Література
1. Сборник рецептур блюд и кулинарных изделий: Для предприятий обществ. Питания / Авт.-сост.: А.И. Здобнов, В.А. Циганенко, М.И. Пересичный. – К.: Издательство А.С.К., 2002. – С. 102.
2. Прилуцкий В.И., Бахир В.М. Электрохимически активированная вода: аномальные свойства, механизм технологического действия.- М.: www.misrt, ru.

УДК

ENERGY EFFICIEENCY FOR DISTILLATION INSTALATIONS 2.PROCESSING OF SALVIA (*SALVIA SCLAREA* L.)

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A comparative analysis of technological regimes for the treatment of sage (Salvia sclarea L.) in Bulgaria and Russia by steam distillation. Presented is the total cost of steam, specific heat consumption and performance in stationary and mobile periodical and continuously operating distillation apparatus.
Key words: energy efficiency, distillation installations, salvia.

INTRODUCTION: Muskatnata sage (Salvia sclarea L.) is a perennial, herbaceous plant of the family *Lamiaceae*, which is grown in many European countries - Moldova, Ukraine, Russia, France, Italy, Spain, Bulgaria and others. The essential oil contained in the colors is used in perfumery and cosmetics, as well as isolation of linalylacetate [5, 8, 10].

In our country, four varieties were selected, shall conduct such processing is by steam distillation in periodically-acting stationary and mobile devices [4] and in constant-force apparatus [5].

In Ukraine and Russia in the distillation is conducted periodically, and continuously operating apparatus (apparatus Revazov-Moskalev – URM-2 and NDT-3M) [1, 9].

In the literature, no evidence for energy efficiency of distillation plants used in the processing of salvia.

In our previous study [12] determined the energy efficiency of distillation processes performed flower and leaf material (rose, lavender petals, pine needles and grass from geranium) processed in Bulgaria. Examined are the technological regimes of processed raw capacity of the distillation apparatus 5 m^3, in water-steam (rose) and steam (for other materials) distillation is fixed cost of steam and cooling water using 2 and 4 in the number of distillation equipment for distillery processing of raw material per cycle. Determined is the specific heat consumption i.e. proportion of the use of steam compared to the amount of raw material required for the cycle: a rose blossom – 2,3; lavender petals – 1.8; pine needles – 1.2 grass from geranium – 2.8. Found is the ratio of consumption of cooling water used in condenser-cooler to the quantity of processed raw material needed to cycle: a rose blossom - 1.3; lavender petals - 0.795; pine needles – 0.788 and geranium grass – 1.325 [12].

Akteryan was analyzed the energy efficiency of distillery capacity of the distillation apparatus 5 m^3, the processing of rose, lavender petals and pine top hamper [2]. The author states: specific fuel glowing vapor (kg steam / kg raw material), heat distillation (MJ heat / kg raw material) and the cost of cooling water in condenser-cooler (kg water / kg raw material). These indicators are as follows for the top hamper pine 0.72, 1.9 and 8.2, for lavender petals – 0.80, 1.6 and 4.7, for rose – 3.4, 9.5 and 24.1 , respectively. The differences that occur in the three materials with the author explains the different type of process, i.e. kind of distillation water-steam (for rose) and steam (for others) and technological parameters – speed, temperature and duration of the distillate process. The data show that the processing of raw materials essential oil distillation is an energy-intensive process.

Irinchev [6] was presented an experimental column for distillation of essential oils and floral-herbaceous material, such as indicators for the processing of sage, following consumption of steam for 1 t raw material is 294 kg/t (speed of distillation) and time processing of raw material in the work zone 20 min, when productivity 3,40 t/h.

Irinchev [6] was found that the processing of universal mint distillation apparatus with a capacity of 2,5 m^3 distillation rate is 5 %, while lavender and sage is 8 % and a continuously operating apparatus URM -2 – 51 %. The higher rate of distillation, which is used in continuous current apparatus, is reduced in almost half the consumption of steam (60 %). This high rate distillation is the main reason for obtaining essential oils with significantly higher ester content than if the same material could be distilled into universal distillation apparatus.

According Tanasienko [11] continuous apparatus URM-2 along with the pros have the following disadvantages: greater duration transport of digested material; – load of raw material from open bunker, hand-loading auger -insufficient density and manually load, which makes a significant loss of oil, leading to lower production output.

