

P-12: Cavitation Occurrence by the Vibro-Resonance Method

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Increasing rates of industrial application of cavitation in various chemical and manufacturing processes confirms the uniqueness of its technological capabilities. Therefore, in recent years an increasing number of scientific studies is devoted to optimizing of cavitation processes and improving of cavitation equipment. So, the most common methods of cavitation treatment are ultrasonic and hydrodynamic, which although are a universal, but have some drawbacks. Thus, the ultrasound treatment that is strongest among other types of cavitation treatment is still low productive and mostly discrete. Variety of hydrodynamic cavitation process is highly productive, but does not provide high intensity of cavitation fields. Therefore, there is need in creating of a new method of cavitation treatment, which can combine advantages of existing ones.

We have developed and investigated a new method, which is characterized by a considerable level of intensity of cavitation fields in combination with continuous productive treatment. The method is called vibro-resonance method (VRM) of cavitation processing and its feature is the occurrence of cavitation field in the resonant oscillation regimes of cavitation nuclei in the treated liquids (Pat. Ukraine N66323; Pat. Ukraine N66550). A base component of vibro-resonance cavitators is vibrating plates with holes for the flowing fluid, immersed in a processed liquid. Electromagnetic vibrodrive provides vibration plate of motions, and provides variable frequency oscillations. Processing of liquids has been carried out at low frequency (25-250 Hz) of vibration plates. The peculiarity is that for certain processed liquids with a specified range was chosen the frequency of vibration of cavitation occurrence plates, which is equal to the own frequencies of vibration motions of cavitation nuclei, existing in the liquid.

It is known that in the oscillating systems during matching or multiplicity of frequencies of external located energetic impact with frequencies of own vibration sharply increases the amplitude of vibrational displacement and oscillating system moves in resonance. Thus, if an external energetic impact is longer in time, then oscillating resonance becomes stable, and its existence is supported by the minimum values of external energetic influence. Exactly this property of oscillating systems was underlying of VRM of cavitation occurrence. Frequency range, which is equal to the resonant frequencies of cavitation nuclei oscillations was experimentally determined due to chemical, physical and mechanical properties of the treated liquid. Further processing of the liquid has been carried out under the resonant regime with the maximum achievable oscillations amplitude of cavitation nuclei. Exactly this regime is accompanied by the formation of cavitation fields of maximum intensity, minimum energy for cavitation processing, and its maximum efficiency.

VRM of cavitation treatment was approved for the activation of tap water in the experimental setup. For 15 minutes at the amplitude of vibrations of cavitation occurrence plates of 2-2.5 mm and resonant frequency of 75-80 Hz has been processed 10 liters of water. The result of water treatment is its restructured, which lead to modification of water clusters structure. Water clusters in such form are better absorbed by organisms and plants. Thus, the amount of energy was about 160 W.

References

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