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PREVENTIVE MAINTENANCE PRACTICAL APPLICATION CASE FOR AIR PISTON COMPRESSOR

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Keywords : **preventive maintenance; air compressor; availability.**

Abstract: The large amount of air piston compressors used in our days in industry makes applicable to that class of technological equipment the preventive maintenance techniques, that is a maintenance system based on a continuous survey of some parameters. The principle of that system is that the increase or decrease of those parameters can be a sign of the presence of some deficiency in function. This system is valid for both parametric and catastrophic defectives, especially in the case of use of automatic survey systems. By this system the exact locus of repair was known before the start of repair.

1. THE PREVENTIVE MAINTENANCE

In a large number of technologies the compress air represents a most important work agent. This is a fact underline by average 40%-60% electric energy consumption for compress air production in most enterprises.

The large amount of air piston compressors used in our days in industry makes applicable to that class of technological equipment the preventive maintenance techniques, that is a maintenance system based on a continuous survey of some parameters [1]. The principle of that system is that the increase or decrease of those parameters can be a sign of the presence of some deficiency in function. This system is valid for both parametric and catastrophic defectives, especially in the case of use of automatic survey systems.

In the case of the absence of such of automatic survey systems, the preventive maintenance system can be based on repetitive and systematic measurements of the parameters of interest that can be used later to establish the evolution tendency in time of the technical equipment. With those measurements, some can establish the limits when the correction actions are necessary in order to bring the equipment function to the normal. The amount of data necessary to do that must be big enough to relay on it the correction decisions.

2. THE PRACTICAL APPLICATION GENERAL CONDITIONS

One of the most used air piston compressor is the prototype 3V45/7 produced at Resita, Romania (Figure 1, [5]). Its technical characteristics are:

- outflow………………………………………..45m^3/h
- final upset pressure……………………………7 barr
- maximal intermediate pressure………………2,1±0,15 barr
- number of stages………………………………2
- cooling water flow ……..………………………225 l/min
- compressor mass……………………………...7744 kg
- the electric engine power ……..……………...300kW
- the electric engine rotation speed……………300 rpm
- tension………………………………………..6000 V
- frequency………………………………………50Hz
- intensity…………………………………………31,4A