To avoid these shortcomings is developed NDT-3M apparatus, it is characterized by much higher performance as sage processing in NDT-3M – 3011 tons, and in the apparatus of the type URM-2 processing 857 tons, as compared between two continuously operating apparatus used for the processing of sage can be noted that the rate of distillation of NDT-3M is 625 l / h, and for URM-2 is 397, the cost of steam required to obtain 1 kg of oil is as follows: for NDT-3M is 147 kg, and for URM-2 is 167 kg [11].

It was found that processing in continuous-current machines received essential oil has a high content of basic component – linalylacetate, since distillation is shorter (35-60 min) and the amount of condensate units is less than [1, 4, 6, 9, 11].

Overall, it can be concluded that much better use of constant current device type NDT-3M than URM-2. It is known that the processing of raw materials essential oil in certain technological regimes are differences, due to the type of distillation (water-steam and steam) and the technological parameters of the distillation process (speed, temperature and duration of the distillation process).

The purpose of this work is a comparative analysis of technological regimes processing muscatna sage in Bulgaria and other countries as Russia and Ukraine, in stationary and mobile periodical and continuously operating distillation apparatus. MATERIALS AND METHODS: The estimated cost of steam for stationary periodical distillation apparatus with capacity 5 m^3, the most widely used in Bulgaria and 17 m^3 – work with existing mobile devices periodically. Distillation of whole raw technological parameters: bulk density 200 kg/m^3, speed 10…12 % distillate temperature 25 – 30 GA (optimal 45 – 50°), duration 1.5 to 2 h. It was found that cutting the raw material prior to loading apparatus leads to better utilization of volume 300 – 400 kg/m^3 [4]. The operation mode:

- Filling and heating of raw material – 40 min;
- Distillation – duration processing Sage – 120 min;
- Discharge of raw material and washing apparatus – 20 min.

In Bulgaria, as energy is used for dry saturated steam with the following parameters: pressure p = 0.6 MPa, temperature t = 159 °C, enthalpy i = 2757,2 kJ/kg and specific heat of evaporation r = 2082,2 kJ/kg [7]. In Russia for processing into sage distillation stationary device type PC-1500 is accompanied by the following process parameters: speed run – 75 – 90 l/h of distillate temperature – 35 – 40 °C, the loading density of the material - 150 – 200 kg/m^3; mean mass loading material in the volume of the cube – 290 kg; quantity of distillate, % by mass loading material – 40; duration of distillation – 1,75 h; Performance of camera – 105.0 hours, daily – 2530.0; oil content in waste % as raw material – 0,005; removal oil content % to output 90; oil content in the distillate,% (after Florence Court) – 0.054 [13]. The operation mode:

- Loading and closing the hatch 20 min;
- Supply of steam and heat the feedstock to the beginning of distillation 15 min;
- Distillation of essential oil feedstock 105 min;
- Stopping sets and dropping condensate 5 min;
- Opening hatch cover downloads and handling of waste 15 min;
- Preparation device for loading 5 min;
- a total of one complete cycle for processing Sage needed 165 min.

In Russia, using dry saturated or superheated steam. The pressure of steam in the highway 0.4 – 0.5 MPa, temperature of the superheated steam distillation of sage should not be greater than 150 °C. The water used in heat exchange apparatus must be clean with a temperature not higher 20 – 25 °C [8, 13].

In the processing of raw materials in mobile periodic distillation apparatus type KTT – 18 is fed dry saturated steam at a pressure of highways from 0.3 to 0.4 MPa. The rate of distillation is in the range 500 – 550 /h, temperature of the distillate 35-40 °C. Duration of distillation 1,5 – 2,0 h, productivity – 0,7 t/h. The duration of heating the raw material in the container (the beginning of distillation) – 20 – 30 min [13]. Full cycle of operations (load box, transport, distillation of essential oil discharge residue supply container box) is 3,5 h.

The technical characteristics of continuous-current apparatus URM-2: displacement of column is 3 m^3; performance 2,5 t/h; stay raw material in the column 30 – 45 min [6].

The technical characteristics of continuous-current apparatus NDT-3M are working volume of the column 4,9 m^3; output 3,2 – 3,5 t/h; stay raw material in the column 30 – 40 min [11].

