Energy Efficient Installations for Distillation of Essential Oil Plants

Georgi Valtchev[1], Albena Stoyanova[2], Violeta Rasheva[1], Stanislava Tasheva[1]

Abstract - **An energy efficient modular distillation installation with a cohobation system for extraction of essential oils from different crops has been proposed. A thermodynamic analysis has been made and there has been pointed out the ways for decreasing the energy consumption for realization of the technological process.**

Key words – **energy efficient installations, distillation.**

The development of ecological agriculture in the Republic of Bulgaria created an opportunity for growing essential oil plants – cultivated and wild. The available industrial distillation installations concentrated in certain regions of the country and manufactured for the conditions of centralized industrial growing and processing of these crops, proved out to be inefficient for the new needs of processing small quantities of crops. At the market there are offered different installations for distillation with batch operation, which do not always answer the contemporary technology and energy effectiveness. As energy carrier there is usually used water steam that is obtained in a steam generator, in which organic fuel is burnt. The energy consumption exerts considerable influence on the prime cost of the products. During the process of obtaining water steam, its transportation to the consumer, its consumption and usage of the condensate that is obtained and the secondary water steam, there are hidden enormous reserves for increasing the energy efficiency of the installation. The ways for achieving this effectiveness are:

- improvment of the performance of the condensate facilities;
- decreasing the steam leakages because of breaks, seals etc.;
- averting the scale deposition;
- maintaining good heat isolation of the steam pipelines, condensate reservoirs, distillation and heat exchange apparatuses;
- decreasing the consumption of the technological waters;
- selection of a suitable technological scheme with minimum energy consumption.

The aim of the present work is on the basis of the thermodynamic analysis to be made out an energy efficient installation for distillation of oils from different species of crops.

[1]Georgy I. Valtchev is with the Department of Industrial Heat Engineering, Higher Institute of Food and Flavor Industries, blvd. Maritza 26, 4002 Plovdiv, Bulgaria, E-mail: g_valtchev@abv.bg

[2]Albena Stoyanova is with the Department of Essential Oils, Higher Institute of Food and Flavor Industries, blvd. Maritza 26, 4002 Plovdiv, Bulgaria, E-mail: alstst@yahoo.com

[1]Violeta D. Rasheva E-mail: v_rasheva@abv.bg

[1]StanislavaTasheva

There are known different technological and heat schemes for distillation of essential oils [1 – 4]. In Fig.1 is shown a scheme of a distillation installation. With a boundary surface I there is given a scheme of a still for distillation of oils. On a modular principle depending on the producers' wish, it could be completed with 1, 2, 3 and 4 stills. The number of stills is determined by the raw material, which is being processed at the moment as well as by the perspectives for a greater amount of raw material.

For a large number of essential oil crops there is not needed additional extracting of the essential oil from the distillation waters in the cohobation system. With a boundary surface II there is shown a scheme of a cohobation system that should be at the distillation installation for such crops, for which extraction of the secondary oil is obligatory. The technological and heat scheme in Fig.1 gives opportunities for treatment of different species of crops with inclusion or exclusion of the cohobation system. On it there are shown results from the material and energy balance as well as the temperatures of the incoming and outgoing flows. All calculations are done on the basis of oil extraction from rose blossom, and at a volume of 1,5 m^3 of the still. The necessary steam consumption per one still is 0,065 kg/s for an operating cycle of 3 hours at the following operating mode: filling and heating up to the temperature of evaporation - for 40 min; distillation - for 120 min, and draining out and washing - for 20 min.

The water consumption for condensation of the distillate per one still is 0.458 kg/s, at which the cooling water is heated from 20 to 80^{o}C.

The cohobation column is calculated for continuous treatment of distillation waters at operation in two variants with two stills for a period of time of 6 hours, and with four distillers for 12 hours. The necessary mass flow of the cooling water in the cooler of the cohobation apparatus is 0,2 kg/s, at which it is heated from 20 to 60^{o}C. The heat of condensation and part of the heat of cooling of the distillate in the heat exchanger at the cohobation apparatus is used for heating of the distillate from 20 to 85^{o}C before its entry into the cohobation column. The thermodynamic analysis indicates that the energy consumption at the distillation installation with four apparatuses can be decreased by approx.16% at the treatment of a unit amount of the product in comparison with an installation with two stills. A saving of 10% is achieved by the usage of waste waters from the cube of the cohobation apparatus for flooding of the still.

