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Wear maps: their developments and applications

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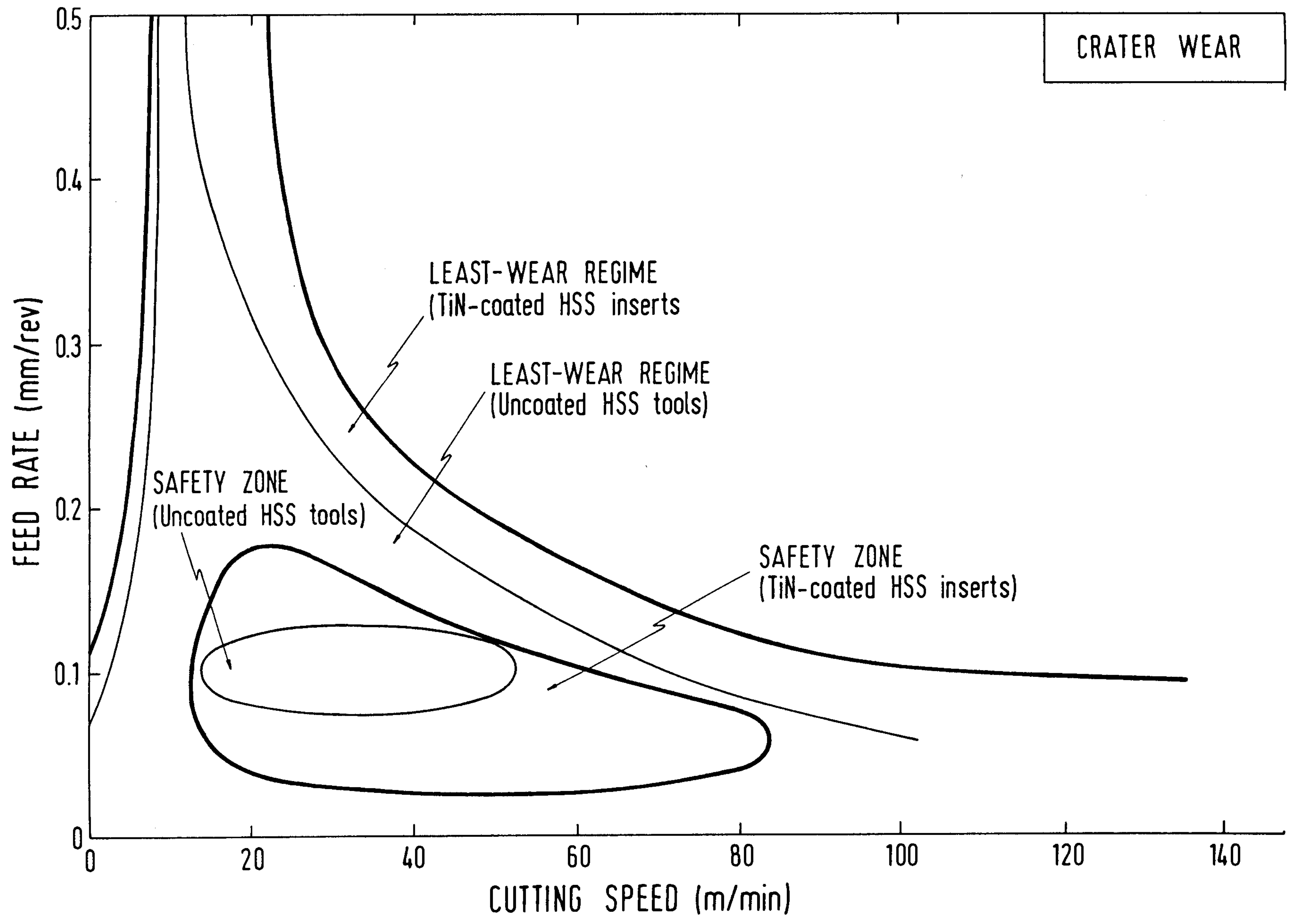
Abstract

Wear maps have now been generally accepted as a meaningful way of presenting wear data. These maps, which present wear data in a graphical manner, are able to provide a global picture of how materials in relative motion behave under different sliding (or operating) conditions; they also relate the various dominant mechanisms of wear observed to occur under different conditions and provide the anticipated rates of wear. With the ability to provide information on the sliding conditions under which a mild form of wear will take place as well as when a transition to severe wear is likely to take place, wear maps can be useful to designers when they have to make optimal decisions in the design and materials selection of tribological contacts. Wear maps are similar to phase diagrams in that their construction is generally a very time-consuming process. Apart from requiring a considerable amount of test data, appropriately calibrated wear models are needed to predict wear behaviour and the expected wear rates in conditions where no wear data is available. This has led to the paucity of wear maps in the technical literature.

In this presentation, the development of wear maps, the associated wear-mapping methodology and some recently published wear maps will be introduced. Particular reference will be made to mapping the wear of both coated and uncoated tools during single-point dry turning operations. These maps are able to assist in the optimisation of machining conditions so that the required rate of materials removal could be attained with an acceptable level of tool wear. When the maps for coated and uncoated tools are suitably combined (an example of such a combined map for high-speed-steel (HSS) tools is given in Fig. 1), it provides information which can assist in the selection of machining conditions so that these coated inserts can be used cost effectively. When machining conditions are inappropriately selected, the benefit imparted by the wear-resistant coatings deposited onto tool inserts can be significanly reduced.

Fig. 1 A combined map for the crater wear of TiN-coated and uncoated high-speed-steel (HSS) tools during single-point dry turning operations.


CRATER WEAR
LEAST-WEAR REGIME
(TiN-coated HSS inserts
LEAST-WEAR REGIME
(Uncoated HSS tools)
SAFETY ZONE
(Uncoated HSS tools)
SAFETY ZONE
(TiN-coated HSS inserts)
FEED RATE (mm/rev)
0
0.1
0.2
0.3
0.4
0.5
CUTTING SPEED (m/min)
0
20
40
60
80
100
120
140