RESULTS AND DISCUSSION: Table 1 summarizes the technological regimes for operating different types of distillation apparatus used in Bulgaria and Russia. Presented are data on mobile distillation apparatus KTT type – 18, periodic PC-1500 and continuing existing URM-2 and NDT-3M used in Russia. Calculated

parameters of mobile periodic distillation apparatus with a capacity of 17 m^3 and stationary periodic distillation apparatus with a capacity of 5 m^3 used in the processing of sage in Bulgaria as stationary periodic distillation apparatus calculations are made for processing of whole and cut raw material. The data shows that the largest specific heat consumption in the use of periodic-type distillation apparatus PC-1500 in Russia, followed by periodic ground processing equipment and all material in Bulgaria and the lowest is fuel specific heat at use of mobile distillation apparatus used in Russia and Bulgaria, then the corresponding constant current distillation apparatus used in Russia.

Table 1 – Comparisons of some technological parameters

Indicators	Mobile distillation apparatuses		Periodical operating distillation apparatuses			Continuously operating apparatuses	
	Type KTT-18	17 m^3	PC-1500	DA (whole)	DA (cut)	URM-2	NDT-3M
	Russia [9]	Bulgaria	Russia [13]	Bulgaria		Russia [13]	
Distillation rate, l/h	650-725	100	75-90	100	100	350-400	700-800
Temperature of distillate, °C	45-50	35	35-40	35	35	35-40	35
Quantity of leads distillate,% by weight of raw material	18	50	50	50	50	23-29	24
Specific consumption of heat kg steam / kg raw material	0,137	0,250	3,78	1,499	1,643	0,467	0,280

Differences obtained by calculating the specific heat consumption depends on technological parameters of the distillation process, namely the rate of distillation, the distillate temperature, duration of distillation. Depending on the speed of distillation can be said that at a lower rate of distillation range of 7.5 to 9.0 % for PC-1500 have the higher specific heat and the lowest cost when we mobile distillation apparatus type used – 18 KTT in Russia. What can be concluded that the specific heat consumption is a function of the rate of distillation, but also the type of distillation apparatus.

In the calculation of stationary and mobile periodical distillation apparatus used in Bulgaria, the speed of distillation is taken 10 %, in which the specific heat consumption is lowest in mobile periodic distillation apparatus with a capacity of 17 m^3, and for stationary distillation apparatus with a capacity of 5 m^3 lowers the processing of the whole material. The temperature of the distillate in calculating distillation apparatus used in Bulgaria has taken 35 °C.

Depending on the temperature of the distillate is only observed difference in mobile distillation apparatus KTT-18 used in Russia, with other data submitted to the temperature of the distillate are relatively close in value. What can be concluded from the data that the temperature of distillation does not significantly affect the specific consumption of heat, but has a significant influence on the calculation of the cost of cooling water required for condenser - cooler used after distillation apparatus.

It's been estimated for the cost of cooling water of the periodic stationary and mobile distillation apparatus used in Bulgaria as a result of which the cost of mobile distillation units with a capacity of 17 m^3 consumption is 0,085 kg/s, and for stationary distillation apparatus with a capacity of 5 m^3 processing across and milled material consumption is 0,025 kg/s. The literature provides no evidence for a continuously operating machine URM-2 cost of cooling water is 0,7 kg/s at a temperature of cooling water 20 °C. From the data shows that water consumption in continuous current apparatus is much greater than the periodic force, but this can be explained by differences in technological regimes, with continuous current apparatus is derived in many more essential oils from raw materials than regular force. Another criterion for comparing modes of processing the submitted distillation apparatus is the percentage of essential oil remaining in the distillation waste water, as evidenced by a lower percentage of essential oils in mobile and have periodical distillation apparatus, and the highest in continuous operating apparatus which can be explained by the rate of distillation apparatus and short duration of the process of distillation.

In the literature, differences in specific consumption of heat in the processing of pine, flower and grass materials [2, 13], due to the type of distillation (water-steam and steam), in our case the difference is explained by the mode of the apparatus (periodic, continuous and mobile).

In Fig. 1 represents the performance of the distillation apparatus in t / h. The data show that the highest productivity is in continuous current NDT-3M apparatus used in Russia, and lowest in the periodical apparatus type PC-1500 is also used in Russia. The data presented confirm the literature [8, 13] that much more

appropriate is the use of continuously operating apparatus for processing of raw materials than stationary existing distillation apparatus.

