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ANALYSIS OF MODERN MONITORING METHODS OF EQUIPMENT AT PETROCHEMICAL PLANTS IN THE PROCESS OF OPERATION

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АНАЛІЗ СУЧАСНИХ МЕТОДІВ МОНІТОРИНГУ ОБЛАДНАННЯ НАФТОХІМІЧНИХ виробництв В ПРОЦЕСІ ЕКСПЛУАТАЦІЇ

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The article analyzes modern monitoring methods of equipment at petrochemical plants in the process of operation. The article suggests general requirements for designing of control devices and particularly primary converters for measuring parameters of a magnetic field.
Key words: *control, monitoring, method, parameter, technological conditions.*

1. Introduction. In current economic conditions, one of the main ways to increase profitability of industries with a continuous production cycle is the reduction of costs for the operation of technological equipment and elimination consequences of accidents.

One of the main features of continuous industrial equipment operation of environmentally unsafe industries is cyclical works, destruction under the influence of medium and parameters of technological process. Also hidden technological defects have a significant impact on integrity of equipment.

Hazardous fatigue fractures and various defects of corrosive nature are formed in metalwork as a result of long-term operation of petrochemical production equipment and various adverse factors. In the overwhelming majority of cases statistic data show that the causes of defects in equipment are operating parameters and operating conditions.

The operation of modern petrochemical equipment is characterized by wide range of operating areas, which depend on technological processes of production: operating pressure, operating temperature, operating medium.

Under the influence of loads a number of deformations occur: metalwork is strongly deformed, welds are destroyed in welded structures, cavities and coarse cracks are formed, liquation inclusions of foreign material are appeared and etc. As a result of imperfections in the manufacturing technology or operation under difficult conditions various defects such as affecting the integrity of or homogeneity of the material, deviation from a given chemical composition, a structure or specified sizes, changing their shapes (configuration) are appeared.

The problem of detection defects always remains relevant. It requires new methods, approaches to control monitoring and the development of new devices and measuring equipment.

The vast majority of industrial metalwork of petrochemical equipment is made of ferromagnetic material - domestically and foreign manufactured steel, for example, a large number of these materials are the basis of reactor designs and installations.

Thus, carbon steel and cast iron occupy a considerable part of specific quantity of metal in the equipment design and their range is very significant. Also it should be noted, that the thickness of the applied equipment also varies within wide limits from 2.5 until 650 mm, which in turn requires the development of appropriate methods and instrumentation. Almost all of the alloying additives are magnetic materials, which gives the opportunity to use control of their magnetic field.

2. Analysis of monitoring methods and instruments for its implementation. The basis of existing methods of diagnostics and monitoring of industrial equipment is the study of the physical properties of materials under the influence of X-rays,

infrared, ultraviolet and gamma rays, radio waves, ultrasonic vibrations, magnetic and electrostatic fields, etc.

There are a very large number of techniques used in analysis. It can be very useful to classify the measurement process according to a variety of criteria: visual method, x-ray testing, gamma-testing, radio-testing, infrared testing, magnetic particle testing, eddy current testing, thermoelectric testing, velocimeter method, tribo-electrical testing, electrostatic testing, ultrasonic testing, resonance method, impedance method, free vibration method, cupellation testing [1].

Thus, after comparing the methods we can say that each has its own advantages and disadvantages and can be used only for a specific type and size of defects and a limited list of materials. Some methods have particular sensitivity within the specified limits. The other number methods are used for detecting defects only on surfaces or operating at a certain depth, control only heated products, compare structure of material or require additional equipment and methods of protection (e.g. biological protection with gamma-testing) and others. One common drawback of all methods is the relatively low degree of automation of a primary sensor, percentage of its controlling surface and level of flexibility and mobility.

Both methods and instruments have significant differences and therefore cannot be used as universal. In the same way they are not effective for specific measurements and accurate enough to get the result. According to the characteristics and parameters instruments can be divided into portable and stationary, single mode and multi-mode, multi-parameter, single and multi-channel, single-frequency and multi-frequency.