In Fig.2 is given a distillation installation with a cohobation system with allocation and connections between the particular apparatuses.

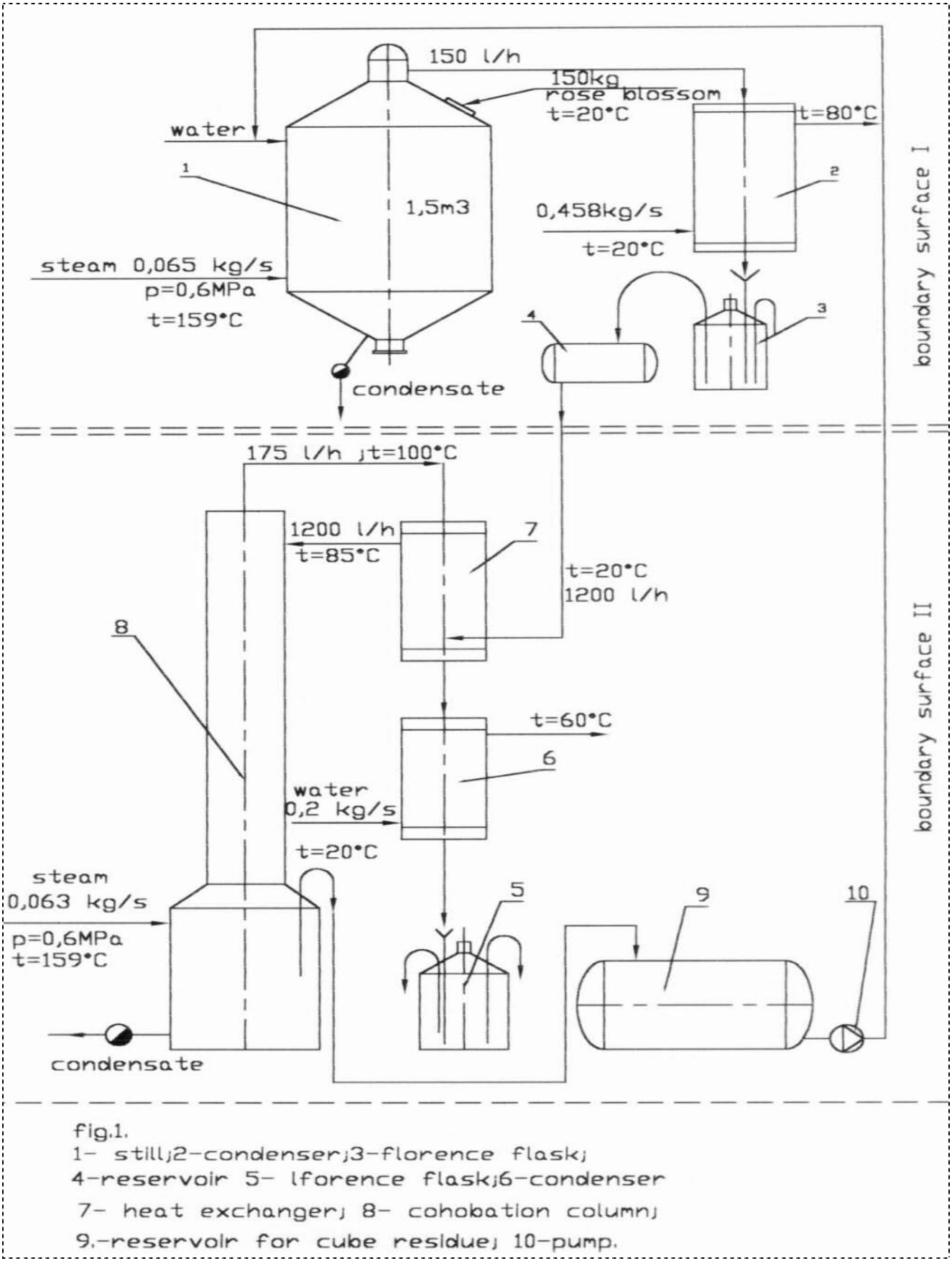

fig.1.
1- still;2-condenser;3-florence flask;
4-reservoir 5- florence flask;6-condenser
7- heat exchanger; 8- cohobation column;
9.-reservoir for cube residue; 10-pump.