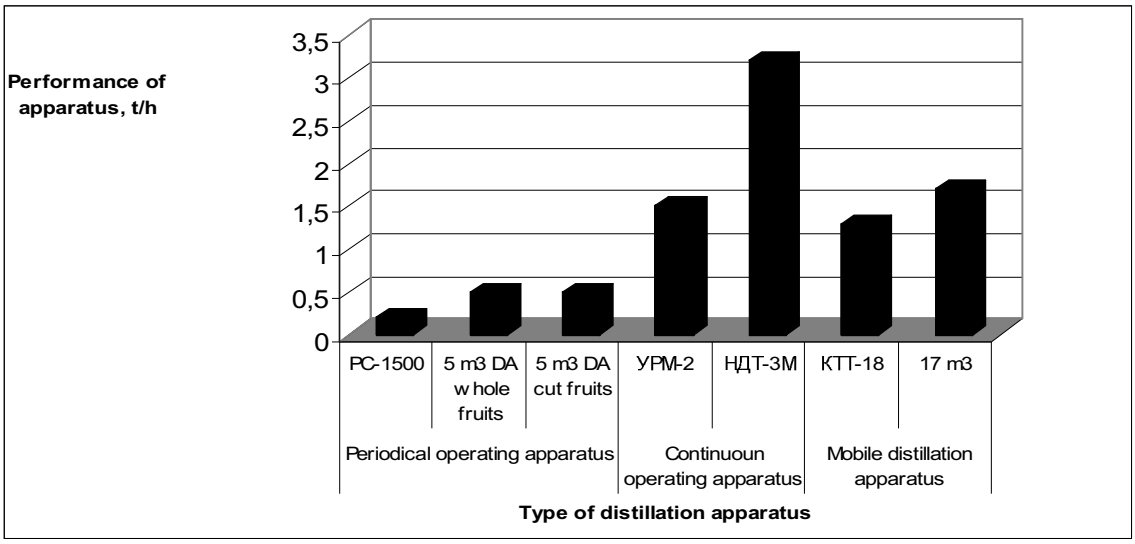

Figure 1 – Performance of the instrument to the mass of raw material

In Fig. 2 presents the total cost of steam for the processing of sage in periodic, continuous distillation and mobile devices. The data shows that the lowest cost of steam is produced by continuously operating apparatus on account of higher raw performance than periodical operating. The advantage of continuous current apparatus is full of essential oil extraction of raw materials, but also obtained and more residual oil in the waste water due to reduced duration of the distillation process in continuous current machines. You could say that reducing the duration of the distillation process and increase speed, these parameters affect the extractive oil feedstock.

It was impressed that the lower the cost of regular steam mobile apparatus type used -18 KTT in Russia after mobile apparatus type 17 m^3 of used in Bulgaria, then continuously current and periodic distillation apparatus.

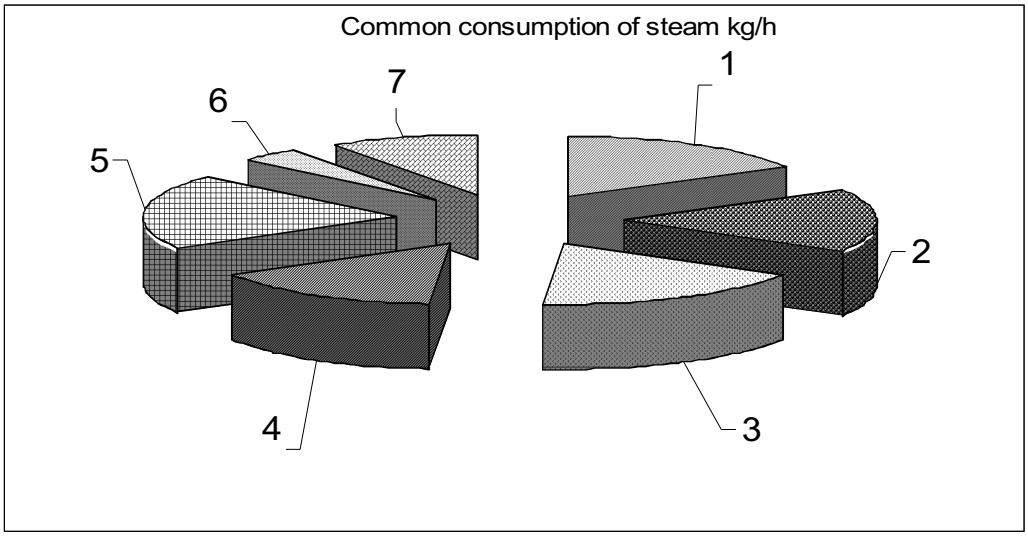

Figure 2 – Consumption of steam per cycle of the apparatus

(Periodical operating distillation apparatus: 1-PK-1500, 2-5m^3 aim, 3-5m^3 have been sliced, Tickle distillation apparatus 4 - URM-2, 5 - NDT-HM;
Mobile distillation apparatus 6 - KTT-18, 7-17 m^3)

