THE WAYS OF PRODUCING UNIFIED MATHEMATICAL MODELS WITH REGARD TO DESIGN OF INNOVATIVE CAVITATION TECHNOLOGIES

Ivanitsky G., Konyk A., Nedbaylo A.E., Tcelen B., Gozhenko L.

Institute of Engineering Thermophysics of the National Academy of Sciences of Ukraine, 2a, Zhelyabova Str., Kyiv, 03680, Ukraine

Phone. (+38044) 424-14-96, *E-mail: ittf_tds@ukr.net*

In recent years there has been a trend of widespread use of hydrodynamic cavitation in various technologies, such as wastewater treatment, preparation of nanoemulsions, biodiesel synthesis, water disinfection, and others.

The study of the cavitation phenomena with the view to its using for intensification of various technological operations, associated with processing heterogeneous liquid media, first of all in biotechnologies requires the clear understanding of most important features of the cavitation processes and ability of predicting the influence of main determinative factors as well.

It is established that at present time there is no clear theoretical basis for understanding the possibilities and limitations of the cavitation devices used in solving specific problems. It is shown that the simulation of the operation of hydrodynamic reactors is based, for the present, on empirical approaches. Obviously, the study of the phenomena of cavitation for the purpose of their rational and effective use in industrial technologies requires a unified approach to the analysis of cavitation mechanisms and the prediction of their action on the object under study, regardless of the type of cavitation reactor.

The present work highlights the different aspects of hydrodynamic cavitation including the basic mechanisms, as well as bubble dynamics analysis with recommendations for optimum operating parameters and reactor designs. The ways of construction of general mathematical model of cavitation reactors, which is based both on the results of own comprehensive research on cavitation methods and on the analysis of publications on the topics, are discussed.

Universal mathematical models are proposed, which from thermodynamic positions, and with maximum consideration of the determining factors describe adequately the dynamics of single bubbles and bubble clusters in a wide range of regime parameters change without using limiting assumptions. Within the framework of the model, a number of factors and physical mechanisms are considered, which influence the effectiveness of the cavitation effects. The ways of further modification of these models are discussed with regard to the problem of optimizing cavitation reactor operation.

The proposed methodology can be considered as an initial stage in the development of effective cavitation devices, with reference to the creation of innovative technologies based on the selection of the rational design of cavitation reactors and their optimum operation modes.