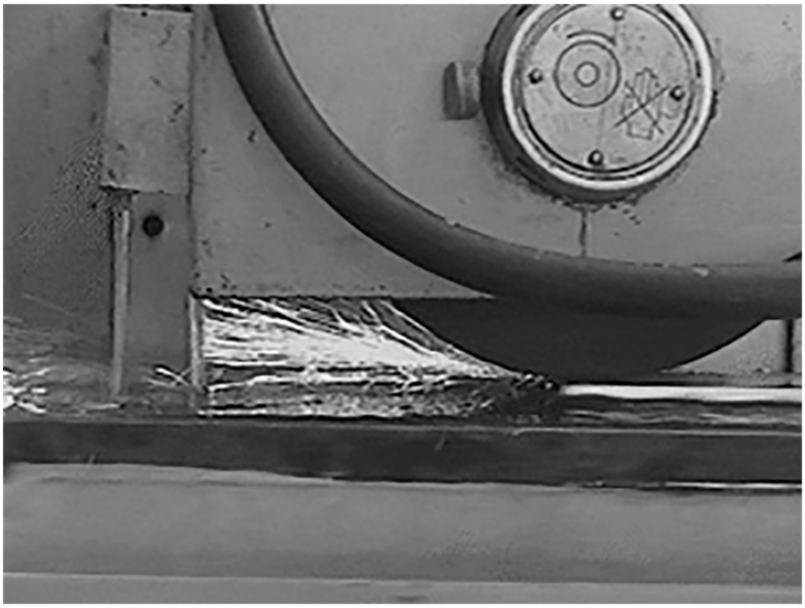

Fig. 7. Sludge stream capture curtain coolant

With this method of feeding coolant is not fully perform its lubricating and cooling function, so it is necessary to use this method in combination with others. The construction method of implementing defensive coolant is shown in Figure 8.

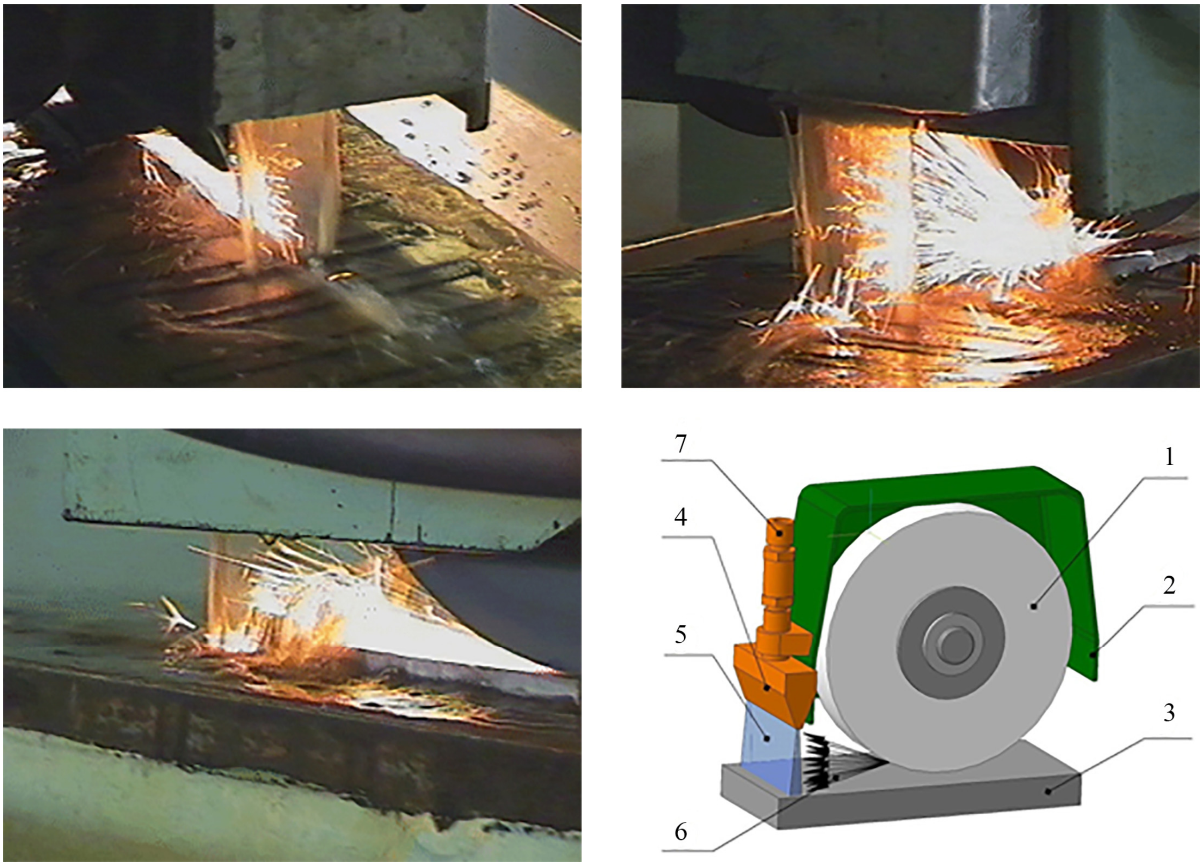

Fig. 8. Device for the barrier method coolant supply

Capture grinding torch is achieved through the vertical nozzle arrangement for supplying coolant for machining area so that the path of the torch creates a barrage curtain of liquid. When grinding parts 3 Circle 1 of the treatment zone is heading torch grinding 6. On line 7 the coolant supply system of the machine, through the valve and connecting pipe, the liquid is fed into the slot nozzle 4. The jet coolant 5 from the nozzle 4 of the processing area catches the torch grinding 6. waste liquid is given by regular cleaning of the drainage system of the machine. Elements of the coolant supply system mounted on the body guard 2. The device allows you to modify the terms of the expiration of the coolant from the and the fluid pressure δ nozzle 4 by changing the thickness of the jet in the system P.

