Vibration Problems of High Power Air Blower Machine

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ABSTRACT

In this paper the vibroactivity of a high power air blower is estimated periodically monitoring absolute vibration of housing-type bearings, permanently monitoring relative vibration displacements of a ventilator shaft and simulating the equations of the rotor finite element obtained in a analytical form by applying Maple package.

Air blower SF01-18 machine is modern technological equipment operating in Lithuanian JSC «Lifosa» since 2000. High power (5600 kW) induction electric motor rotates at 1500 rpm and the air blower ventilator at 3119 rpm through a gearbox. The external diameter of the blower is 3.6 m. The machine technical condition is evaluated monitoring the vibration by two methods: 1) periodic measurement of absolute vibration velocities of an electric motor and gearbox bearings, 2) permanent monitoring of relative vibration of a blower shaft. The vibration measurement results indicate that technical condition of the new induction electric motor is critical. Synchronous frequency (24.74 Hz) vibration magnitudes of housing-type bearings (13 mm/s) predominate in the spectrum at the rated power. The experimental test of balancing a rigid rotor, measuring the resonance frequency and evaluating electromagnetic energy transformation failure have provided information that rotor shaft is bent in the first lateral mode due to mechanical and electromagnetic forces acting on it.

The first step to reduce excessive vibration has been taken by balancing the electric motor rotor in situ after disconnecting it from the machine but it has not given positive results – after loading vibration has sufficiently increased. It has proved that the first cause of increased vibration is insufficient synchronous dynamic stiffness of the whole rotor system of the electric motor, not it unbalance. The second - the rotor nominal operating speed (25 Hz) is close to the first resonance frequency (27 Hz) of machine. Stiffening of housing-type bearings supports increased resonance frequency (up to 37 Hz), and again loading the machine has not provided positive results. An additional cause of high vibration lies in an electromagnetic energy transformation mechanism. The flow chart of the eccentricity rise of the rotor in a high power induction motor elucidates the third cause – vibration excited by an electromagnetic phenomenon. Dynamics of a motor is modeled and investigated by FEM with eighteen degrees of freedom. The first out of six degrees of freedom belongs to a rigid rotor. The vibration displacements of the main points of the rotor have been determined experimentally and by modeling.