THE CYBER-PHYSICAL SYSTEM FOR COULOSTATIC EXPERIMENT. THE CORROSION MONITORING UNIT

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The term 'cyber-physical systems' refers to integration of computation with physical processes [2]. Usually, the term used to describe embedded systems as well as networks monitoring and controlling physical processes which, through feedback circuits, can affect computation flows. They combine cyber capabilities (communication, computation and control) with physical capabilities (sensing and actuation) to solve problems that neither part could solve alone. Many contemporary experiments in sciences, in particular in physics, require the observation of experiment outcomes with IT devices. The combination of physical experiments and IT devices can be seen as a special case of CPS.

Methods and devices for estimation of corrosional losses or corrosion rate constitute the basis of the corrosion monitoring. Electrochemical methods are very popular. They can be easily automated, are highly sensitive (corresponding threshold of mass losses detection is 10^{-9} g) and allow to determine instant values of corrosion rate. Among them the techniques registering the respond for applied direct or alternative signal seem to have the best perspectives. This group that includes the polarisation resistance method, impedance spectroscopy, coulostatic and other relaxational techniques is based on assumption of direct relations between corrosion rate and such characteristics like polarization resistance R_p and charge transfer resistance R_F.

In this case the whole process of corrosion rate measurement can be divided onto three stages: 1) determination of the process' mechanism, selection of corresponding definition of R_p and equations which depict relations between the mathematical model parameters and characteristic constants of the process; 2) determination of corresponding constants and calculation of parameters; 3) determination of R_p and calculation of corrosion rate.

One must note that there is plenty of factors those can change dramatically the whole scope of concepts mentioned at the first stage description: passivation,

hydrodynamic mode, presence of inhibitors or other surfactants, chemical or physical inhomogeneity of corroded system, and the like. Hence, time limitations for the determination process occur and requirements to the computer system can be described in terms of requirements to the cyber-physical one. From other side, in this specific case of electrochemical measurements some functions of the CPS described earlier [1] become not actual; e.g., potential/current programming control, sensor preparation/renovation; others, such as thermal and hydrodynamic control, reagents input are getting more important.

References

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