Study of Nozzle Distance and Oil Flow Rate Effects on the Droplets Size of Minimum Quantity Lubrication

Kelvin Leong Jiun Kiat 1, Nur Izzati Khoirunnisa Ismail 1, Nurrina Rosli 1*, Erny Afiza Alias 1

1 Faculty of Mechanical & Manufacturing Engineering, Universiti Malaysia Pahang, 26600 Pekan, Pahang
*nurrinarosli@ump.edu.my

Abstract:
Minimum Quantity Lubrication (MQL) machining process has been widely applied to replace the traditional lubrication and cooling method that brings various drawbacks involving environment, human's health and manufacturing cost. Although the amount of oil being used in the MQL machining process is extremely little, oil mist formed in the cutting zone still can successfully prolong the cutting tool life and improve the surface quality of workpiece. However, the size of lubricant oil droplets must be fundamentally investigated to clarify the lubricating mechanism in the cutting zone. This paper is aimed to study the droplets size of lubricant oil delivered by a commercial MQL generator. Experiments were conducted to study the effects of vertical nozzle distance and lubricant oil flow rate to the droplets count and size. As a result, the smallest diameter of droplets were found to range in between 10 µm – 22 µm. With increasing vertical nozzle distance, the diameter became larger due to the increasing dominancy of air flow that influences the movement of droplets. With increasing oil flow rate, the droplets tend to merge together, forming multiple larger size of droplets. The size of lubricant oil droplets did not significantly change when varying the vertical nozzle distance starting from 35 mm and oil flow rate starting from 18 mL/h. Finally, the control dial to adjust oil flow rate when using an MQL generator with internal feeding system application must be handled properly to ensure precise amount of oil mist successfully being delivered to the cutting zone.

Keywords: Minimum Quantity Lubrication (MQL); Oil flow rate; Vertical nozzle distance; Oil droplets size; Number of droplets

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