The other can vary by different output modes and information storage, bandwidth, the ability to work with a PC or other devices, standard laboratory equipment, the duration of the battery life and reliability.

Most flaw detectors are not suitable for monitoring measurements and require two or more operators. During inspection the sensors in most cases are held by operator and such conditions lead to increased measurement errors and defined as a secure method of work.

Summing up analyzed methods and flaw detectors, which are used to control production, we should define generalized characteristic of them:

- Structurally, the instruments are a set or complex;
- The remote sensors are not universal, as a rule, are made to the size and shape of the diagnosed equipment, in most cases, they are awkward;
- Most sensors are not fixed and held by the operator that has a significant impact on the accuracy of measurements;
- Significant impact on the work of most types of sensors has an external electrostatic and magnetic fields.

For a more complete and accurate technical inspection of equipment it is necessary to apply the maximum reliable integrated non-destructive testing methods.

In particular, for identifying dangerous emerging and developing defects of different nature can be effectively used one of magnetic methods listed in Figure 1. According to the adopted classification [2], this allows to record wave elastic stresses that occur as a result of internal restructuring of the local dynamic material of construction.

The most effective way to solve this problem is by magnetic method of nondestructive testing.

The first main advantage of this method is that the result of research is given almost instantly.

Secondly, when it is carried out, the process equipment does not need to be decommissioned.

Thirdly, among existing non-destructive methods of control, the magnetic method is not only one of the most universally used to control the structure and mechanical properties of objects from ferromagnetic materials, but also the most high-performance and provides enough necessary measurement accuracy and maximum coverage of the structure.

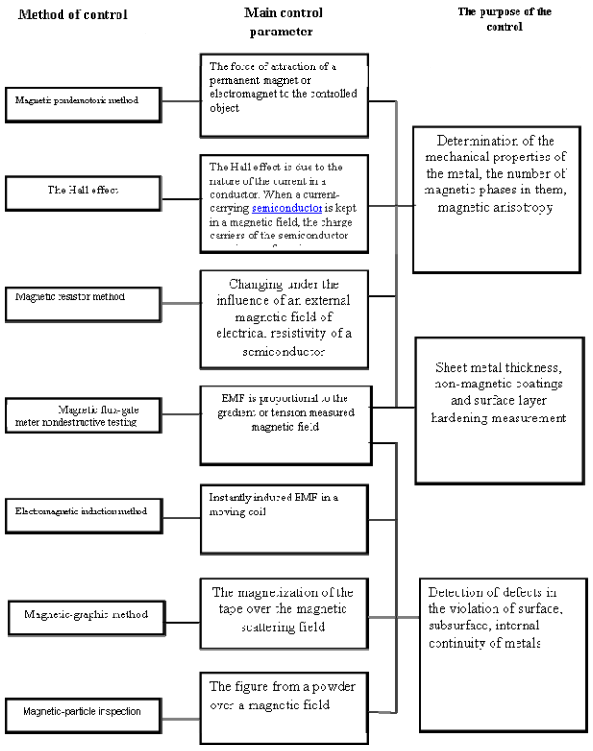

Fig. 1. Classification of magnetic control methods

The fourth feature is that the magnetic method of monitoring allows you to reduce the cost of research, since there are no costs for the manufacture and testing of prototypes. This is especially true for industrial equipment of large volumes due to the increased labor intensity and duration of the manufacturing process of control samples for mechanical testing and metallographic research.

One of the main parameters by which one can judge structural changes and control development process, along with others, is the coercive force Hc. Due

to the fact that under the influence of technological factors, Hc in the zone of elastic deformation of the material gradually changes according to certain dependencies directly related to the peculiarity of the proceeding technological process. And when the defect appears and develops, the value of Hc is not relevant, because parameters and dynamics of defect development are paramount, which is controlled by the magnitude of the scattering field.