Torch grinding moving from the cutting zone consists of the abrasive wheel material, workpiece material and variably dispersed spray coolant. The main difficulty for trapping metal are grinding wastes, whose characteristics (size and particle velocity) change largely under the influence of technological factors (grain diameter and the longitudinal feed speed of the grinding wheel, removes the allowance value) and the fabric. To effectively capture the torch needs to be determined parameters barrage curtains of coolant: the width and thickness of the liquid jet, the velocity of its flow, as shown in Fig. 9, 10.

To determine the ecological barrier method of coolant supply at flat grinding wheel periphery (capture sander dust, waste plume, as well as spray and coolant vapor) was held metering limit permissible concentration of harmful substances in the working area of the machine operator, with different methods of coolant supply by means of a universal analyzer "GANK 4C". The concentration of hazardous substances in the work area of the machine operator was not less than 20% less than the permissible concentration limit.

Based on the submitted barrier method coolant supply may talk about the allocation of new functional properties of cutting fluids - trapping, which is to reduce the maximum concentration of harmful substances in the work of the machine operator area by neutralizing the torch grinding waste of individual particles of sludge and fine vapor process fluid from the cutting zone by their physical interaction with the coolant [14-17].

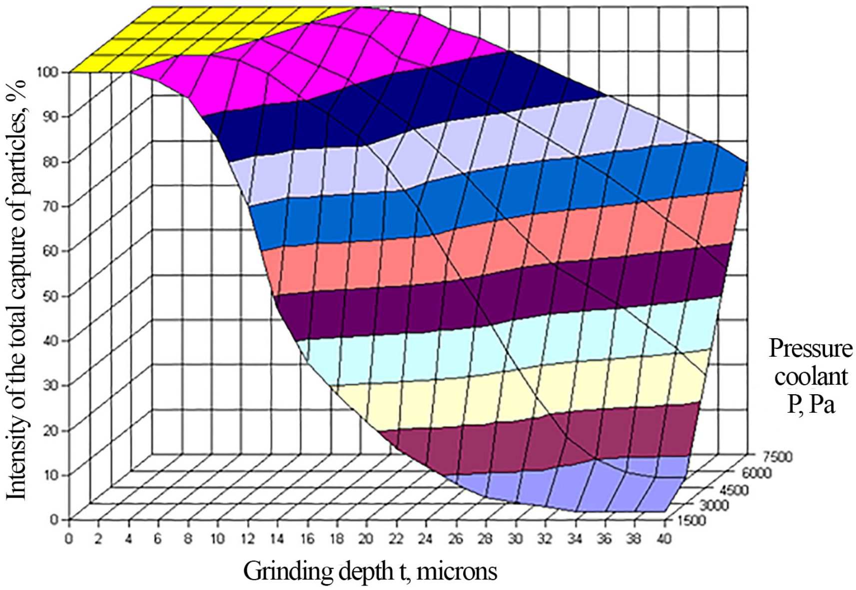

Fig. 9. Effect of grinding depth and pressure of coolant supply in the intensity of the total capture of particles of grinding waste (nozzle sectional thickness δ=1 mm)

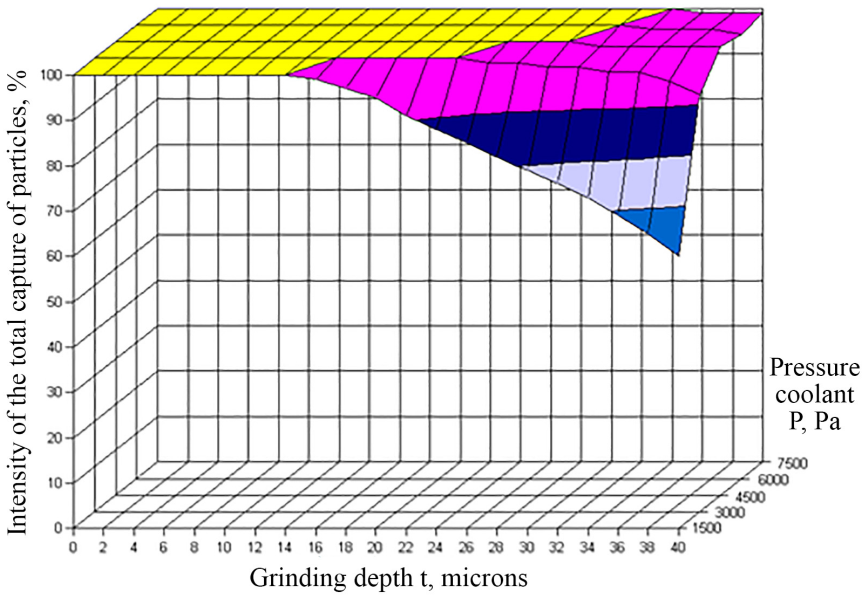

Fig. 10. Effect of grinding depth and pressure coolant to capture particles of grinding sludge waste plume (the thickness of the nozzle δ=3 mm)

Obstruction method inert coolant to the material: metal or nonmetal nonmagnetic or magnetic material, as well as the type and composition of the abrasive wheel ligament. Analysis coolant barrier method (Fig. 9, 10) shows that its effectiveness, depending on the technological implementation modes may be up to 100%. This method of coolant can be implemented alone or combined with other methods of coolant [18-21].

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