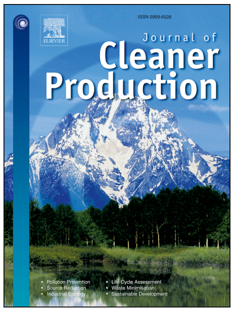
Accepted Manuscript



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PII: S0959-6526(17)32352-1

DOI: 10.1016/j.jclepro.2017.10.059

Reference: JCLP 10851

To appear in: *Journal of Cleaner Production*

Received Date: 7 March 2017

Revised Date: 5 October 2017

Accepted Date: 6 October 2017

Please cite this article as: Stachurski W, Sawicki J, Wójcik R, Nadolny K, Influence of application of hybrid MQL-CCA method of applying coolant during hob cutter sharpening on cutting blade surface condition, *Journal of Cleaner Production* (2017), doi: 10.1016/j.jclepro.2017.10.059.

Amount of words: 13 495

Influence of application of hybrid MQL-CCA method of applying coolant during hob cutter sharpening on cutting blade surface condition

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Abstract

Abrasive machining processes are aimed at the complete removal of the coolant which is designed mainly to cool and lubricate the machining zone. This results from economic reasons, which require a decrease in the general production costs, as well as environmental reasons and the necessity to adjust production processes to ever-stricter environmental protection regulations. Complete coolant elimination is difficult to achieve in grinding processes. The heat and high temperature that appear in the area of contact between the tool and the workpiece cause an unacceptable deterioration of the quality of the machined surfaces. The research presented here concerns the determination of the influence of the application of the MQL-CCA hybrid method that decreases the amount of the coolant applied during sharpening of the hob cutters on the condition of the cutting blades' surface layer. The MQL-CCA method consists of the simultaneous introduction into the grinding area of both a minimal amount of the lubricating agent using the minimum quantity lubrication (MQL) method and the coolant in the form of compressed cooled air (CCA). For comparison, the tests were also carried out by applying the coolant with the flood method (WET) and with MQL, as well as by providing CCA. The research results show that (in the described range of changes in grinding parameters) solely applying the MQL-CCA method does not cause considerable changes in surface layer microhardness as compared to "wet" processing. The differences in microhardness values (on the Vickers' scale – HV) obtained closest to the grinding surface are 3-5 units. At the same time, for both of the applied grinding depths (0.01 and 0.03 mm) changes in microhardness were observed up to approximately 40 µm from the cutter dressing surface. In the case of the MQL and CCA methods being applied separately, the drop in microhardness was observed up to approximately 60-70 µm from the grinding surface, while microhardness at a depth of 10 µm was smaller by approximately 70-100HV for each grinding depth. Moreover, the surface roughness obtained when using the MQL-CCA method is comparable to that obtained during grinding with the flood method. For a grinding depth of 0.01 mm, the difference in the *Rz* parameter values is 4.6%, while for a grinding depth of 0.03 mm it was only 2.5%. In the case of applying the MQL method, the obtained surface roughness with a grinding depth 0.01 mm is approximately 30% larger in relation to WET and approximately 47 % larger for a grinding depth of 0.03 mm. As far as the CCA method is concerned, the roughness is approximately 135% greater as compared to WET for both grinding depths. The SEM images for the MQL-CCA and WET method did not reveal any typical defects in the form of feather edges or chips on the edges of the ground surfaces. Simultaneously, burrs occurred on edges that were ground using minimal lubrication with the