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Design of a Reactor for the Preparation of Disinfectants

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Abstract

The design of an automatic reactor for the elaboration of disinfectants was carried out, based on the identification of the process variables at the laboratory level, to determine the physical parameters of the sizing of the equipment, for which, the process variables were determined. Laboratory level as: pH, temperature, density, viscosity, turbidity, consistency, foam level and residence time for the product, as well as: diameter, height, power, length of the agitator, diameter of the agitator and revolutions per minute for the team. With the design of the reactor, the process was simulated by producing a disinfectant with different characteristics (color, odor), of each sample, determining the density and viscosity for later, with these data proceed to calculate the power of the agitator, height and diameter of the reactor values thus obtained to compare them with the data of the equipment and validate the same with the components of agitation and mixing, demonstrating in this way that the equipment meets the design characteristics.

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Keywords

Disinfectants, Variables, Process, Reactor, Automation, Design, Validation.

Introduction

The technological advance goes hand in hand with the research and design of new equipment and processes that allow a constant innovation in industrial production systems (BRITO, 2001) in its different areas, thus achieving economic dynamism and the development of a country, for this reason in the laboratories of Unit Operations (BRITO, 2001) and industrial processes of the Faculty of Sciences of the Polytechnic School of Chimborazo is working on research to obtain new products with the design of equipment (BRITO, 2000) that help on the one hand to improve the education of their students and on the other hand, to improve the production system at local, regional and national level.

For the above, and in order to have a team to help develop disinfectants, the design of an automatic reactor (Diseño y construcción de un liofilizador para el secado de la remolacha azucarera, 2016) for the production of this product was carried out of cleaning, based on the identification of the process variables (Brito, Y Otros, 2017), subsequently carrying out the engineering calculations for the sizing of the reactor (Chuiza, Y Otros, 2009) with the following results: Volume of 130 L, a height of 0.62 m, a diameter of 0,58 m, the length of the agitator arm of 0,59 m, with a 1 Hp motor.

In order to validate the operation of the equipment (BRITO, 2000), a disinfectant was prepared, determining

the parameters established in the INEN 820 Standard of Ecuador (Instituto Ecuatoriano De Normalización (INEN), 1982), for which, We proceeded to pass the raw material through the head or bell, where the effects of shearing, crushing and collision of the particles are produced by the propeller, thus achieving a better and faster homogenization (Obtención de alcohol a partir de remolacha, 2016) obtaining the disinfectant with the following characteristics: density of 1,15 g/mL; the viscosity of 1,48 g/cm.s; turbidity of 10,48 NTU; pH equal to 7,66; Degree of Foam of, 0,66 mL and reaches a stability after 48 min (OCON, y otros, 1980), values that meet the quality standards of the established norm.

Therefore, it is shown that the equipment exceeds the efficiency of conventional agitators (GEANKOPLIS, 1991), developing a large work force with low engine power and minimal effort, decreasing the time in solutions, dispersions and emulsions, allowing This way a greater production translated into productivity..

Materials and Methods

In every design process, procedures are required that are formulated in a logical manner for the acquisition of information and compliance with objectives, that is, the product of the preparation of disinfectants and their use in different Industrial Fields (BRITO, 2001), it has been done through the selection of the most appropriate means and processes, since they are very useful for data analysis and decision making, that is, they help determine the process variables for the subsequent design of the equipment; that, it allows to discover properties of the phenomena, that in natural conditions it would be impossible to reveal them.

It is for this reason that the equipment was built to produce a disinfectant, for which, we proceeded with the mixture of quaternary ammonium in distilled water and prior drastic agitation add nonyl phenol, until a homogeneous mixture is obtained, later the dye and essence, cellosize is added and stirred, left to stand for approximately 24 hours for use, after which, laboratory tests were performed on: density, viscosity, pH, turbidity, etc., of the disinfectant, by means of the data collection, of the tests that were carried out in the equipment, Turbo Automatic Mixer, in addition the power of the motor that is used to obtain the disinfectants was calculated; in this way verifying and validating the operation of the built reactor (Fig. 1).

Results and Discussions

Team design

Once the variables that are involved in a stirring and mixing process have been identified (BRITO, 2000), the calculations were made to size the reactor and the values for this were: Volume = 130 L; Tank Height = 0,62 m; Diameter = 0,58 m; Arm Length = 0,59 m; etc., for this Automatic mixer size is recommended 1 Hp motor.

