5TH WORKSHOP ON SURFACE ENGINEERING

THE QUALITY OF THE 5251 ALUMINIUM ALLOY'S SURFACE AFTER ABRASIVE WATERJET CUTTING PROCESS

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SUMMARY

The authors carried out an analysis of the influence of the cutting head traverse speed on the flatness, waviness and roughness of surfaces made of aluminium alloy 5251 after cutting process, as well as the influence of changing the quality factor on values of selected descriptors of the emitted high-frequency acoustic emission signal.

INTRODUCTION

The influence of machining conditions on the geometric structure of the obtained cuts can be accurately determined by the use of the acoustic emission signal analysis [1—3]. Additionally, statistical dependence models developed between the given process quality indicator and the registered selected acoustic emission signal parameters in the frequency domain allowed for the prediction of the surface texture of the obtained cuts on the basis of the acoustic emission signal emitted during the machining process.

DISCUSION OF RESULS

Analysis of shows that increasing the traverse speed during cutting of aluminium alloy 5251 caused an increase in the irregularities occurring on the cut surface, both in terms of roughness and waviness (**Fig. 1**).

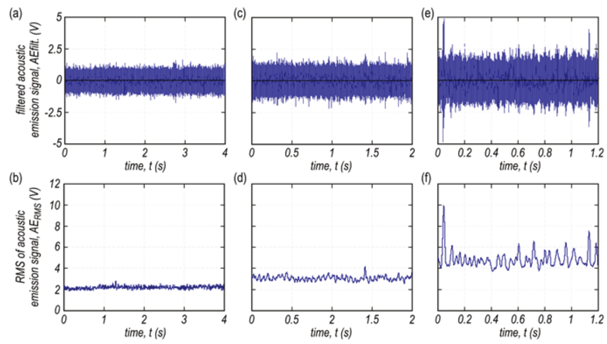
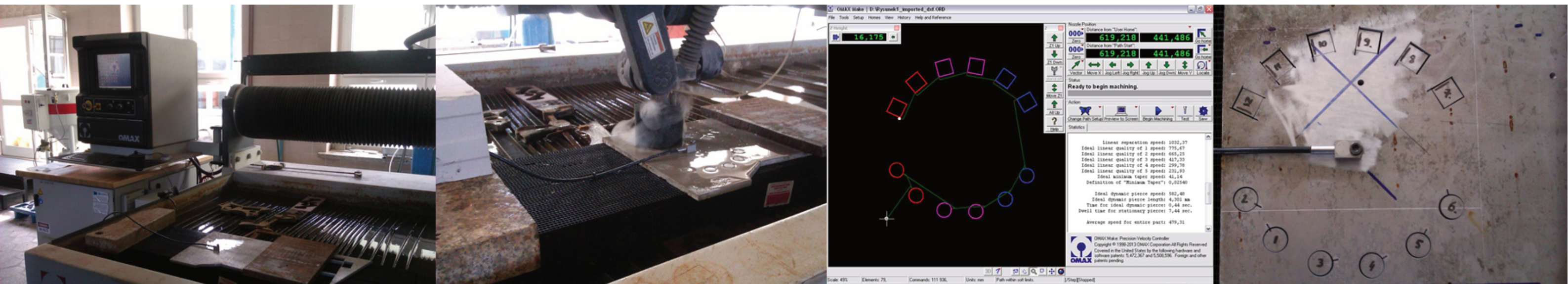


Fig. 2. AE values of this signal for different cutting quality: (a) and (b) illustrate Quality #5, (c) and (d) illustrate Quality #3, (e) and (f) illustrate Quality #1.



❶ Precision OMAX® 55100 JetMachining® Center (OMAX Corp.), ❷ View of cutting area (Kistler 8152B211), ❸ OMAX Make software with defined cutting path and parameters ❹ Cutted samples

Process parameters and conditions: p = 365 MPa, 0.3 kg/min of garnet mesh 80 (Powergarnet A/S, Juelsminde, Dennmark), focusing tube diameter 0.76 mm, signal acquire frequncy 2.5 MHz.

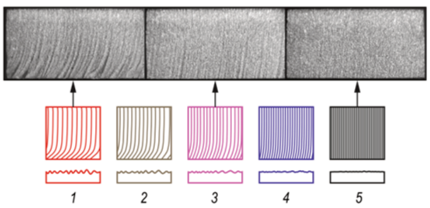


Fig. 1. Changes in surface finish with the quality assigned by cutting quality indicator in the precision OMAX® 55100 JetMachining® Center by OMAX Corp.: (a) corresponding image of the original cut surfaces, (b) schematic drawings illustrating the striations on the cut surface (1 — lowest quality, 5 — highest quality).

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When the cutting process was carried out both with the lowest (v_f = 232 mm/min) and a medium traverse speed (v_f = 418 mm/min), the most numerous group of apexes occurring on the cut surface reached heights ranging from 80 to 110 µm. For the highest traverse speed (v_f = 776 mm/min), apexes with heights of 170–210 µm were the most numerous. Flatness of the examined surfaces for Quality #5 assumed a value of *FLTt* = 0.02 µm; for Quality #3: 0.03 µm; while in the case of setting the worst cutting Quality #1, its value increased to 0.04 µm. The progressive loss of flatness indicates a proportional decrease of the cut surface quality and an increase in the traverse speed.

Changes in the AE signal values (amplitude and the effective value) registered for different cutting quality are presented in **Fig. 2**. Changes in the traverse speed from 232 to 776 mm/min caused an increase in the signal amplitude from 1.25 to 2.5 V, as well as of its effective value — from 2 V to the level of 5 V. In both cases, the growing variance of the mean of the observed values is clearly visible. The AE_{RMS} value represents changes in the course of the cutting process far more clearly than the signal amplitude.

The best fit of the model to the empirical data obtained for the power function — for the model representing the changes of the *Sa* parameter regarding components representing waviness (SF filter). The fit of the model to the data expressed as the coefficient of determination was at a level of 0.933, whereas for the exponential function describing the changes of *FLTt* parameter, the coefficient of determination was 0.893. Finally, the quality of the machined surface can be evaluated by expert system with the use of both equations:

$$\hat{FLTt} = 0.024 \cdot AE_{st.dev.}^{0.371}, \qquad \hat{Sa} = 3.341 \cdot AE_{st.dev.}^{0.335}.$$

CONCLUSION

Deterioration of the quality of surfaces cut with a waterjet contributes to increasing values of the above-mentioned statistical distribution parameter values that describe the spectral density of the AE signal. This relationship may be successfully used, at least in selected conditions, for the more precise prediction of the surface texture parameter values, than in situations when such information is unavailable.

LITERATURE

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