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STUDIES OF DYNAMIC OPERATING LOADS GENERATED BY CENTRIFUGAL MACHINES AND UNITS

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In the process of transporting gas over long distances, gas compressor units (GCU) are important equipment. During the operation of the GPU, high dynamic loads occur that affect its reliability. These loads can be expressed in terms of the root-mean-square value (RMS) of the vibration velocity at characteristic points of the GPU. These loads are the causes of the following defects [3]:

– the development of defects both in the base metal of pipes and in welds
– destruction of supporting structures;
– violation of the integrity of protective coatings (anti-corrosion);
– damage to technological equipment.

For this reason, it is essential to study the dynamic loads, and, as a consequence, the oscillation processes of the gas compressor unit.

The purpose of this work is to study the dynamic characteristics of the gas-pumping unit, based on the conducted vibration survey and the creation of a mathematical model of the unit.

Vibration survey and assessment of the vibration state were carried out for 4 EGPU - 4.0/8200-56/1.26-R-10-01, located at one compressor station. The study was carried out in accordance with the attached Atlas Copco manufacturer's instruction 2946 0444 04 "Test Data - Condition Monitoring" for ZT series compressors. On fig. 1 shows vibration measurement points. Measuring instruments: Vibrometer type SKF Microlog CMXA 70. Sensor type - CMSS2200 [4].

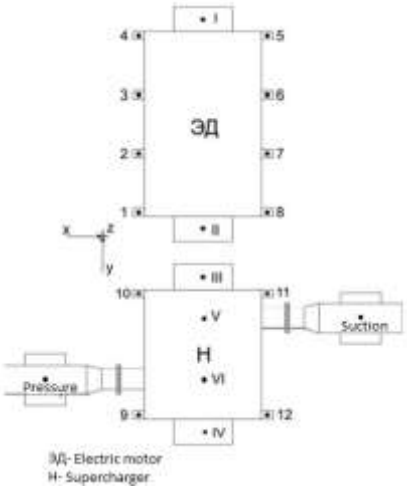

Fig. 1 Scheme of point location for measuring vibration of EGPA-4.0/8200-56/1.26-R NTs 220-11-1SMP

Based on the results obtained empirically, a graph of the RMS vibration velocity at characteristic points was built.

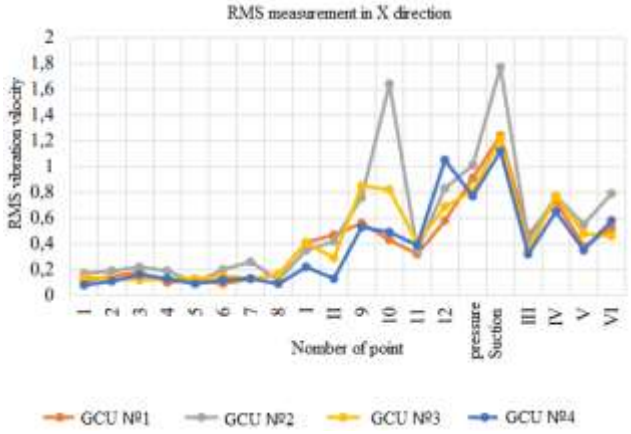

Fig. 2 Vibration velocity RMS at characteristic points

If we analyze the points according to STO Gazprom 2-2.3-324-2009, then some of them are in the B1 range, and some border on the C1 zone. Points located on the discharge line are exposed to large vibration values, the maximum values are at the suction and pressure points, such points require special attention.

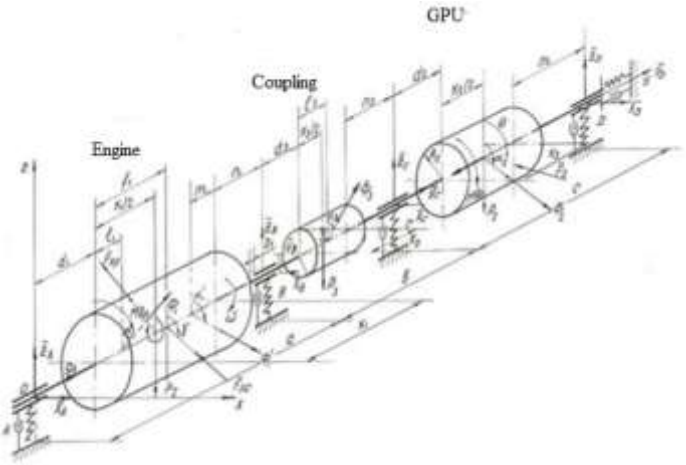

Fig. 3 General scheme of the electric motor, gas turbine and clutch

In order to further compose a mathematical model of the system shown in (Fig. 3.), the Lagrange equation of the 2nd kind in generalized coordinates will be used

$$\frac{d}{dt}\left(\frac{\partial T}{\partial \dot{q}_{ijk}}\right)+\frac{\partial T}{\partial q_{ijk}}-\frac{\partial E_p}{\partial q_{ijk}}=Q_{ijk}$$

,

where $Qijk=\frac{Ai}{\partial qijk}$, where A_i - the sum of the products of external forces. T is the kinetic energy of the system. E_p is the potential energy of the system [2].

As a result, a matrix was compiled, which was solved in the MathCad software package [1]. Numerical calculations for point "A" are presented below.

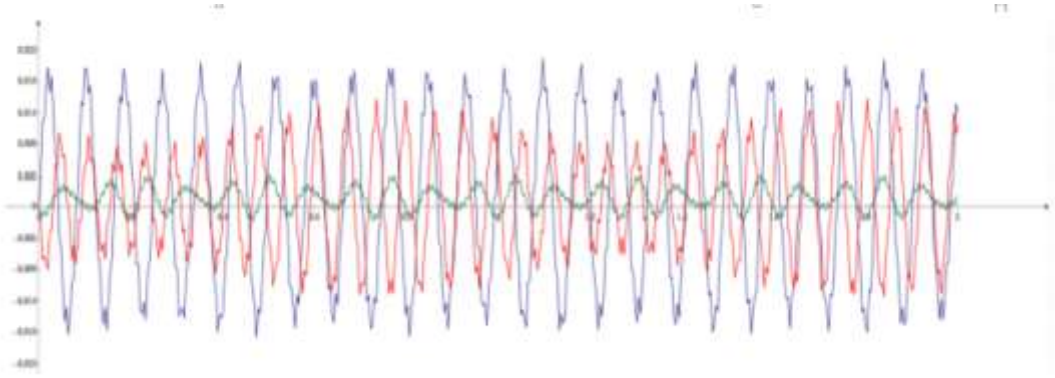

Fig. 4 Overlay of the displacement amplitudes of the components at point A.

The results of the study of oscillatory processes in the system make it possible to establish the dependence of the reciprocating movement of the system elements along the x, y, z axes and their inclination angle ϕ on time.

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