Performance Testing of Cutting Fluids

The importance of cutting fluid performance testing has increased with documentation requirements of new cutting fluid formulations based on more sustainable products, as well as cutting with minimum quantity of lubrication and dry cutting. Two sub-problems have to be solved: i) which machining tests feature repeatability, reproducibility and sensitivity to cutting fluids, and ii) to what extent results of one test ensure relevance to a wider set of machining situations. The present work is aimed at assessing the range of validity of the different testing methods, investigating correlation within the whole range of operations, materials, cutting fluids, operating conditions, etc. Cutting fluid performance was evaluated in turning, drilling, reaming and tapping, and with respect to tool life, cutting forces, chip formation and product quality (dimensional accuracy and surface integrity). A number of different work materials were considered, with emphasis on austenitic stainless steel. Cutting fluids from two main groups were investigated, water miscible (reviewed from previous work) and straight oils. Results show that correlation of cutting fluid performance in different operations exists within the same group of cutting fluids, for stainless steel. A possible rationalisation of cutting fluid performance tests is suggested. In order to select a set of basic tests and optimise them for use as general and standardised testing methods, an original approach to the evaluation of cutting force and tool life uncertainty is proposed.