Annals of Warsaw University of Life Sciences - SGGW
Forestry and Wood Technology № 87, 2014: 51-54
(Ann. WULS - SGGW, For. and Wood Technol. 87, 2014)

The development of technology for obtaining essential oils from Scots pine tree folige.

MARIS DAUGAVIETIS, KASPARS SPALVIS
LSFRI „Silava”

Abstract: *The development of technology for obtaining essential oils from Scots pine tree folige.* Essential oils have been well known for several decades. They are very commonly used in several cosmetic products and aromatherapy for their good smell and benefits and effects on bacteria. Conifer tree essential oils are the organic combination mixture (mainly terpene) which is obtained from the foliage of a pine – needles and twigs.

The environmental factors that influence and effect the production of essential oil in Scots pine trees (*Pinus Silvestri*)s has been investigated in this paper. In addition, the overall study in this research project analyses the consumption of essential oils and describes the industrial equipment used for the production of essential oils from the needles. Also the results of essental oils and the seasonal dynamic quality in Latvia are investigated.

According to the results of the experiment performed in this study, the time substance of essential oils and water disengagement was defined in laboratory conditions where the temperature ranged from 20 to 90 ^{o}C , maintaining constant temperature in thermostat. By using specific pilot equipment various tree steam distillation process parameters of essential oils of pine were investigated in the study.

In general, the main objectives of the research is to point out and examine the results of essential oils, their quality, overall time of the process, the consumption of the steam depending on the hydrodistolation process with a special system, intensity and to identify the stages of an ordinary foliage. The results of the research can be used to optimize the processing of needles oil and manufucture new needles oil processing plant.

Keywords: essential oils, needle foliage, steam distillation, steam consumption

INTRODUCTION

Essential oil extraction is one of the oldest forms of recycling plant biomass. In literatureIis posibility to find detailed description of essential oil eduction technologies from plants with high (more than 1.5% of the biomass content) essential oil content.

Unfortunately, there is the lack of information about the process of extracting essential oils from biomass with low content of essential oils, such as Scots pine (Pinus Silvestris) and Norway spurce (Picea Abies) biomass[1.].

The aim of the research was to obtain information about steam distillation process parameters while refining softwood needle foliage to find ways of improving the energy efficiency of the process.

MATERIALS AND METHODS

In the process of this research we used pilot equipment, which principal scheme is shown in figure 1.

Distillation tank capacity is 270 liters, which allows about 20 kg loading of unchopped and 40 kg chopped needle foliage[2.].

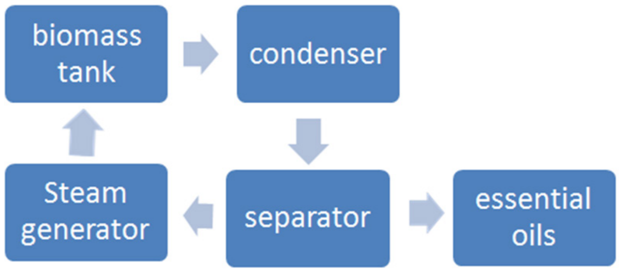

Figure 1. Principal scheme of the pilot equipment.

In order to determine how the intensity of the distillation impacts essential oil outcome, as well as affects the time of acquisition, experimental device was connected to an industrial steam generator. In this way it is easy to provide even flow of steam, as well as to regulate its supply. The distillation intensity rate was calculated by measuring the run time, the quantity of condensation mass, originated while processing as well as loaded needle foliage weight. Acquired oil was checked for its outcome, density and refractive coefficient.

To find out about needle foliage chopping impact on essential oil outcome and its extracting time, we performed essential oil acquisition both from unchopped and chopped pine needle foliage. Length of chopped needle foliage – not more than 4 cm. Chopped needle foliage with smaller particles could cause congestion, and as the result – a steady flow of steam through needle foliage mass would not be guaranteed [3.,4.].

To determine the ending of distilling process flowing condensate was poured into a measuring cylinder and allowed to settle. If inside the condensate weren't settled visible amount of essential oil - extraction process is over. Acquired oil was checked for its outcome, density and refraction coefficient.

