1.14.22. LONG-TERM CONTROL OVER SERVICE LIFE INDICES OF METAL STRUCTURES

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1. Methods of early diagnostics of cracks in structures of transfer cranes using magnetic structuroscope. One of the factors preconditioning the ageing and wear of structures is cyclic exposure, i.e. multiply repeated loads and strains.

For metal structures operating under cyclic loads, local ageing or local wear of material in certain zones called as stress concentrators is characteristic feature. End result of cyclic exposure is occurrence of micro-macro-cracks in a material. Unfortunately, regulations (PB 10-382-00 "Rules on arrangement and safe operation of cargo lifting cranes") and standards do not specify the minimal size of admissible cracks. Probably, cracks detected by traditional flaw detection methods (ultrasonic, magnetic particle testing; visual and measuring control) should be considered as inadmissible.

Revealing of structure sections having exhausted their cyclic strength is one of the tasks of specialists performing on-site inspections of construction. Here, zones, where occurrence of cracks within the period between inspections is most probable, is meant.

Large number of studies are devoted to the problem of operative field search of local worn-out sections defining the service life of construction. During examination of transfer cranes of various design by the OAO "SibPSC" specialists, magnetic characteristic of metal – "coercive force" – is measured in the most loaded points. Magnetic characteristics are determined by means of structuroscope KRM-C-K2M under the methodology RD IKC "KRAN"-007-97/02 (RD IKC "Kran" -07-97/02 "Magnetic testing of stressed-strained state and remaining service life of lifting structures during performance of their inspection and technical diagnostics (expert examination of industrial safety)" – M.: 2002.

Examples of studies are presented that were performed by the OJSC "SibPSC" specialists on the lower booms of hollow beams of transfer crane manufactured in 1969 by VTA KRAFT (DDR) and in upper, mostly loaded zones of field butt welds of the span shell near supports of tubular crane manufactured in 1975 by the PO "Sibtyazhmash" (Krasnoyarsk).

Comparison of calculated estimations, field measurements, analysis of coercive force values, as well as results of laboratory micro-structural studies are presented. Presented graphs and figures demonstrate satisfactorily coincidence of research results.

Conclusion. Coercive force is an integral characteristic of material responding to all variations in the structure of steel.

As non-destructive testing of any other types, method can serve as one of criteria during adoption of one or another engineering decision on operational conditions of diagnosticated equipment in the intervals between examinations.

With all its drawbacks related mainly with insufficient methodological elaboration, this method can be used for operative, on-site testing of the metal structures state.

2. Long-term control over service life indices of metal structures (specimens-witnesses of remaining service life). In essence, above presented examples are the cases of early detection of the working-out of remaining operation time by individual zones of

metal structures. Naturally, any measurement methods possesses with certain accuracy, trustworthiness, etc.

The most correct method for determination of remaining service life of operated structures is to take and study comprehensively samples of metal from bearing structures. By the state of metal, it is possible to speak with certain degree of probability about the material degradation extent and, hence, working-out of the remaining operation time of structure. Results of an analysis of material taken from the main bearing structure of crane can be called as results of monitoring of the construction state.

In fact, piece of metal was within the composition of crane structure from the moment of its manufacturing and was taking up all loads and exposures. Unfortunately, such method of determination of the remaining service life has no prospects due to the fact that sampling by itself varies significantly the shape of structure and, hence, reduces considerable the service life of remaining structure.

For the long-term control, it is proposed to attach to structures specimens possessing with known and given in advance characteristics. Specimens are installed on structures in cartridges. Every specimen within a cartridge possesses with cyclic strength characteristics corresponding with different terms of working-out of the predicted remaining service life – 10, 50, 80, 90%, for example. By the destruction of first specimens, it is possible to adjust indices of subsequent ones. Finally, accuracy of service life determination by the results of detection of destructions in first three specimens must be high enough (due to availability of statistical data). Process of observation over specimens does not present any complexity: it is necessary only to inspect periodically cartridges with record of appeared specimen destructions in log. By the set of destruction data, engineer in charge for the crane safe operation can estimate the remaining service life of crane.

Proposal fits well into the solution of problem of endurance tests of experimental models of large-size cranes, which, in my opinion, are performed rarely under RD (ruling documents) requirements… Through application of specimens, manufacturing plant can observe its cranes operated within functioning production facilities and obtain even through a quite short period of time data on service life of assemblies and elements. To that end, to set other characteristics of specimens within a cartridge – 1, 3, 5, 10% of service life, for example. We have succeeded to achieve installation of specimens-witnesses of remaining service life on a metal structure of casting crane within one of the metallurgical enterprises.

In the process of installation, the following methods were debugged:

- setting of endurance characteristics of specimens;
- installation of specimens and control over their state;
- methods of determination of service life of crane metal structures by indices of specimens.