Influence of cutting edge microgeometry on the cutting forces and surface roughness of machining difficult-to-cut materials

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The paper presents research investigating the influence of cutting tool microgeometry on cutting forces and machined surface roughness when milling the difficult-to-cut nickel alloy Inconel 718. Cemented carbide tools with different cutting edge rounding sizes (5, 8, 15, 30, and 45 μm) were tested under defined cutting conditions for both roughing and finishing operations. Cutting forces were measured in-process using a piezoelectric dynamometer, while machined surface roughness parameters (Ra, Rq, Rz) were evaluated after machining using a contact profilometer. Previous research into cutting edge microgeometry suggests that modifying the cutting edge of milling tools can substantially extend effective tool life, reduce cutting forces during the process, and ensure higher quality of the machined surface.

The results showed that the smallest cutting edge rounding (5 μm) led to lower initial cutting forces but faster wear progression. The larger roundings (15, 30, and 45 μm) reduced the wear rate but increased cutting forces and worsened surface roughness. An optimal balance between tool life, cutting forces, and surface quality was achieved with the 8 μm rounding.

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