The Influence of the Nature of the Gas into the Cavitation Destruction Organic and Biological Contanination of Wastewater from Brewing Industry

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Abstract – The influence of the nature of the gas (oxygen, nitrogen, a mixture of nitrogen and oxygen in the ration of 1:1) on the efficiency of ultrasound treatment has been investigated . The degrees of the destruction of organic substances and the degrees of water disinfection have been calculated.

Keywords – ultrasound cavitation, the degree of the destruction of organic substances, the degree of water disinfection, wastewater treatment, the nature of the gas.

I. Introduction

One of the important problem of the modern water purification is insufficient level of wastewater treatment without damage to the environment and people's health. Small amount of fresh water causes the reuse of wastewater for technological purposes. However, this cannot always be done, because modern technologies of water purification, mostly,do not provide the appropriate level of purification. So, it is necessary to modernize them and introduce new technologies of water purification.

One of the new methods is ultrasounds water purification. Ultrasound has a destroying effect into organic and biological contaminants, which are the basic components of wastewater from biotechnology production [1].

II. Experimental part

The process rate and the degree of the purification of polluted water under ultrasound action depends on the conditionals of the process. The experiments were carried out at the constant parameters, means frequency of 22 kHz, temperature of 298 K, pressure of 1 • 105 Pa, process duration of 1-120 min.,the nature of the gas being the only variable . We use oxygen, nitrogen and a mixture of nitrogen and oxygen in the ration of 1:1. The object of the study was the wastewater of «Brewery Kumpel ».

The main indexes in determining the influence of ultrasound to the wastewater treatment of «Brewery Kumpel » are chemical oxygen consumption and microbial number. Based on the obtained experimental data chemical oxygen consumption and microbial number the calculation of the degrees of the destruction of organic substances and the degrees of water disinfection under the influence of various gases on the water purification process have been conducted. The degrees of the water purification have been calculated for the final value chemical oxygen consumption and microbial number (in the 120 min of ultrasound effect to these samples of water).

Comparing obtained results of the destruction of organic substances during bubbling the gases of different nature (fig.1) the lowest degree of water purification has been achieved during oxygen bubbling -7,5 %. Better result has been obtained during nitrogen bubbling -11,67 %. The highest degree of the destruction of organic substances has been observed during common action of nitrogen and oxygen – 35,29 %. Exposing the wastewater under ultrasound action during 120 min have obtained the degree of purification 47,37 % has been obtained, which is 1,3 times higher, than during the action of the most efficient gas – mixture of oxygen and nitrogen in the ration of 1:1.

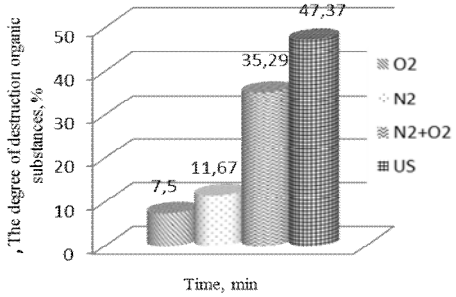

Fig. 1 Dependence of the degree of destruction of organic substances on the influence of gases of different nature

Conducting similar comparison of influence the nature of the bubbling gas to the degree of water disinfection from biological contaminants (fig.2), we can observe the lowest degree of water disinfection during bubbling nitrogen – 26,22%. Oxygen bubbling and the action of the ultrasound itself has shown close values of the degree of the water disinfection – 39,34 % for oxygen and 40,76 % for ultrasound. The highest value has been achieved during bubbling the mixture of oxygen and nitrogen in the ration of 1:1 – 41,58 %.

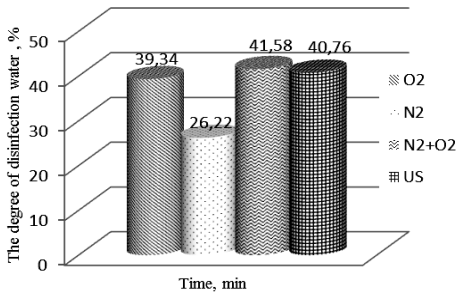

Fig. 2 Dependence of the degree of water disinfection from the influence of gases of different nature

In further research it is advisable to consider the action of the separate gas to the water purification process from organic and biological contaminants, exactly nitrogen. Under different conditions of the process,exactly when we use the action of the ultrasound itself, bubbling gas and common action ultrasound with gase, we can observe

a certain regularity for the degree of the destruction of organic substances (fig.3.) and for the degree of water disinfection (fig.4.). The lowest results in both cases have been achieved during bubbling the nitrogen itself, the degree of the destruction of organic substances is 11,67 % and the degree of water disinfection is 26,22%.