In order to determine dependence of condensate decomposition time from the temperature was chosen graduated 15 ml tube, poured in 10 ml of distilled water and 2 ml of pine essential oils. Tests were performed at 20; 25; 30; 35; 40; 45; 50; 60; 70; 80; 90 °C temperatures. The tube with water and oil was immersed in a thermostatically controlled water bath. When water in the bath reached the selected temperature, a test tube was rapidly removed from it, intensely shaken and placed back in the water bath with the same selected temperature.

Stratification time was measured in seconds from the moment the one stops shaking the tube until there is a clear boundary between the two phases. Every test was repeated 5 times

RESULTS

Body of the chapter The intensity of distillation significantly affects the timing of distillation process. Analyzing the obtained oils was defined correlation between oil density and intensity of the distillation. Oil density ranges from 0.840 up to 0.864 g/ml, similar to the change in refractive index of 1.4655 at run-intensity of 0.11 kg /h per 1 kg needle foliage up to 1.4755 to 0.90 kg /h per 1 kg needle foliage. If distillation rate rises above 0.5 kg/h per 1 kg needle foliage, growth of density and refractive index is minimal.

This coherence can be explained by the composition of essential oils - as oil consists of various components, the distillation under a low intensity dividing the components with low density, but to guarantee redistillation of the heaviest oil fractions it is necessary to provide distillation rate exceeding 0.4 kg/h per 1 kg needle foliage.

On the figure 2. can be seen yields of essential oil during the distillation of a small (0.11 kg/h per 1 kg needle foliage), medium (0.40 kg/ h per 1 kg needle foliage) and large (0.90 kg/h per 1 kg needle foliage) run intensity. Most amount of the oil can be obtained with a large consumption of steam, but even if the steam consumption decreases less than 0.25 kg/h per 1 kg needle foliage, essential oil yield increases.

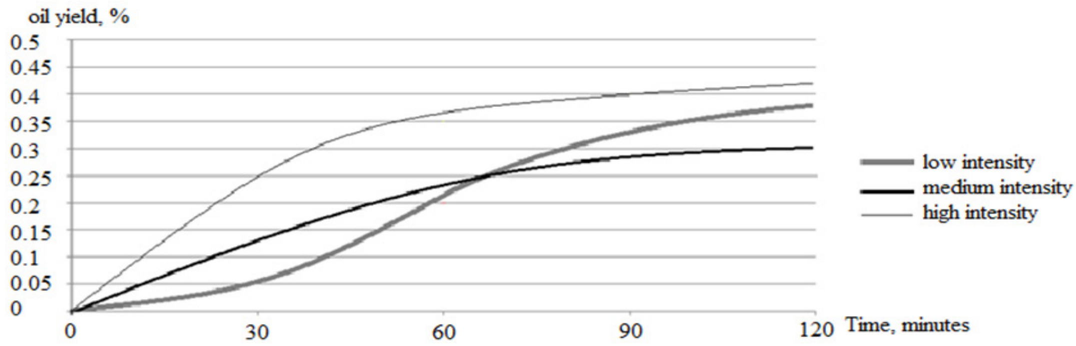

Figure 2. Yields of essential oils during the distillation.

The coherence between the intensity of the distillation and the total amount of consumed steam is important for construction process of steam generators for distillation systems. Yet this information do not provide us the key to understanding of how to use steam consumption rationally.

During the calculations of steam consumption per unit of obtained essential oil it can be observed that an increase in the intensity of distillation causes steam consumption increase too, however, increasing the steam consumption above 0.4 kg/h per 1 kg needle foliage, the amount of steam consumed per unit of essential oils, doesn’t change much. It can be explained by the fact, that intensification of the distillation process provides an increase in essential oil yield and reduces necessary process time. This correlation is shown in figure 3.