It is possible to determine in advance the appearance of the defect zones in equipment by the actual change in the magnetic properties of the walls of the ferromagnetic material during using a stationary magnetic sensor with magnetically sensitive elements. This method of investigation can determine the most striking areas of equipment during the process, it makes it possible, due to the dynamics of changes in the parameters of the process, to "correct" the foci of destruction of metal and prolong its controlled operation.

Therefore, when monitoring would be ensured through continuous monitoring and dispersion of magnetic field controlled by region on the current object. Therefore, the control unit must be securely installed on a stationary object control, if necessary, should move across the surface of an object on the specified path, and at regular intervals to record and give necessary information in the right form in any way by a specified distance.

One of the features of monitoring the equipment of industrial facilities is control in areas that are difficult to access and areas where "non-dangerous" local defects have been identified during maintenance, but which allow the operator to continue to operate this equipment on condition of constant monitoring. In order to accurately link the results of monitoring all problem areas of the equipment material, it is necessary move sensors along a given route in their own motion, with reference to the path or by the established reference beacons.

The modern classification of magnetic methods of control and analysis of the equipment allow us to draw a conclusion that devices and methods for monitoring the integrity of the walls of industrial equipment conducted with the help of matrix magnetic sensitive elements are not exist nowadays. It is necessary to establish general requirements for the design of control devices and especially the system of primary transducers for measuring magnetic field. Thus, the design of the sensor must have primary converters and function of dividing the electromagnetic field in the extent and area of the converter. It should suppress influence on original signal converter changes the electromagnetic field, not typical for defects due to constructive field, which contains matrix magnetic sensitive elements.

5. Conclusion. Based on the analysis of the possibility of using existing magnetically sensitive elements for operation in industrial facility monitoring systems, we come to the conclusion that basic requirements for such converters, their power supplies and schemes for preliminary processing of the output signal must be developed. Converters should be determined by a number of indicators:

-high sensitivity detection of subsurface defects at low values of operating voltages and currents;

-high temporal and thermal stability;

-high level of transformation (easy connecting to a group of-matrix);

-high noise immunity;

-the reliability of the information obtained;

-accuracy and durability;

-the relative simplicity of design;

-minimum weight parameters;

-a simple and convenient way of installing and fixing;

-possibility to install on any form the surface of the object;

-possibility to install on any material controlled object;

-possibility of independent installation without any preliminary preparation of the surface of an object;

-possibility of installation on outdoor and indoor platforms;

-easy maintenance mode;

-transmission of information in any way (wired or wireless);

-transmission of information in the specified temporary mode;

-possibility to adjust the conversion function of matrix magnetic sensitive elements;

-stabilization of parameters of matrix magnetic sensitive elements whiles their long-term exploitation;

-low cost and price.

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Література

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Карманов М.І., Батурин О.І., Іванов В.Г. Аналіз сучасних методів моніторингу обладнання нафтохімічних виробництв в процесі експлуатації.

У статті проведено аналіз сучасних методів моніторингу обладнання нафтохімічних виробництв в процесі експлуатації. Зроблено висновок на основі відповідних фактичних результатів. Запропоновано загальні вимоги до конструкції пристроїв контролю і перш за все до системи

первинних перетворювачів для вимірювання параметрів магнітного поля

Ключові слова: *контроль, моніторинг, метод, параметр, технологічні умови.*

Карманов М.И., Батурин А.И., Иванов В.Г. Анализ современных методов мониторинга оборудования нафтохимичных производств в процессе эксплуатации.

В статье проведен анализ современных методов мониторингу оборудования нефтехимических производств в процессе эксплуатации. Сделан вывод на основе соответствующих фактичних результатов. Предложены общие требования к конструкции устройств контроля и прежде всего к системе первичных преобразователей для измерения магнитного поля

Ключевые слова: *контроль, мониторинг, метод, параметр, технологические условия.*

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