Average results have been achieved under the action of ultrasound itself. For the degree of the destruction of organic substances it is 47,37% and for the degrees of water disinfection it is 40,76 %.

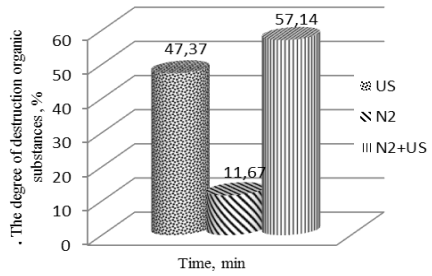

Fig. 3 Dependence the degree of the destruction of organic substances from the conditianals of the process

The deepest purification from organic and micro-biological contaminants has been observed during the common action of ultrasound with nitrogen. The degree of the destruction of organic substances is 57,14%,which is five times higher,than the action of the gas itself and 1,3 times higher than the action of ultrasound itself. The degree of water disinfection is 86,93%, which is 3,3 times higher than the action of the nitrogen itself and 2,1 times higher than sounding water, which confirms again the expediency of the common usage of ultrasound and nitrogen.

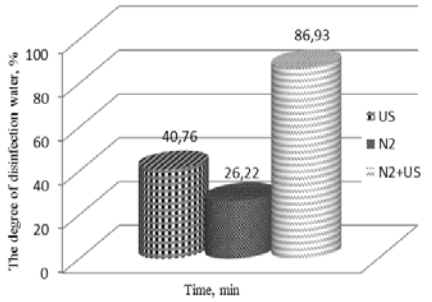

Fig. 4 Dependence the degree of water disinfection from the conditianals of the process

Comparing the effect of all gases (oxygen, nitrogen, a mixture of nitrogen and oxygen in the ration of 1:1) in cavitation conditionals with the effect of the ultrasound itself (fig.5.) has been established that in ultasound field the least expedient is the common action of ultrasound and the mixture of nitrogen and oxygen in the ration of 1:1 (the degree of the destruction of organic substances is 16,67 %). The degree of the destruction of organic substances during oxygen bubbling is average – 31,25 %. The effect of ultrasoun itself is better, than its common action with oxygen and with the mixture of nitrogen and oxygen (the degree of the destruction of organic substances is 47,37 %), but less effective than sounding of wastewater in an atmosphere of nitrogen (the degree of the destruction of organic substances is 57,14 %, which is 3,4 times better than using ultrasound with mixture of nitrogen and oxygen in the ration of 1:1.

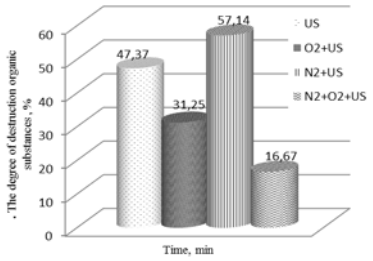

Fig. 5 Dependence the degree of the destruction of organic substances from the nature of the gases into the cavitation conditianals

For desinfection wastewater into cavitation conditionals (fig.6.) bubbling the mixture of the gases and the action of ultrasound itself have shown close values (38,16% and 40,76% accordingly). The common action of ultrasound and oxygen is more effective, we have reached the degree of water disinfection 81,05%, which is 2 times higher than the action of ultrasound itself and bubbling the mixtures of the gases. But the most expedient is the common action of nitrogen and ultrasound, the degree of the destruction of organic substances is 86,93 %.

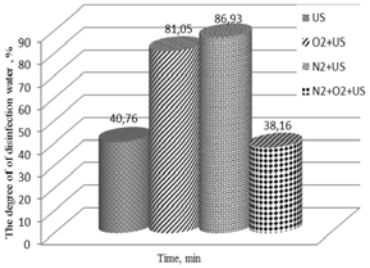

Fig. 6 Dependence the degree of of disinfection water from the nature of the gases into the cavitation conditianals

Conclusion

The degrees of the destruction of organic substances and the degrees of water disinfection has been calculated. Has been proved that the ultrasound cavitation destroy organic compounds and has negative effect to biological contamination, which are contained in wastewater. Has been determined that the common action ultrasound with gases are more effective than the effect from the gases itself. The highest purification effect has been achieved during the common action of ultrasound and nitrogen. The highest degree of the destruction of organic substances is 57,14 % and the highest degree of water disinfection is 86,93 %.

References

[1] S. Nasseri, F. Vaezi, A. H. Mahvi, R. Nabizadeh, S. Haddadi, “Determination of the ultrasonic effectiveness in advanced wastewater treatment”, J. Environ. Health. Sci. Eng., ran, vol. 3, no 2, pp. 109-116, 2006.