CONCLUSION: A significant advantage of a continuously operating distillation apparatus in comparison with the periodic stationary and mobile due to the reduced duration of the trial run, the increased speed, there is a more complete extraction of oil and reduced raw material consumption of steam, but can also be said that following these parameters have a greater loss of essential oil extracted with water. Distillation is an energy-

intensive process and the condition of market economy in Bulgaria is appropriate to use mobile and stationary devices periodically.

REFERENCES

1. A. N. Alekseev, T. Marchenko Technologies equipments of essential, synthetic and perfumery-cosmetic productions Moscow, "Pishtepromizdat" 1957.
2. Akteryan S. Analysis of energy efficiency in obtaining essential oils by distillation, Proceedings international seminar materials, Khabarovsk, Rossa 2001.
3. D. Valtchev, S. Tasheva, A. Stoyanova, V. Rasheva. Processing of grain, grass and leafy materials. Calculation of distillation systems. Scientific works `EMF 2008 t.I, 2008, pp. 330-337.
4. Georgiev, Ev. Technologies of the natural and synthetic aromatic products. Zemizdat, Sofia, 1995.
5. Georgiev E., A. Stoyanova - Directory of experts of the flavoring industry BNAEOPC, Plovdiv, 2006.
6. Irinchev I., the ability to use active all destilatsonni apparatus "Revazov-Moskalev", Bulletin for the development of industry fragrant, Issue 1, 1972, 1-25.
7. Kimenov D. Guide for thermodynamic properties of water and steam. Plovdiv, 1995.
8. January I. Ponomarenko, EI Bobrakov, EV Mezentseva, V.F. Volchenkov, V. I. Varivoda. Investigation work experimental column for distillation of essential oils from floral-grass raw material. scientific investigation University of essential cultures, Working , Volume V, 1972, 178-182.
9. I. Sidorov and others. - Technology and natural essential oils and sinteticheskih dushistыh substance ed. Light pishtevaya promыshlennosty, Moscow, 1984.
10. Sokolynikov N., A. Kondratskiy. Technologies of essential oil productions. Processing Moscow "Pishtepromizdat", 1958.
11. Tanasienko F. Floral-grass raw materials of apparatus continuous operating NDT-3M. VNIIЭMK, Essential raw material and technology essential oils, Processing, volume 1, 1968, 340-350.
12. Tasheva S. Investigation of energy efficiency distillation installation for manufacturing floral and leafing essential raw materials in Bulgaria., Processing of Equipment and technology food productions, Mogilyov, 2011, Part 1, 26-30.
13. Chipiga A. - Guide technologies essential oil proceedings, ed. “Light and food production”, Moscow, 1981

УДК

DETERMINATION OF THE ACTUAL NUMBER OF TRAYS FOR COHOBATION COLUMN 1. AT MANUFACTURING OF CONIFEROUS DISTILLATION WATER

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The required actual number of trays for a cohobating column, manufacturing distillation waters from coniferous plants, is defined according to the McCabe-Thiele graphical method. Calculations for determining of the plate number were done on the base of three concentrations of feed distillation waters – minimal, average and maximum. The height of the column is also determined.

Key words: cohobating column, number of trays, coniferous.

INTRODUCTION: In the world there are more than 17 500 known plant species, and about 300 of them have industrial importance for obtaining of different essential oil products. One of the main processes for producing of essential oil products is distillation. In the process of essential raw materials distillation the primary distillate is obtained. It is then cooled and separated in decanters into two fractions – primary oil and primary distillation waters. These waters still contain certain quantity emulsified, mechanically trapped and dissolved essential oil. After additional processing of the primary distillation waters this oil is extracted as a secondary oil and the rest waters, called secondary distillation waters usually are discarded [2, 17].