UDC 66.021:628

USE OF A ROTOR-PULSATION APPARATUS TO INCREASE THE EFFICIENCY OF THE OXYGEN ABSORPTION PROCESS IN AQUEOUS SOLUTIONS

Dr. Sci., Professor Obodovych O.M.[1], PhD Buliy Y.V.[2], PhD Pereiaslavtseva O.O.[1],

PhD Stepanova O.E.[1]

[1]Institute of Engineering Thermophysics of the National Academy of Sciences of Ukraine

[2]National University of Food Technologies

Abstract: Experimental studies of the process of oxygen absorption in aqueous solutions using a rotary-pulsation apparatus (RPA), which implements the method of discrete-pulse energy input, have been carried out. As a result of research, the values of the parameters characterizing the efficiency of aeration, namely the oxidizing capacity of aeration for different modes of operation of the dispersant-mixer, were obtained. The high efficiency of using RPA has been proven in comparison with some aeration devices.

Анотація: Проведено експериментальні дослідження процесу абсорбції кисню у водних розчинах при використанні роторно-пульсаційного апарату (РПА), в якому реалізується метод дискретно-імпульсного введення енергії. В результаті досліджень було отримано значення параметрів, що характеризують ефективність аерації, а саме окислювальної здатності аерації для різних режимів роботи диспергатора-змішувача. Висока ефективність використання РПА доведена у порівнянні з деякими аераційними пристроями.

KEYWORDS: ROTOR-PULSATION APPARATUS, AERATION, OXIDIZING CAPACITY, DISPERSANT-MIXER. КЛЮЧОВІ СЛОВА: РОТОРНО-ПУЛЬСАЦІЙНИЙ АПАРАТ, АЕРАЦІЯ, ОКИСЛЮВАЛЬНА ЗДАТНОСТЬ, ДИСПЕРГАТОР-ЗМІШУВАЧ.

The principle of energy-saving equipment consists in the maximum use of the supplied energy to obtain the final product. Rotary-pulsation apparatus (RPA) refers to devices that are widely used for obtaining finely dispersed emulsions, suspensions and for homogenization of liquid mixtures. They are also used in the microbiological, food and dairy industries, where production processes involve high-speed chemical reactions. The intensification of physico-chemical processes in RPA leads to a significant reduction of consumed energy, reduction of equipment dimensions, combination of several technological processes in one device. Some technologies that use RPA as part of the implementation of the method of discrete-pulse energy input are considered in [1].

The purpose of the work is to evaluate the efficiency of using a rotarypulsation apparatus in the process of aerating aqueous solutions. The experimental setup consists of a vessel with a total volume of 50 l, a disperser-mixer, an ejector assembly, a recirculation pipeline, an air duct, an electric motor, the shaft of which is connected to the shaft of the disperser-mixer through transmission and bearing assemblies. The stuffing box ensures the tightness of the disperser-mixer. A control and control unit (CCU) consisting of a frequency converter, an ammeter, and an electricity meter is provided to control the frequency of rotation of the rotor and control the energy consumed. Determination of the

efficiency of aeration is based on the use of chemical oxidation with oxygen of the air supplied to the installation, sodium sulfite, which is a component of the aqueous model solution. As a result of research, the values of the parameters characterizing the efficiency of aeration, namely the oxidizing capacity of aeration for different modes of operation of the dispersant-mixer, were obtained.

Comparative characteristics of aeration conditions, sulfite number and energy consumption of some aeration devices according to the proposed generalized aeration criterion are given in table 1.

Table 1

Comparative characteristics of aeration conditions, sulfite number and energy consumption of some aeration devices

Typ aeratora	Air consumption, m3 /h	K_L, h -1	Oxidizing capacity, kg O2 /m3 h	Aeration efficiency, kg O2 /(kW·h)
Rehau length 75 cm; the height of the water layer 45 cm [2]	3,9	19,33	2,01	3,77
Perforated stirrer №/K8, TL =32,3 ^{o}C [3]	н/д	2153,0	10,50	0,24
Rotary-pulsation apparatus (n= 47, 5 rpm)	0,54	1909,0	5,0	50,0

Conclusions:

The work experimentally proved the high efficiency of using rotarypulsation devices in the process of oxygen saturation of aqueous solutions. The presence of a stator allows to increase the speed of mass transfer by more than 50%. When comparing the efficiency of aeration with some installations, it was determined that the specific energy consumption per unit of dissolved oxygen was an order of magnitude lower than samples of pneumatic and mechanical aeration.

LITERATURE:

1. Микро- и наноуровневые процессы в технологиях ДИВЭ: Тематический сборник статей/ под общей ред. А.А. Долинского; Институт технической теплофизики НАН Украины. – К. Академпериодика, 2015. – 464 с.

2. Серпокрылов Н. С. Снижение энергопотребления систем аэрации сточных вод / Н. С. Серпокрылов, А. С. Смоляниченко.// Вестник ТГАСУ. – 2010. – №3. – С. 192–199.

3. Хабибрахманов Р.Б. Исследование массообменных характеристик аппаратов с перфорированными мешалками сульфитным методом / Р. Б. Хабибрахманов, С. Г. Мухачев. // Вестник Казанского технологического университета. – 2014. –Т.17, №2. – С.140-143.