The Extract Production Line with the Application of Ultrasonic Technologies

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***Annotation* – The article is devoted to the prospects of the development of the extract production line with the use of ultrasonic technologies. The advantages of the product, its novelty and economic efficiency of the development are also described in details.**

***Index Terms* – Extraction, technological line, ultrasound.**

I. INTRODUCTION

IN DIFFERENT branches of the industry there are similar problems at the production of new products. At the realization of dissolving, dispersion, emulsification, extraction, degassing, etc. it is necessary to accomplish the influence in dispersed media with liquid phase. If a new product should be in solid state or powdery, there is a need to use atomization with further drying, i.e. to realize the influence in gas-dispersed media. At the final stage the problem of packaging of ready product should be solved.

The problem is in a fact, that all stages of the manufacture of new product are various, and they all require individual approach to their acceleration.

One of the methods of the intensification of mentioned above technological processes is an energy influence by high-intensity mechanical vibrations of ultrasonic frequency on the technological process. There is a large number of the ultrasonic technological equipment of both Russian and foreign production. This equipment helps to realize separate technology. They are ultrasonic extractors, atomizers, dispersers, ultrasonic apparatuses for the welding of the thermoplastic materials and others [1] - [3].

General disadvantage of such equipment is its narrow orientation directed to the intensification one or few similar technological processes.

Thus at the production of new product it is necessary to propose such engineering solution, which allows taking into account all positive aspects of the ultrasonic action at different stages. One of the possible solutions is an integration of several highly specialized technological ultrasonic apparatuses in one production line. Such integration lets achieving synergetic effect.

II. THEORY

The technological line will be intended for the extraction of herbal raw material in order to extract useful substances in powdery or liquid state packed in hermetically sealed container. It will consist of different ultrasonic apparatuses of specialized function and auxiliary equipment.

It is supposed to realize following stages of the production.

1. Crushing of feedstock up to specified fraction.
2. Adding of extra agent in defined proportion for the extraction of useful substances.
3. Extraction and simultaneous mixing with the purpose of the extraction of useful substances.
4. Atomization with simultaneous drying of ready liquid extract. At that the extra agent can be returned to the second stage for repeated use.
5. Dosage of obtained useful substances (in powdery state) with simultaneous packaging into hermetically sealed container (it is possible to pack liquid extracts).

For the intensification of the extraction process high-intensity mechanical vibrations of ultrasonic frequency should be applied. Technically it can be achieved by the use of the ultrasonic technological apparatuses of the series “VOLNA”, “VOLNA-M” and “BULAVA”. Cavitation influence is able to accelerate the extraction process (speed enhancing of the process in hundreds of times and exit of useful substances) in comparison with other methods of the intensification.

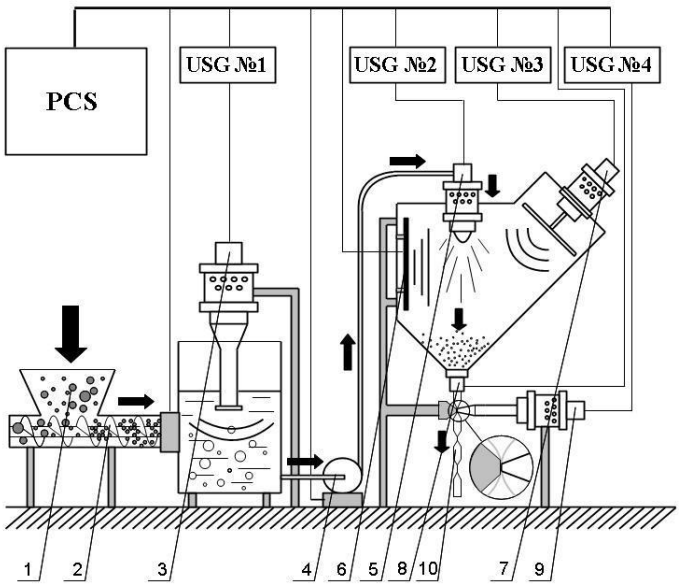
To obtain aerosol with specified dispersion of the drops the atomization from vibrating surface is used. It can be technically achieved due to the application of the apparatuses of ultrasonic liquid atomization of the series “TUMAN”. Ultrasonic atomization allows controlling the size of obtained aerosol (drop diameter and distribution).

