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Analysis of corrosion resistance when turning martensitic stainless steel X20Cr13 under chilled air-cooling

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ABSTRACT

Amongst different methods of cooling in machining, application of air is considered to be the cleanest and most environmentally friendly one. The aim of this paper was to explore the possibility of chilled air-cooling considering the corrosion resistance when turning martensitic stainless steel X20Cr13. Thus, a comparison between an alternative cooling technique where compressed air is refrigerated and jetted to the cutting zone by means of Ranque-Hilsch counter-flow vortex tube and the conventional flood cooling with oil-in-water emulsion was done. The corrosion resistance was determined by electrochemical testing and the surface condition was analysed with both Scanning Electron Microscopy (SEM) and Energy Dispersive X-ray Spectroscopy (EDS). From the results presented herein, it can be concluded that the specimen cooled with chilled air has better resistance to corrosion activity after a certain longer time in relation to the specimen cooled with emulsion. In addition, the specimen cooled with chilled air has lower surface roughness, which has a positive effect on the corrosion resistance. Hence, in the scope of environmentally friendly machining the vortex tube based chilled air-cooling can be successfully applied when turning difficult-to-cut martensitic stainless steel.

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Izvirni znanstveni članek

Analiza korozijske obstojnosti martenzitnega nerjavnega jekla X20Cr13 pri struženju, hlajenim z ohlajenim zrakom

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POVZETEK

Pri strojnih obdelavah je uporaba zraka najčistejši in okolju najbolj prijazen način hlajenja. Namen prispevka je raziskati vpliv hlajenja z ohlajenim zrakom na korozijsko obstojnost pri struženju martenzitnega jekla X20Cr13. Izvedena je primerjava med hlajenjem s komprimiranim zrakom, ki se ohlajen vpihava na rezalno mesto skozi vrtinčno cev Ranque-Hilsch in konvencionalnim hlajenjem s curkom emulzije olja v vodi. Korozijska obstojnost je bila ugotovljena z elektrokemičnim testiranjem, kakovost površine pa z elektronskim mikroskopom (angl. SEM) in energijsko disperzijsko rentgensko spektroskopijo (angl. EDS). Iz rezultatov je razvidno, da je vzorec hlajen z zrakom po daljšem časovnem obdobju bolj odporen na korozijo v primerjavi z vzorcem hlajenim z emulzijo. Dodatno ima vzorec hlajen z zrakom nižjo površinsko hrapavost, kar ima pozitiven učinek na korozijsko obstojnost. Zaključimo lahko, da je v skladu z okolju prijazno strojno obdelavo, pri struženju problematičnega nerjavnega martenzitnega jekla mogoče uspešno uporabiti hlajenje z vpihavanjem zraka skozi vrtinčno cev.

PODATKI O ČLANKU

Ključne besede:
Struženje
Nerjavno jeklo X20Cr13
Korozijska obstojnost
Hlajenje z ohlajenim zrakom
Vrtinčna cev

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