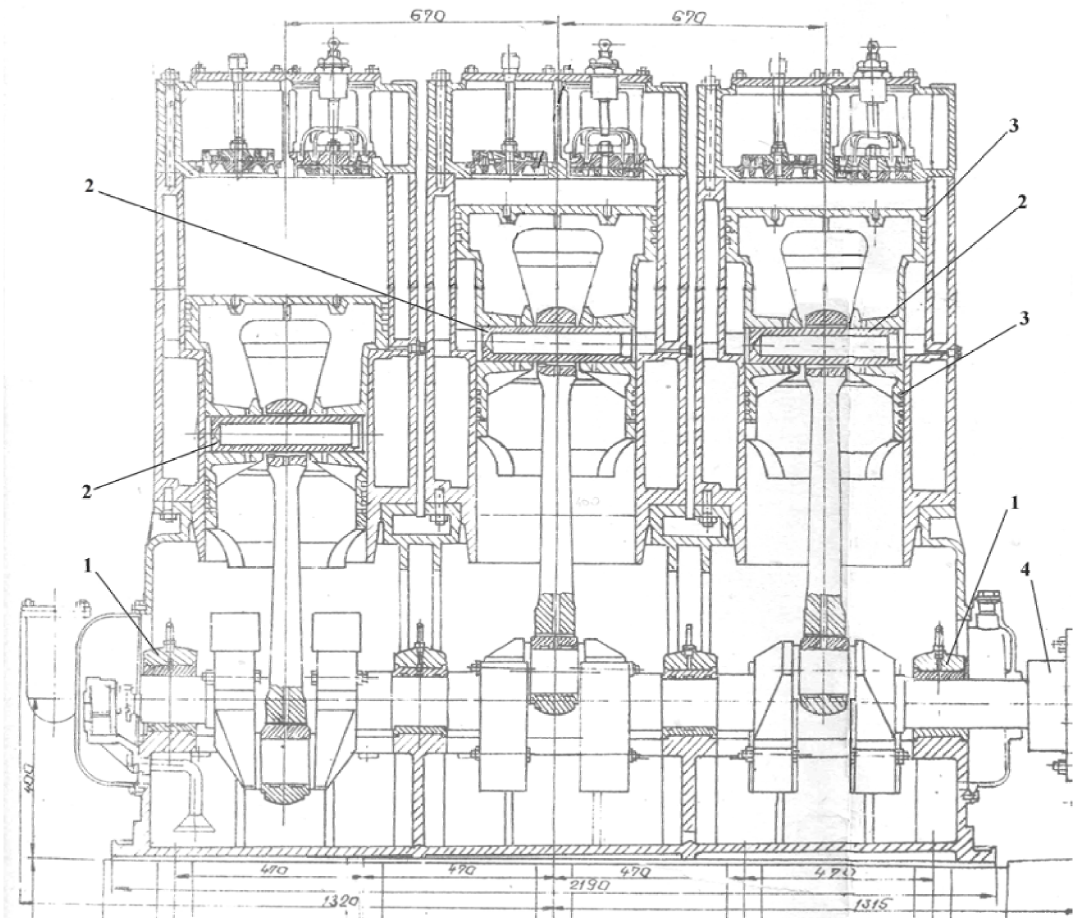

Figure 1: 3V45/7 compressor cross-section with vibrations interest points

In the case of the present application of preventive maintenance the following parameters where considered to be measured ([2], [3]):

a) *The compressor outflow* – a decrease of this parameter indicates a depreciation of the piston rings and/or a damaging of the valve tightness;

b) *Each maximal stage pressure* – a non-uniform partition indicates decreases in aspiration valves tightness from the second stage and at those of the low-pressure cylinder;

c) *Vibrations* – the vibrations can deliver the richest data about the technical condition of the equipment. The survey parameter will be relative to vibrations of the crank axle (see Figure 1). The data delivered by those vibrations will be about:

1 - The bearing box of the crank axle;

2 - The piston pin;

3 - The piston rings;

4 - The clutch in between the electric engine and the compressor;

5 - The bearings of the electric engine (not on Fig.1).

In order to measure the vibrations in the targeted points, the speed transducers from “Schenk” was used, with a range of measurements from 1 to 20000Hz, and sensors based on Eddy currents effect.

Generally, we lack the maximal and minimal tolerable values given by the producer in order to be able to do a correct evaluation of the compressor. So, the authors recommend the use of evaluations of the changing in time of vibrations parameters, which is a repair programming due to an increase in vibrating parameters values greater than values obtained by calculus.

d) *The lubricants* – the oils for compressor are obtained from selected oils by acid refining or by selected solvents refining.

Those specific oils and their characteristics are as follows in Table 1 ([6]):

Table 1: the characteristics of the specific compressor oils

Characteristics	**K40**	**K65**	**K90**	**K120**	**K150**
Density to 15^{0}C	0,915	0,915	0,920	0,922	0,938
Flammable point [^{0}C]	200	220	225	240	250
Viscosity at 50^{0}C	38…45	61…68	80…95	115…130	145…160
Viscosity at 50^{0}C [^{0}E]	5…6	8…9	10,5…12,5	15…17	19…21
Viscosity index , min	60	60	60	60	60
ASTM color, min	5½	5½	6½	7	8
Solidifying point [^{0}C]	-20	-25	-10	-5	-5
Ash, max. [% mass]	0,01	0,008	0,01	0,005	0,005
Coke number, max. [%]	0,3	0,4	0,6	0,8	1
Organic acidity, KOH/g max., [mg]	0,08	0,08	0,08	0,1	0,15
Alkalinity, mineral acidity	lack	lack	lack	lack	lack
Water	lack	lack	lack	lack	lack

The survey parameters in this case will be:

- The flame temperature must not decrease below 200^{0}C;
- The frozen temperature must not increase over -15^{0}C;
- The viscosity must be maintained in between 4,5^{0}E and 12^{0}E at 50^{0}C temperature;
- An oxidize over the prescribe limits is not allowed;
- The lubricant consumption must be under 50g/1000m^3 at the low pressure stage suction air, and 80g/1000m^3 at the high pressure stage suction air.
- The temperatures of lubricants in the crankcase oil-pan and in the circuits must not be over the prescribe values. An increase over those values indicates an insufficient lubrication, luck of radial gap between bearing and the mandrel, and so on;
- The analysis of the suspension particles and precipitate particles. The presence of flat particles indicates a normal wear, the presence of spiral particles indicates an abrasive wear, the presence of angular-shaped particles indicates the metal fatigue, and finally, the presence of nodular particles indicates the pitting wear;
- The decrease of the lubricant pressure indicates an increase of presence in foreign particles.

3. CONCLUZIONS

The preventive maintenance practical application main goal was to increase the availability for air piston compressor. The availability formula is:

$$D = \frac{T_F}{T_F + T_0} \tag{1}$$

Where:

$$T_o = T_{op} + T_{oa} \tag{2}$$

T_F – the functioning time
T_o – the stopping time
T_{op} – the planned stopping time
T_{oa} – the accidental stopping time

By this system, the accidental stops were eliminated and the planned stops were reduced because the exact locus of repair was known before the start of repair ([4]).

By increasing the availability the equipment productivity increased also and the total expenses was decreased.

Another great advantage of the system was the increase of the safety in functioning. The only disadvantage that can be mentioned was the total costs to implement the system.

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