

1.8.8. VIBROACOUSTIC DIAGNOSTICS AND REAL-TIME CONDITION MONITORING OF RECIPROCATING MACHINES

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The level of methodological support of functioning algorithms of diagnostics and a condition monitoring systems (SDM) dangerous industrial objects defines reliability and a degree of their security from unpredictable emergencies. From the moment of occurrence of the first SDM reciprocating machines and, in particular, reciprocating compressors, on present time the basic attention is given monitoring and diagnosing of following units:

- valves – working capacity;
- the cylinder – wear process of condensation, rings and working surfaces, easing of fastening of the piston;
- slider–crank mechanism – the increased backlash in the bearing of the top head of a rod, wear process of a basic surface crosshead, wear process of a rod, deterioration of greasing;
- connecting rod gear – the increased backlash in connecting–rod and crankshaft bearings, deterioration of greasing;
- the compressor casing – easing of fastening, the base.

For this purpose measure following parameters:

- the compressor casing vibration;
- the crosshead vibration;
- static and dynamic deviations of a rod from a normal;
- vibration (absolute or relative) bearings;
- temperature of valves;
- pressure in cavities of compression (the indicator diagram);
- loading on a rod.

Long-term experience of researches of parameters vibroacoustic signals of reciprocating compressors, diagnostics and a condition monitoring of reciprocating compressors shows, that vibroacoustic signals with a sufficient degree of reliability and adequacy not only characterize structural parameters of reciprocating compressors units and details, but also adequately show the increased dynamic loadings on units and details [1 – 7]. Thus the condition monitoring of all vitally-important units of reciprocating compressors is provided [5].

Characteristics of vibroacoustic signals are functions of technical state of units and details. It has allowed to develop a row of methods and algorithms of processing vibroacoustic signals and other physical processes [1 – 7]. On their basis the automatic expert system of decision-making support is created. The system defines more than 20 defects and faults [5]. It provides a condition monitoring of reciprocating compressors in real time ("real-time"). Diagnosing is implemented in rate of diagnostic signals measurement. The period of diagnosing unlike "on-line" SDM does not exceed time of development of faults and the defects caused by objective processes of wear process and accumulation of fatigue damages. The period of measurement of diagnostic attributes, at occurrence of subjective damaging factors, is caused by time of reaction a control system of a reciprocating compressors and the personnel for a signal about necessity of performance of correcting actions on elimination of destructive factors or stopping of the machine.

The methodology of reciprocating compressors diagnosing is based, including, and on the analysis of a vibroacoustic signal on an angle of rotation of the shaft according to a

time chart of a valves job [4], which unlike uniform segmentation of a signal allows to fix definite faults of reciprocating compressors units and details.

The analysis of vibroacoustic wave in different high-frequency bands has allowed to determine correlation spectral an invariant in the form of an attitude of harmonious components dispersions with of reciprocating compressors defects and faults [2], to execute normalization of levels of diagnostic attributes of faults, to get stable results of the analysis vibroacoustic activity of reciprocating compressors and to diagnose a row of faults, who are rather difficult for defining other methods of a signal processing.

Increase of exactitude and reliability of diagnostics whom achieve by correction of a form of amplitude-phase performance of vibroacoustic channels in view of a relationship of its parameters from a range of an initial signal. It allows to compensate non-uniformity and nonlinearity of performance of vibroacoustic channels of an extending and a transforming of a signal from a source up to the analyzer. For this purpose define multiplicative function of correction of a range and an additive function of correction of a phase of a signal for different meanings of the amplitude, corresponding to good and failure conditions [3].

The system real-time monitoring COMPACS® [1, 6, 7], ensures safety maintenance of reciprocating compressors. Thus the system meets the requirements, shown to SDM the equipment of dangerous industrial objects [8].

Thus, it is possible to state:

1. Practically in all SDM the methodology of a technical state determination of units and details of reciprocating compressors is based on a measuring of direct structural and technological parameters (relative displacement, pressure, temperature, etc.) and realizes “on-line” technology; expert systems use values of direct structural and technological parameters; parameters of indirect processes (vibroacoustic waves) are used for an estimation of value of these parameters without realization of diagnosing and the reasons of faults and defects occurrence;

2. In SDM COMPACS® the methodology “real-time” monitoring and diagnosing is based on a measuring of direct structural and technological parameters and on use of parameters of indirect processes (vibroacoustic waves); algorithms of decision-making support expert system with automatic definition (in rate of measurement of diagnostic signals) more than 20 faults and defects of units and a degree of their danger are realized.

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