ACTUAL STATUS OF EDDY CURRENT NON-DESTRUCTIVE TESTING IN RUSSIA

Alexey G. EFIMOV, Andrey E. SHUBOCHKIN

RII MSIA “SPECTRUM”; bld. 1, Usacheva St., 119048, Moscow, Russia
Phone: +7 (499) 245 56 18, Fax: +7 (495) 933 02 95; e-mail: aeshubochkin@mail.ru, grazier@mail.ru

Abstract

The paper covers the aspects of the actual status of eddy current control in industrial production. The article describes the basic classes of eddy current instruments, which are widely used by the State monopolies, such as Russian Railways, Gazprom, etc. and shows the requirements for operating characteristics of portable flaw detectors. Separately recorded automation equipment of eddy current testing for industrial applications in the steel mills.

Keywords: eddy current, pipeline, automatic control.

1. Introduction

Eddy current testing, as one of the main methods of non-destructive testing, is widely used nowadays in various industries [1].

The main areas of application of this type of non-destructive testing (NDT) are defectoscopy, structurescopy of metal parts; thickness measurement of coatings for various purposes. Eddy current testing is used for input and output quality control in the production, as well as periodic monitoring during the life cycle of products for critical applications.

Nowadays on the Russian market the domestic manufacturers of NDT equipment successfully compete with the World leaders in NDT. The choice of the instrument is primarily determined by characteristics of the controlled object and the conditions of control. It should be noted that the skill level of the operating staff has a significant influence on the choice of NDT tools. The advantage is gained by those manufacturers of eddy current NDT tools who are more familiar with the specifics of the field of device application and who can adapt them to the needs of the end customer.

Another feature of the Russian NDT market is a large number of different Registers of NDT instruments regulating their application in various industries. There are Registers of the main State monopolies, such as Russian Railways and Gazprom; marine and river registers; the nuclear industry and civil aviation registers; registers of tools approved for application in hazardous facilities; and, of course, the State Register of measuring devices [2].

Today the State Standards in Russia are used only as recommendation, and in most industries they are replaced by International Standards and internal regulatory documents.

Eddy current testing in Russia and in the Republics of the former Soviet Union has its own characteristics, related to the specific objects of control and conditions of testing. In this regard, the equipment produced in Russia, has a number of differences from the analogues all over the world. [3, 4].

It should be noted that recently there is a tendency to combine several NDT methods in one device. It happens because some customers (such as JSC "RZD") try to reduce the range of purchased and serviced equipment. As the result "symbionts" appear, the devices which carry out successfully the main function, as a rule ultrasonic one, but eddy current function works not at full strength. Such NDT devices which combine several methods are produced by the following companies: Votum, NPG Altek, NPP "PromPribor".

The main manufacturers of eddy current NDT equipment in Russia are JSC RII MSIA “SPECTRUM”, JSC Constanta, NPK Luch Ltd., NPP PromPribor, NPC Kropus Ltd. There are several directions in eddy current nondestructive testing, and the Russian researchers are often inferior to foreign companies, and they even also surpass them.

One of such directions is defectoscopy /flaw detection and flaw measurement in the objects with protective coatings of considerable thickness, when the results of measurements are independent from
the working air gap (if this gap is up to 10 mm for the probe with coil diameter 5 mm). JSC RII MSIA Spectrum produces the portable single-channel flaw detector VD-90NP (Fig. 1a) and 15-channel flaw detector VD-91NM (Fig. 1b). The main sphere of application of these flaw detectors is to control pipes of large diameter with protective coatings during their production and running. In this case the flaw detectors can discover the defects of 0.3 mm depth and more through the coating of 8 mm.

Figure1. Eddy current flaw detectors VD-90NP (а) и VD-91NM (б).

In-line eddy current flaw detector VD-41P (Fig. 2) was developed to control different metal assortment; it can be easily integrated into the flexible manufacturing line thanks to its wide communicational capabilities. The main difference from the analogues of the other manufacturers is the original design of the probe, which significantly improves signal-noise ratio using additional pair of differentially connected signal coils.

Figure 2. In-line eddy current flaw detector VD-41P
Traditionally, the aerospace industry is science intensive trend in Russia. Taking into consideration the complexity of the tasks and the high responsibility for the accuracy of the testing results, almost all the developments are made on the basis of the large-scale scientific researches. Significant progress was achieved in the field of thickness measurement of galvanic coatings, including multilayer coatings. JSC Constanta produces the wide range of equipment for eddy current thickness measurement of coatings now. The new development of this company is the thickness gage Constanta K6TS (Fig. 3a), it has a wide range of probes which allow to control almost all types of coatings in the range of 0.5 micron up to 120 mm.

![Figure 3. Eddy current flaw detectors: Constanta K6TS (a) and VD 3-81 EDDYCON with rotating probe (b)](image)

It is also important to say about the success of JSC Constanta in testing of carbon fibers, carbon-carbon composites and carbon-graphite materials. The special probes were developed for thickness measurement and flaw detection such as volume fiber damages, inclusions and thinning in nonwoven and woven carbon fibers and carbon-carbon composites.

NPP PromPribor shows traditionally European approach to design of eddy current flaw detectors and probes, as well as the presentation of testing results, in their flaw detector VD 3-81 Eddycon (Fig.3b). The testing results are presented in the form of complex plane; the traditional form of the probes is used. It will be convenient for those customers, who are accustomed to use the devices of Hocking and GE.

For aviation and aerospace industry JSC RII MSIA Spectrum has developed the following eddy current structurescopes, which allow to define mode of deformation and anisotropy of properties of aluminum alloys: eddy current structurescope VE-26NP, based on the phase method of metal conductivity measurement; and anisotropy conductivity gauge VAE-10N (Fig. 4) based on the amplitude method.
Research and Training Center "Cascad" has developed the unique eddy current device for quality control of superconducting wires, it can measure the proportion of copper and non-copper material and at the same time it is used for flaw detection in copper coating. The main problem was to develop the device with the stable probe parameters in order to avoid adjustment of equipment during the testing of long wires.

JSC SPC Molnia has developed 32-channel flaw detector for the automated control of outer surface of the main gas pipelines (Fig. 5). The unique feature of this flaw detector is complicated mathematical treatment of testing results, using the wavelet and Fourier transformations. It significantly improved its accuracy.

It should be noted that there is intense competition among the Russian manufacturers of NDT equipment, as well as between the Russian and foreign companies. The producers in Russia are usually specialized in specific area of NDT tools application. Some companies manufacture only portable small devices, others focus on the automated industrial metal-consuming NDT systems. The companies can be also divided according to the type of manufactured devices: thickness gauges, flaw detectors, structurescopes, etc.

If we look at the price situation on the market of eddy current NDT tools, the Russian manufacturers offer their tools 3 or more times cheaper than their foreign competitors, when the tools have similar characteristics. High reliability of the equipment is achieved thanks to the actual elemental base and manufacturing technology.
Рис. 5. Multi-channel automated eddy current flaw detector for gas pipelines control during re-insulation of pipelines.

References