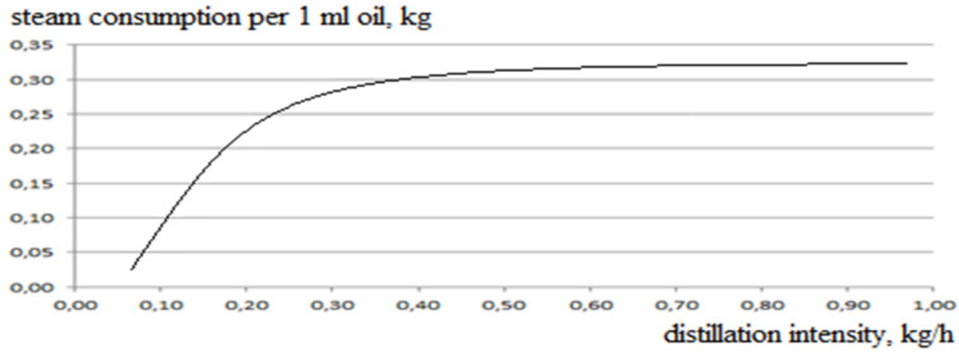

Figure 3. steam consumption at different distillation intensity.

During the research about distillation timing and yields of essential oils it was proved that needle foliage chopping don’t provide relevant increase of essential oil yield, yet it contributes to a reduction in run time of distillation. In addition, it should be noted that if you chop needle foliage, it can be be possible to load for 50% raw material mass.

Clarifying pine essential oil and water stratification time dependence of the temperature. The boundary between the phases shown on figure4.

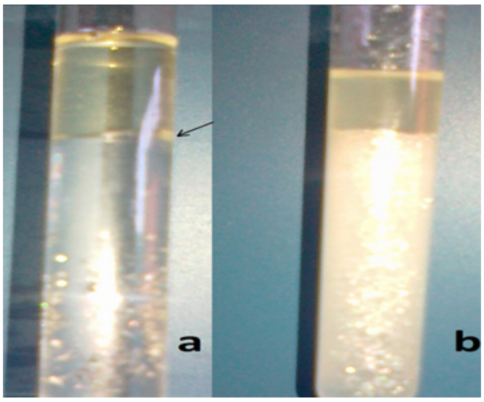

Figure 4. Clear (a) and implied (b) boundary between oil and water layers

At lower temperatures (20, 25°C) stratification isrelatively long, about 1 minute. If the temperature increases - time of settlement diminishes. In the temperature range from 40 to 80 °C stratification time remains practically unchanged. This effect was observed in all the studied pine essential oils. Although stratification time in temperatures above 40 °C does not change or decrease in temperature above 80 °C, it can be observed that the water and oil layers lose turbidity, which shows the oil and water mutual solubility. The possibility to exude oil from the condensate with a higher temperature allows the condensate with the temperature 50^o-60^oC to be routed to the steam generator, thus reducing the energy consumption of steam generation.

Based on the survey data, for pine essential oil extraction following distillation process parameters are recommended: distillation intensity - 0,7-0,8 kg/h per 1 kg needle foliage, process time – 2 hours, the temperature of the condensate for oil distribution - 50^o-60^oC, needle foliage chopping to particle length of 2 cm.

REFERENCES

1. Ягодин, В.И. (1981). Основы химии и технологии переработки древесной зелени,. Изд. Ленинградского ун-та, Ленинград, 223 сс.
2. 85 gallon biocapacity essential oil large capacity steam distillation plant. http://www.heartmagic.com/00giantstill/85gallon.html
3. Е.В. Бараков, А.И. Вахрушев, Г.Н. Черняева. Технология и оборудование производства пихтового масла (обзор). Москваб 1976, 43 с
4. Комплексное использование древесины при рубках ухода (сырье, заготовка, переработка). Иевинь И.К., Галванс У.И., Даугавиетис М.О., Балод В.В., Саусиня Я.М. «Лесная промышленность», 1976, 88 с.

Streszczenie: *Rozwój technologii pozyskiwania olejków eterycznych z drzew sosny.* Olejki eteryczne są znane od wielu lat. Są one bardzo często używane w wielu produktach kosmetycznych i aromaterapii dla ich dobrego zapachu i korzyści takich jak wpływ na bakterie. Olejki eteryczne z drzewa iglastego są organiczną mieszaniną substancji (głównie terpenów), który otrzymuje się z liści z sosny - igieł i gałązek.

Opisano czynniki środowiskowe, które wpływają na produkcję olejku w drewnie sosny zwyczajnej (Pinus Silvestri). Ponadto, opisano ogólnie badania analizy zużycia przemysłowego olejków eterycznych i opisano urządzenie wykorzystywane do przemysłowej produkcji olejków z igieł.