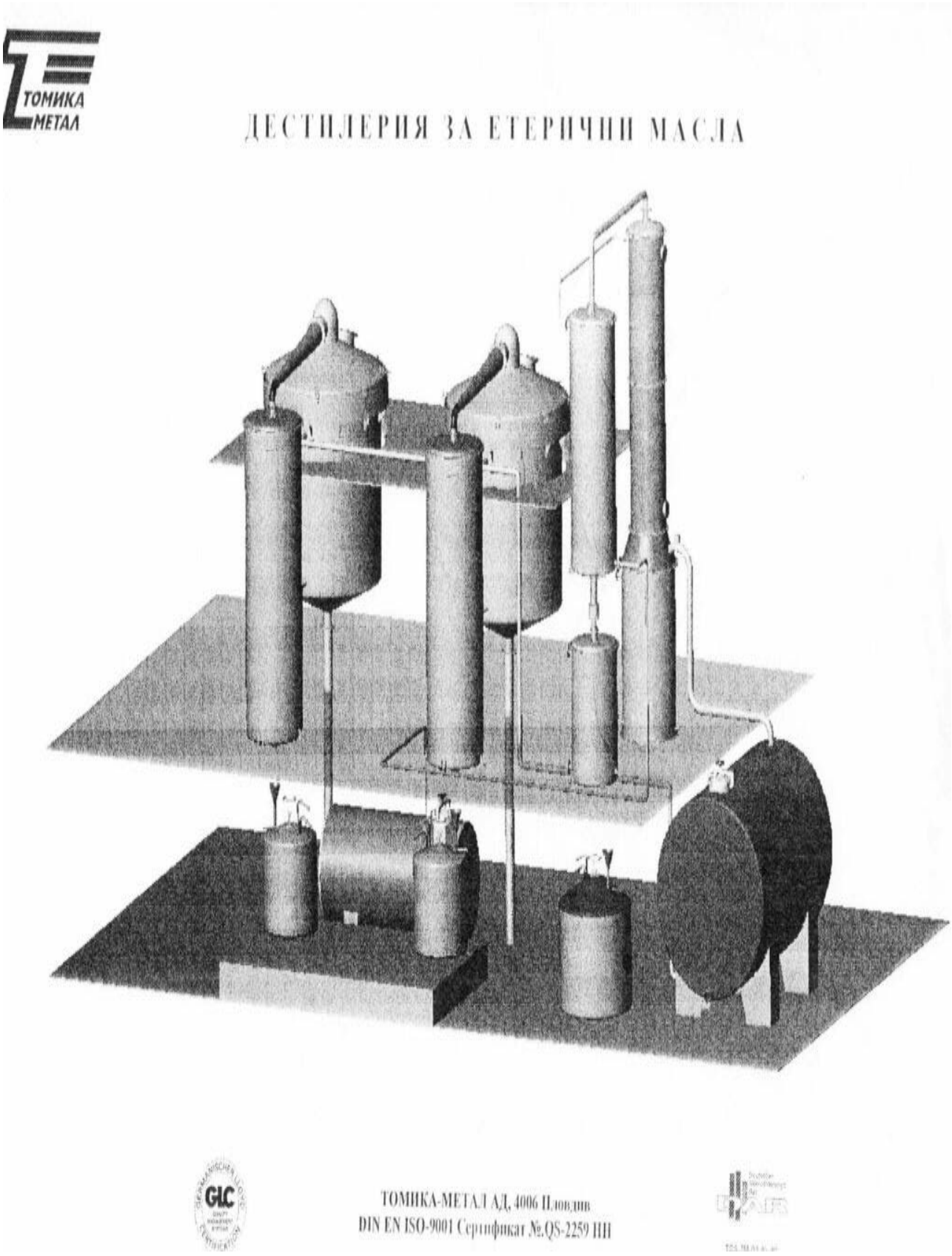

Fig. 2. Distillation installation for essential oils

CONCLUSIONS

1. An energy efficient modular distillation installation with a cohobation system for distillation of essential oils from different crops has been proposed.

2. A thermodynamic analysis has been made and there have been pointed out the ways for decreasing the energy consumption for realization of the technological process.

3. The proposed modular scheme answers the contemporary requirements for production of installations as well as for development of the oil-processing industry. On the basis of the scheme that is proposed it has been worked out a constructive documentation of the apparatuses and the installation will be manufactured at the machine-building plant "Tomika-metal" - Plovdiv, by order of a customer (Fig 2).

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