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QUALITY CONTROL METHOD FOR POWDER MELTED TOOL PLATES

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Abstract

Production of powder metallurgy is highly dependent on the quality of sintering powder parts, which is characterized by relative density sintering. That is why, quality control? witch based on acoustic sound can determined that the relative density of sintering.. Last years, much attention was paid to determining the relative density of powder melted parts. The connection characteristics of composite materials parts is achieved by extensive using the methods of nondestructive quality control.

For realization a control method for composite materials was proposed new solution based on the using the acoustic signals

1. Introduction.

At the current stage of the instrument building in Ukraine, due to the difficult economic situation in manufacturing industry, creating new systems of diagnosis cutting tool is very important for timely finding and removing defective items. In most cases, the diagnostic system requires using expensive devices hardware and software for processing the results of diagnosis, which prevents wide dissemination of data systems on most instrument-making industries of our country. The proposed method of diagnosing powder melted tool plates is cheap and simple solution for solving the technical definition of cutting tool, and early detection unreliable, bad melted composite tools, for improving the reliability and efficiency of machining.

The proposed control method can be used in machine building and instrument building for nondestructive quality control of manufacturing parts using powder melted tool plates.

2. The proposed method description.

2.1. Problems with quality control of tool cutting plates.

It is known that such tool plates are made by powder metallurgy methods in the form of composite structural elements with different mixtures of metal and ceramic powders with influence high temperature and pressure. In such methods even small deviations from the technology significantly affect to the quality of the plates.

In this method the goal is to create such a quality control method of composite cutting plates, or other similar products, the use of which may significantly increase the efficiency of the process of determining the quality of composite cutting plates by stabilizing the regime of formation of acoustic emission in the cutting plate in the form of a high hit to its surface and measuring the response of the crystal structure of the plate vibration-acoustic exciting wave front, where different density and ligament structures in crystals is differently react to this excitement.

2.2. Ways of solving quality control problems.

These problems are solved by the proposed new, more accurate and easy method of control the composite tool-cutting plates, which includes percussion device for the formation of acoustic emission in the body of the plate, and system for receiving acoustic signals - reviews. Very important to set the same conditions to the control signal of acoustic emission, it must be one energy level in the plates at each procedure to check the quality of sintering. The quality of sintering of this plates is determined by the characteristics of the received feedback signal-controlling, which is controlled by using the piezo-electronic sensor of system measurements. Quality of the object is determined by such characteristics as clarity of form burst signal, increasing the speed of its passing through the plate and the damping and large angles of growth and recession of the signal. It is characterized by a high density structure of the plate and points to a qualitative process of sintering. At smaller in

magnitude and speed of acoustic wave amplitude burst signal and lower speed signal attenuation at low angles of growth and decline, indicates that the controlled object has a lower density structure of the plate and determine the error process of sintering the product.

3. Signal processing.

To form the same signal we used hit hammer device which provides the same strike force

Signal-response from the lower surface of the plate is measured broadband piezo-electronic sensor and analyzed acoustic analog system known as device for ultrasonic Defectoscopy. It fixes acoustic graphs of the first wave signal-response, which is reflected from the bottom surface of the plate.

As discussed earlier, the density of powder melted plates depends on its acoustic signal response. It will have different forms and geometric-time parameters, as shown in Fig. 1. They may be characterized by the next features:

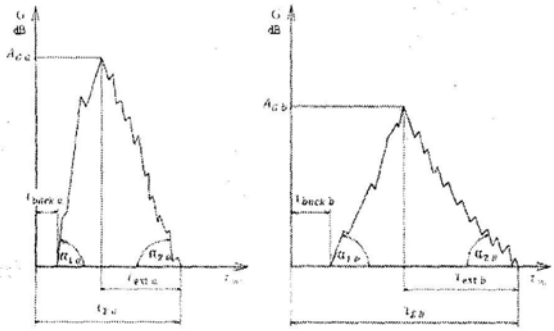

Fig. 1. Examples of received signals.
a) by the high quality of sintering;
b) sintering with defects.

1. Speed of acoustic wave passing through the body plate in one and the other side, defined period of time to return signal to the receiver . It shown as τ_{back} ms.
2. Burst of signal amplitude A_G as energy output acoustic signal-response in dB.
3. Angle of burst acoustic signal - α_1.
4. Angle damping acoustic signal - α_2.
5. Time of extinction acoustic emission of the first wave that resonates by the lower surface of the plate. It shown as τ_{ext} ms.
6. The total time of passing of one wave signal τ_Σ in ms.

