REMOTE SUPPLY MIXING ENERGY TO THE LIQUID

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Abstract

The main problems facing the equipment, where the cultivation process is to ensure the processes of heat and mass transfer in devices, presence of turbulent and stagnant zones, high energy consumption, low heat transfer coefficients when working with viscous fluids.

For the purpose of experimental studies selected weighing the advantages of remote control heat transfer in bioreactors production lines using ultrasonic beam compared to contact methods.

Keywords: *bioreactor, aberration, caustic zone.*

Introduction. The period of rapid development of technology, humanity is increasingly faced with the use of well-known means to perform new, unusual tasks. For example, the mixing process is found in almost every industry, but in most of these industries, the question is not only the implementation of a qualitative process, as evidenced by the equalization of concentration throughout the volume of the medium, but also to prevent foreign components from getting into the medium that is mixed [1].

The most common way to carry out the mixing process is to apply energy by mechanical stirring with a stirrer. To implement the proposed method, it is necessary to introduce a shaft of a mixing device with a stirrer mounted on the shaft, but in this case a number of problems arise, the main one is the sealing of the shaft insertion point. Firstly, the shaft seal does not guarantee that the leakage of foreign microorganisms and contaminants from penetrating the apparatus volume, and secondly, the establishment of any seal results in a loss of friction power in it.

Another possible way is to supply energy due to air or oxygen bubbles that pass evenly through the layer of working fluid; this method is more expedient from the point of view of preventing the ingress of foreign substances, but is accompanied by the formation of stagnant zones in the apparatus [2].

Application of mixing processes for the intensification of chemical, thermal and diffusion processes, which create better conditions for bringing the substance into the reaction zone, to the boundary of the phase separation or to the heat transfer surface. Increasing the turbulence of the heterogeneous system achieved by mixing leads to a significant reduction in the thickness of the boundary layer, to the increase and continuous renewal of the surface of the interacting phases [3].

Methods and materials. The study was conducted on a test bench, based on the installation of UZP-6-1, consisting of 6 emitters with a total power of 300 W and an ultrasound frequency of 36 kHz, which are placed in a submersible unit.

In the field of ultrasonic radiation is placed a cylindrical glass container filled with liquid. A metallic equilateral triangle is introduced into the volume of the fluid, which is fixed at one of the vertices (Figure 1).

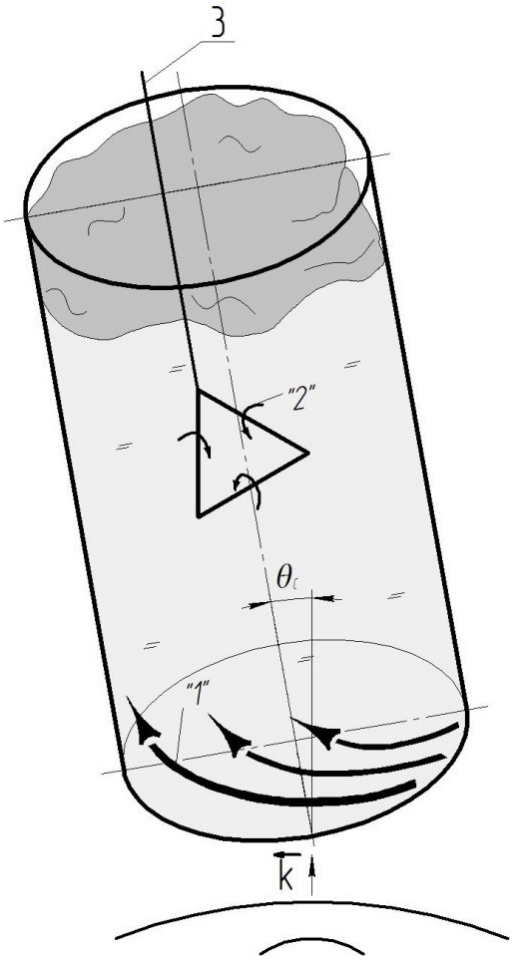

Fig. 1 Visualization of the action of ultrasonic radiation on a metallic triangle in the volume of the working fluid: "1" – global moving stream, "2" – local streams, 3 – triangle holder, k – wave vector.

To increase the efficiency of irradiation and significantly increase the amount of energy that passes through the shell and into the volume of the working fluid, it is necessary to place the body of the container under study at an angle θ_c to the direction of propagation of the ultrasonic wave.

Results and discussion. Sound waves that have passed through the walls of the body and penetrate into the working fluid form a zone of concentration of sound energy and force the liquid to move along the inner surface of the body along an ascending cylindrical spiral, forming a global driving flow throughout the volume. Also, the activity zone is observed in the plane of the triangle, where local flows are formed, twist around the sides of the triangle, thus pulling the fluid layers from the outside inwards (Figure 1). Peripheral layers of fluid and bottom layers move in a horizontal and vertical plane without leaving stagnant zones in the volume of working fluid.

Due to the use of this method of energy supply, it is possible to prevent the use of mechanical mixing devices, the function of which can be performed by penetrating acoustic radiation.

Conclusion. The investigation of the state of a metallic equilateral triangle immersed in a liquid was conducted. The formation of a global moving stream under the action of a sound beam and local, smaller in power flows has been experimentally proved.

It is determined that the sound waves emitted by the longitudinal wave of the vessel into the liquid, serve to the accumulation of sound energy, which generates an upward powerful driving stream in the form of a cylindrical spiral. Thus, there is a turbulization of fluid throughout the volume of the medium, which is complemented by areas of concentration of sound energy in the plane of the triangle.

Determination of specific irradiation parameters makes it possible to more widely apply the properties of resonant manifestations of the influence of sound waves on the volume of working fluid with minimal energy expenditure.

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