APPLICATION OF THE TRACER TRANSIT TIME METHOD FOR FLOW MEASUREMENTS IN CONTROL SYSTEMS

The works and research described in this doctoral dissertation can be divided into two groups: the first one related to the issue of the open channel flow measurement and the second one related to the research on the possibility of using recorded time courses of tracer concentration to determine dynamic parameters of the systems under consideration. The common plane of both issues is the use of sodium chloride and the analysis of the time courses of its concentration in order to obtain information on the object through which the examined medium flows.

The dissertation thesis adopted by the author directs the research contained therein to identify the possibility of improving the metrological properties of the tracer transit time flow measurement method through the appropriate design of the measuring system and the application of appropriate methods for the analysis of the measurement results and verifying the possibility of determining the dynamic parameters of the control object using tracer methods.

The first part of the thesis contains a detailed study of the tracer transit time flow measurement for open channels with the use of sodium chloride as a tracer. This method, mainly described in the literature in the context of flow measurements in closed ducts, was applied by the author to the flow measurement in open ducts. In the course of the work carried out, the influence of all aspects of the method was carefully analyzed in order to obtain the most accurate measurement results. This part of the work concludes with the verification of the thesis by performing the measurement and estimating its uncertainty. The algorithm developed by the author for processing concentration time courses was also applied to historical data obtained by other authors as part of the verification. The results of own measurements, as well as the analysis of historical data, have ended with a satisfactory result, thus confirming the thesis adopted by the author.

The second part of the work was focused to the application of tracer methods for analysis of dynamic parameters of a sonochemical reactor. The author joined a team working on the recognition of properties and development of a control algorithm for a sonochemical reactor and applied tracer methods to determine the dynamic properties of this reactor. The experimental and research stage of this part of the work consisted in the application of the analysis of the residence time distribution to determine the mixing parameters for the sonochemical reactor and the comparison of the results obtained for the same object with sonification on and off. The experiments conducted allowed determination of the dynamic parameters of the reactor under study, and also demonstrated differences in reactor behavior with sonication on and off. The presented methodology was applied in the works of the team the author joined. These works concerned the control of processes in the studied object. The results obtained in the form of dynamic parameters (time constant and retardation of the sonochemical reactor) confirmed the thesis put forward by the author that estimation of the shape parameters of the tracer residence time distribution function would enable determination of the retardation and the time constant of the object under investigation, also for the case of back mixing which occurred in the sonochemical reactor.