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VIBRATION GENERATION ON WATER JET TECHNOLOGY HEAD DUE TO WATER PRESSURE CHANGES

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ABSTRACT: *After recent research activities focused on water jet technology and abrasive water jet process parameters optimalization, it is necessary to stress attention to aspects which have been out of main research stream but they are very important for understanding cutting process physical principles, improving production systems operability and cutting quality improving. The paper deals with a research of technology parameters fluctuation effect on AWJ production system technology head vibration generation during technical ceramics cutting production process. The submitted paper points at possible sources of undesirable vibrations: pump pressure, which can be a reason of reliability and AWJ technology production systems lifetime reduction, and of abrasive nozzle wear increasing as well as of cutting edge quality reducing.*
KEYWORDS: *Water jet, vibrations, amplitude of vibration acceleration*

MEASUREMENT METHODS AND USED DEVICES

A miniature piezoelectric accelerometer from Brüel & Kjær was used for vibration measurements (type: 4507-B-004 parameters: IEPE, TEDS, 1-axis, 100mV/g), which was fixed onto water jet technological head using bee wax. Signals processing and evaluation was carried out with modular system which is based on National Instruments CompactDAQ platform with specialized function module NI – 9233 for vibrations measuring. Signal processing was performed using graphic programming software LabVIEW Signal Express extended with Sound and Vibration Toolkit module which contains a set of tools for vibrations and sounds evaluation. The experiments were carried out in the firm Wating Prešov s.r.o. where during technical GRES ceramics cutting the pressure values of the pump were varied: 200 MPa, 250 MPa, 350 MPa. The technological head speed was 500 mm.min^{-1}. The table 1 summarizes the conditions under which the experiments were performed and for which evaluated graphic dependencies are valid.

Tab. 1 Experiment conditions

Distance of the technological head from the material	*2-3 mm*
Water nozzle diameter	*0,25 mm*
Focusing tube diameter	*1,02 mm*
Cut material thickness	*10 mm*
Abrasive type, abrasive mesh	*Indian garnet, mesh 80*
Abrasive mass flow	*200 g/min*

RESULTS

The figures 1, 2 and 3 represent graphic dependencies of average value of amplitude of vibration acceleration on given frequency at a given pump pressure value. The figure 4 presents a graph which compares of three courses maximal values of amplitude of vibration acceleration on given frequency. Maximal value of vibration acceleration amplitude for analyzed pump pressure value was protracted for each interval within 200 Hz frequency interval. The amplitude value of vibration acceleration less than 25.10^{-6} was neglected. This value was a determination of a limit under which vibrations measured in standby mode (a mode when the device is on and waits for programme activating) are considered to be not generated due to technological parameters.

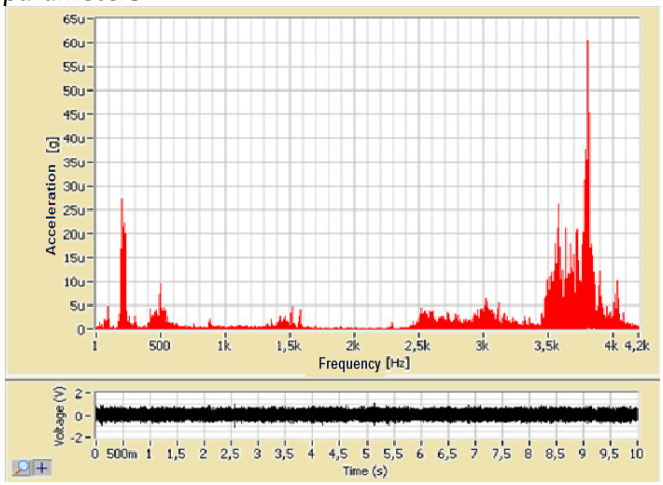

Fig. 1. Dependency of vibration acceleration on given frequency (pressure 250 MPa)