For the testing of cutting plates, which we take as a reference, the method of selection was used. We take the cutting plates from the tools that have already worked out and mostly have good performance on disability. The most resistant composite plate was taken as a reference.

The experiments to examine the quality for a number of cutting plates was made. It gave us the acoustic spectrograms of their quality. Fig. 1. shows us the spectrogram for such well-made plate (Figure A), and plates, with defects in quality (Figure B). They marked all six attributes of quality of powder melted plate.

On the basis of such characteristics as the density of sintering may conduct a comparative analysis of the suitability of composite tool cutting plates, where the symbol a - as indicated by suitable signs of good plates and an index b - would be marked with signs of defective plates.

- ✓ $\tau_{back\,a} < \tau_{back\,b}$;
- ✓ $A_{G\,a} > A_{G\,b}$;
- ✓ $\alpha_{1\,a} > \alpha_{1\,b}$;
- ✓ $\alpha_{2\,a} > \alpha_{2\,b}$;
- ✓ $\tau_{ext\,a} < \tau_{ext\,b}$;
- ✓ $\tau_{\Sigma\,a} < \tau_{\Sigma\,b}$.

By comparing of tested characteristics wafers with features well-produced plates we may successfully monitor their fitness. It is not necessary to conduct a comparative analysis by all 6 parameters of quality. it's possible to test quality and reliability by two or three parameters.

4. Experimental approvement.

The series of experiments was done by this method which confirmed the proposed method.

Here is one of them.

It was taken three tool cutting plates of steel T15K6 for the experiment, and they lifecycle respond such kind of requirements:

- Lifecycle of the tool cuting plate number 1 was exceeded the average life cycle for this material, and the cutting plate retained its properties.
- Lifecycle of the plate number 2 was average time for this material, after that it broke down.
- Lifecycle of the plate number 3 worked much less time than that indicated for this material and broke down.

On (Fig. 2. - 4.) shown the spectrograms of acoustic signal propagation for these plates, the dependence of the amplitude this acoustic signal from the time of its distribution in the body of controlled object.

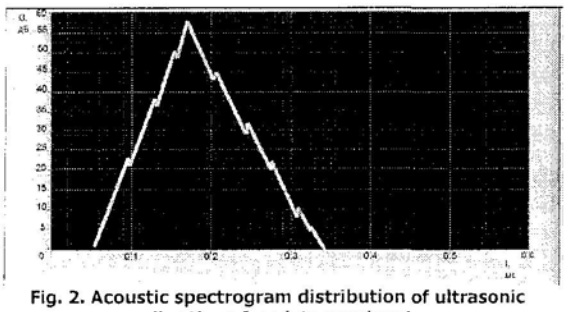

Fig. 2. Acoustic spectrogram distribution of ultrasonic vibrations for plate number 1

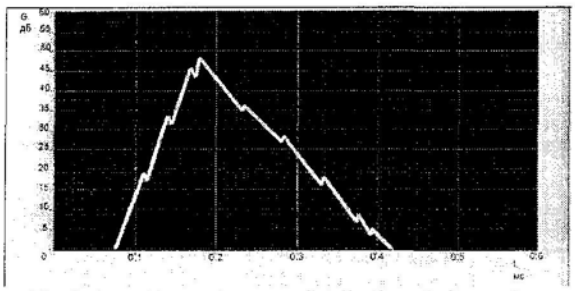

Fig. 3. Acoustic spectrogram distribution of ultrasonic vibrations for plate number 2

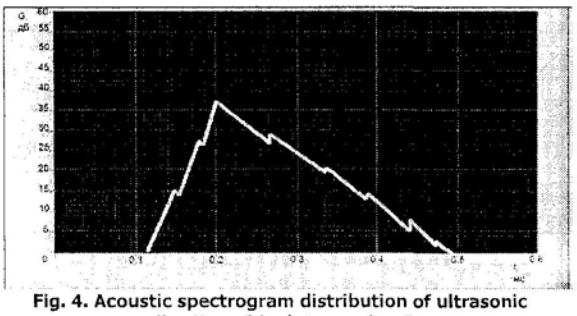

Fig. 4. Acoustic spectrogram distribution of ultrasonic vibrations for plate number 3

Tab. 1.

Results of the experiment

№ of experiment	A_G	τ_{ext}	τ_{Σ}
1	57	46	37
2	0.17	0.24	0.29
3	0.28	0.35	0.39

The proposed method of quality control is confirmed experimentally. Given all the advantages of this method of diagnosing the physical properties of the composite tool reduces the cost of machining, due to the timely removal of defective instruments.

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