Robert Beckenlechner et al., J Material Sci Eng 2017, 6:1 (Suppl)
http://dx.doi.org/10.4172/2169-0022.C1.058

7th Annual Congress on
Materials Research and Technology
February 20-21, 2017 Berlin, Germany

Graphite based minimum quantity dry lubrication at drilling CFRP

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The machining of carbon fiber reinforced plastic (CFRP) causes high tool wear and thus induced costs. One approach is to use liquid cooling lubricants e.g., Minimum Quantity Lubrication (MQL), as known from metal cutting. Due to the unlimited types of CFRP and cooling lubricants, chemical interactions between them cannot be excluded. The humidity of cooling lubricants can also affect the mechanical properties of the CRFP, like a softening of the matrix. An additional consequence can be a reduced fiber-matrix-adhesion which results in lower fracture toughness. Therefore, this article presents a new MQL technology, which is completely dry. For this purpose, a prototypical fluidization device was constructed. It boosts minimal amounts of graphite powder by using compressed air to the cutting zone between the tool and work piece. Graphite was selected as dry lubricant because of three reasons: First, graphite can be used as a dry lubricant; second, the contamination by graphite powder is not relevant as the dust and chips from the cutting process are extracted by exhaustion anywhere and; third, chemical interactions between the carbon fibers and graphite are not to be expected. By spraying tests with internally cooled drills, it was shown that the current fluidization device is already able to deliver graphite mass flows less than 3 g/h reliably. First drilling tests with internal MQDL-supply have shown a significant reduction in tool wear, compared with cooling by pure compressed air. Finally, a H_2O-enrichment device was constructed to extend the fluidization prototype. The aim is to include foreign molecules in the lattice structure of the graphite by using H_2O-molecules. As described in literature, the sliding characteristics of graphite are improved by these additional molecules. The H_2O-enrichment device is able to achieve almost a 90% relative humidity of the compressed air that is used to transport the graphite.

Biography

Robert Beckenlechner has studied Mechanical Engineering at University of Aalen. He has been working as a Research Fellow in Department for Lightweight Construction Technologies in cooperation with Institute for Machine Tools at University of Stuttgart since 2014. He is investigating new cooling and lubricating technologies for the machining of lightweight materials, especially for fiber reinforced plastics.

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