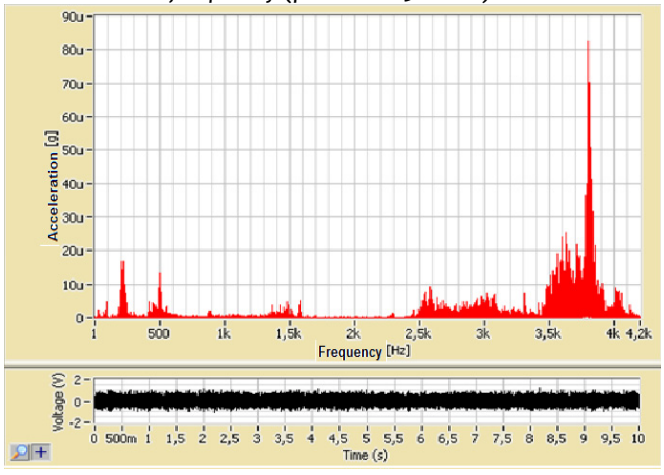

Fig. 2. Dependency of vibration acceleration on given frequency (pressure 300 MPa)

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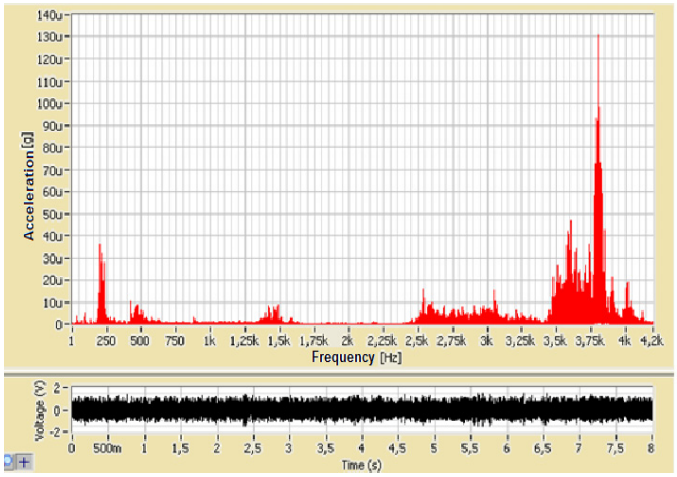

Fig. 3 Dependency of vibration acceleration on given frequency (pressure 350 MPa)

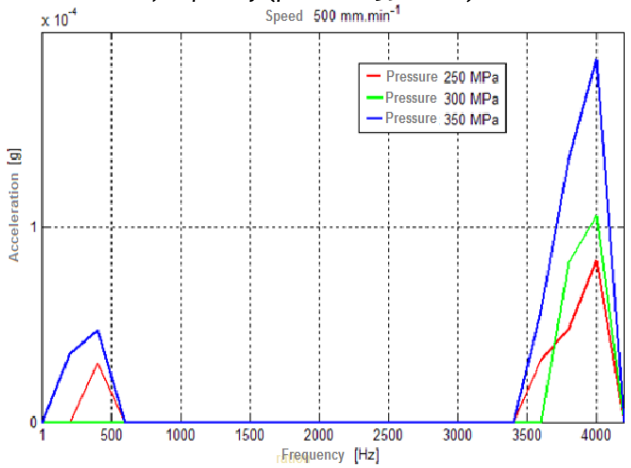

Fig. 4 Comparison of dependency of vibration acceleration on given frequency at three analyzed pressure values

DISCUSSION

On the base of the presented graphic dependencies it can be concluded that the highest vibration values were measured at the pressure values of 250 MPa and 350 MPa within frequency interval from 200 Hz to 400 Hz where the value of vibration acceleration does not exceed 4.10^{-5} g and within frequency interval from 3 400 Hz to 4 200 Hz where maximal value of vibration acceleration amplitude oscillates around the value of $1,3.10^{-4}$ g. The smallest vibration values were measured at pump pressure of 300 MPa where the value of vibration acceleration amplitude within frequency interval from 3 400 Hz to 4 200 Hz is almost half of the pressure 350 MPa and within frequency interval from 200 Hz to 400 Hz no significant values of vibration acceleration amplitudes were measured.

CONCLUSIONS

To sum up, it can be concluded that the pump pressure affects generation of water jet technological head vibrations and that these technological head vibrations can be reduced by change of pump pressure, which could improve cutting edge quality at AWJM cutting.

By reducing undesirable vibration, rising of reliability and lifetime of AWJ technology producing systems, abrasive jet wear reducing, noise level lowering and improving AWJ technology producing system operation safety and hygiene can be achieved.

New knowledge submitted in this paper was formulated on the base of performed experiments and graphic relations. On the base of gained relations, conclusions, recommendations and contributions for scientific activity and business practice were formulated as well.

The experiments were performed as a part of an extensive research carried out in Wating Prešov s.r.o.

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