The reactor was built with AISI 304 Stainless Steel, as it is more resistant to corrosion, so it has a longer life time, which indicates that it is a steel of excellent quality (ESCOBAR, y otros, 2011).

With the validation of the reactor, the following operating conditions were established: rotation speed 7 Hz, optimum volume of mixing 130 L, with this a homogeneous mixture is obtained, which in itself is optimal for the stirring and mixing process (Elaboración De Una Tisana A Partir De Hojas De Aguacate (Persea Americana Mill), Orégano (Origanum Vulgare L.) Y Fibra De Coco, 2016).

Preparation of the disinfectant

The process variables for the preparation of the disinfectant are: Cellosize = 115 g, Quaternary Ammonium = 200 mL, Nonil Phenol = 200 ml, essence = 60 mL, Dye = 1 g; with this formulation, the specifications of the NTE INEN 820 standard are met, achieving a yield of 80% (Table 1–4).

Table.1a Sizing of the tank

No.	Description	Variable	Indicator
1	Volume	130	L
2	Height	0,62	m
3	Diameter	0,58	m
4	Material	Stainless steel304	--

Table.1b Sizing of the support structure

No.	Description	Variable	Indicator
1	Length	0,7	m
2	Base	0,6	m
3	Material	Molten iron	--

Table.2 Sizing of the agitation system

No.	Description	Variable	Indicator
1	Arm Length	0,59	m
2	Agitator thickness	0,03	m
3	Diameter of the Rodete	0,15	m
4	Distance from the Bottom of the Tank and the Rodete	0,03	m
5	High of thePalette	0,12	m
6	Number of pallets	2	--

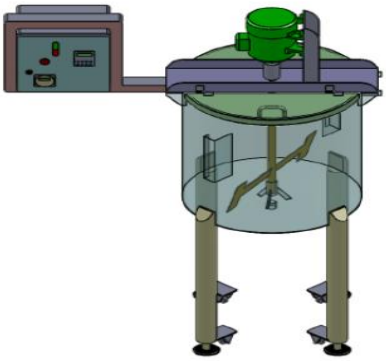
Table.3 Parameters of Topaz-scented disinfectant

No.	Disinfectants	Unidad	Valor
1	pH	pH	7,66
2	Densidad	g/mL	1,15
3	Viscosidad	g/cm.s	1,45
4	Turbiedad	NTU	10,48

Table.4 Degree of Topaz scented disinfectant foam

No.	Disinfectants	Muestra (mL)	Subida de Espuma (mL)	Diferencia Espuma (mL)	Tiempo (min)
1	Topacio	5	8,6	3,6	48

Figure.1 Reactor for the preparation of disinfectants



The disinfectant thus obtained was analyzed at the laboratory level, determining the following physical values: ρ = 1.15 g / mL, μ = 1.48 g / cm.s, turbidity = 10.48 NTU, degree of foaming = 3.66 ml, after 48 min. Chemical: pH = 7.66 and microbiological: agent concentration and disinfectant actuation time:

Before 4x103 CFU / cm2, then 5x101 CFU / cm2 these values indicate that aerobic mesophilic microorganisms were eliminated; due to the use of quaternary ammonium, which acts as a bactericide in the preparation of the disinfectant, the same that was handled under the standards of the NTE INEN for Active Tense Agents.

Conclusions of the study are as follows:

The design variables of the reactor are: Volume of 130 L, height of 0,62 m, diameter of 0,58 m, length of the Arm of 0,59 m and a motor of 1 Hp.

The disinfectant produced complies with the NTE INEN standards, after performing the respective analyzes, the following results of the test tests ρ equal to 1,15 g / mL are obtained; μ of 1,45 g / cm.s; Turbidity of 10,48 NTU; pH equal to 7,66; Degree of Foaming is of 3,66 mL and reaches a stability after 48 minutes and an effectiveness of the disinfectant of 98,75%.

The equipment was validated with the preparation of a disinfectant in 20 min, using a rotation speed (rpm) of 7 Hz, with a yield of 80% and an efficiency of 71%.

It is important to emphasize that the equipment has an automatic control panel, this allows to program the time of ignition, shutdown and mixing, due to the eight memories that the timer has and also to the different speeds presented by the frequency inverter that is of 1-10 Hertz, or what is the same from 60 to 600 Rpm.

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