Production of powdery useful substances is planning to achieve by convective drying (infrared heater). For the intensification of the drying process it is proposed to apply ultrasonic influence in gas-filled gaps. For this purpose the ultrasonic apparatuses of the series “SOLOVEY” are used. The generation of alternating acoustic pressure in gas medium leads to speed enhancing of drying in several times.

Hermetization of the seams at the packaging of obtained powdery useful substances in the container will be accomplished by high-intensity mechanical vibrations of ultrasonic frequency. It can be technically achieved by the application of the apparatuses of ultrasonic welding of the series “GIMINEY-ULTRA”, “GIMINEY-SH”. Under the action of ultrasonic vibrations qualitative and sealed welding seam between two welded thermoplastic materials without heating of them up to the melting temperature and without any (dust, moisture) in the zone of the generation of welding seam is formed.

Thus at the input we have only plant raw material, at the output of the line powdery or liquid useful substances packed in hermetically sealed container are obtained, i.e. the products which are ready to the sale and further application.

The structural diagram of the extract production process is shown in Fig.1.



PCS – Process Control System, USG – Ultrasonic Generator.

Fig. 1. Structural diagram of the extract production line with the use of ultrasonic technologies.

Plant raw material with the extra agent (1) is crushed by the auger (2). The mixture comes to the ultrasonic extractor (3). Obtained liquid extract containing useful extracted substances is supplied by the pump (4) to the column for drying. The aerosol is generated by the ultrasonic atomizer (5). The temperature for the evaporation of the extra agent is formed and maintained by the heater (6). For the acceleration of drying process obtained aerosol is in alternating acoustic field generated by the ultrasonic radiator (7). Received powdery product containing useful extracted substances comes to the dosing unit (8). The packaging into hermetically sealed containers is accomplished by the apparatus for ultrasonic welding (9) and ready packed product is obtained (10). Final product can be used as technological equipment for processing industry, for instance: food, pharmaceutical and chemical.

At present we design separate apparatuses and technologies, which can be integrated in the frame of the complex solution of the problem for the production of new product.

For the ultrasonic extraction there are apparatuses of the series "VOLNA", "VOLNA-M", "POTOK", "BULAVA" and "BULAVA-P" of different variants of performance. Consumed power is from 200 VA up to 8000 VA. Frequency of ultrasonic influence is 18 kHz, 22 kHz, 30 kHz.

For the ultrasonic atomization there are the apparatuses of the series "TUMAN" with various productivity of the atomization. Consumed power is from 100 VA up to 400 VA. Frequency of ultrasonic influence is 22 kHz, 35 kHz, 44 kHz.

For the ultrasonic drying there are the apparatuses of the series "SOLOVEY" of different variants of performance. Consumed power is from 100 VA up to 600 VA. The intensity of ultrasonic pressure is up to 150 dB. Frequency of ultrasonic influence is 22 kHz.

For the ultrasonic welding there are the apparatuses of the series "GIMINEY-ULTRA" and "GIMINEY-SH". Consumed power is from 100 VA up to 3000 VA. The methods of welding seam formation are continuous and press-seamed. The frequency of ultrasonic influence is 22 kHz, 27 kHz.

III. CONCLUSION

Thus proposed approach is used all the advantages presented by ultrasonic action in liquid, solid and gas media in one technological process. In one line several innovative technologies can be realized.

Large nomenclature of the ultrasonic equipment produced by the limited liability company "Center of ultrasonic technologies AltGTU" can be used in the line. The experience of the development of various lines by the specialists of the limited liability company "Center of ultrasonic technologies AltGTU" allows producing lines for the extraction of plant raw material for various productivity and for different raw material – from one kilogram to the ton of useful substances in working shift [4].

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