THE MASSIVE WOOD LIKE EMITTER OF VOC EMISSIONS AND ODOURS

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ABSTRACT

The contribution is interested in problems of volatile organic compounds emitted by wood shavings of different kinds of wood: pine (Pinus sylvestris) sapwood, (Pinus sylvestris) heartwood, English oak (Quercus robur), western red cedar (Thuja plicata) in the comparing of them. In the same time the olfactometric influence of individual components emitted by western red cedar and sapwood of pine was under review. In the work there is also described the relation among the results reported during the olfactometric measuring and the results reported during the measuring of volatile organic compounds especially emitted by cedar wood. The dependence of Limonene and α Pinene olfactory activity on the concentration of organic compounds emitted by tested samples of wood with strong olfactory activity. The properties of odours of the above are judged by equipment Sniffer 9000.

The amount of emission of VOC emitted by choice kind of woods is monitored in dependence on time (72, 336 and 672 hours after planning wood shavings).

The results are compared with sensory perceptions and the qualitative and quantitative analysis of VOCs performed by the help the gas chromatograph (Agilent 6890) with mass selective detector (MS 5973 Network) and short part thermal desorption (model TD-4).

Key words: VOC emissions, solid wood, wood shavings, perception, odour, sniffer 9000

INTRODUCTION

The indoor volatile organic compounds are one of the biggest environment problems. Some of the identified and measured 50 to 300 volatile chemicals in the air of interiors were shown to be carcinogenic and dangerous to the human health and to the fetus. Normal concentrations of these compounds are only rarely higher than 50 $\mu g.m^{-3}$.

Due to the fact that only volatile organic compounds can be odour activity some of volatile organic compounds could contribute to the odour impression of the testing emissions emitted. In our case there are the emissions emitted by finished surfaces of wood based materials.

The separation of the individual compounds in the VOC emissions and their simultaneous detection are essential to determinate which components of the complex VOC mixture are contained in the VOC emissions blends and which volatile compounds have the important influence on odour of testing specimens. One volatile organic compound in odorous products is responsible for the typical aroma. The combination of several compounds gives the typical product smell by the finished surface of the wooden furniture.

The odour has become a part of the products specification made from wooden based materials. The odour of product, in our case some kind of the wood furniture, is near closed with comfort of living. The hedonic influence of furniture is being seen as an annoyance for the furniture using consumers.

New furniture should only smell like new furniture and nothing else. A bad odour of new furniture in an apartment can make living and using the furniture there very uncomfortable. The indicated odour of emissions emitted by the wooden furniture with finished surfaces into indoor air is reported bad quality indoor air for 15–30 % of the general population. Sometimes the smell of furniture means the toxic furniture for consumers.

Because the identification of odour volatile organic compounds emitted by furniture made from wooden based materials with finished surface plays a significant role, we were investigated the quantity and quality contain together with the odour-active of individual organic volatile compounds emitted by wooden furniture into indoor air.

The aim of this study is:

1. to identify the main components contributing to an odour emitted emissions by finished surface of wooden furniture;
2. to solve the odour impact of the individual chemical compound in the correlation with the concentration of measured emissions;

Due to the fact that only volatile substance can be odour active, gas chromatography in the conclusion olfactometric detector system, is the preferred analytic method. The combination of sensory and instrumental methods is a powerful approach to identify the volatile compounds, which are responsible for an odour.

EXPERIMENTAL METHODS

USED METHOD

We used for the measurement special combined techniques of the sensorial analysis E-nose Sniffer in conclusion with the GC-MS chromatography and the thermal desorption.

We collected air containing VOC emissions into the desorption tubes on the sorbent TENAX TA where the emitted air is evaluated and split of the effluent of chromatography column into two streams. One stream is analyzed by the detector of the gas chromatography and the second stream is passed into an effluent of Sniffer. The sniffing port obtains a human olfactory response. We reached by using this special technique the identification of odour components by Sniffer in the same time, when we reached results of gas chromatography. The results of gas chromatography is the chromatogram with quality and quality identification of chemicals and the results coming in the same time from human olfactory response sniffer is the olfactogram. We can compare the both reached results the quality and quantity determinate volatile organic compounds to the sensory results, so results of the chromatogram and the results of the olfactogram.

Some kinds of wood become among the important sources of volatile organic compounds and so the sources of odours. We were investigating the VOC emissions emitted by some kinds of wood (cedar, oak, pine (heartwood and sapwood)and so in this time we investigated the odour impact of these VOC emissions emitted by tested specimens of wood. We prepared the thin wood shavings with the surface $1m^2$ and then we started to collect VOC emission emitted by tested kinds of wood. The collected emissions of VOC were analyzed on GC connection with Sniffer for odour identification of individual organic compounds in their blend.

METHODS OF VOC TESTING WERE SET VIA STANDARDS

ISO 16000: 2007 Indoor air.;

ISO 16000–1: 2007 General aspects of sampling strategy.

ISO 16000–5: 2007 Sampling strategy for volatile organic compounds (VOCs).

ISO 16000–11:2007 Determination of the emission of volatile organic compounds sampling, storage of samples and preparation of test specimens.

VOC SAMPLINGS IN SMALL-SPACE CHAMBERS WERE DONE ACCORDING TO:

ISO 16000–6: 2007 Determination of volatile organic compounds indoor and test chamber air by active sampling on Tenax TA® sorbent, thermal desorption and chromatography using MS/FID.

ISO 16000–9: 2007 Determination of the emission of volatile organic compound from building products and furnishing-Emission test chamber method.

The main impact for odour has the irritant thresholds of emitted chemicals that means at what level a chemical is an odorant for the first time and then becomes an irritant. We compared the thresholds. Threshold or odorant delectability refers to the theoretical minimum concentration of odorant stimulus necessary for average population.

Testing wood shavings were prepared from these kinds of solid wood: Cedar wood, Oak, Heartwood of Pine and Sapwood of Pine.VOC emissions measuring Time: 24 h 14 days after the preparing of wood shavings.

USED EQUIPMENT

- small-space chamber for VOCs testing.

TECHNICAL PARAMETERS OF SMALL-SPACE CHAMBER FOR VOCS TESTING

Inner dimensions of small-space chamber 1 m^3 (0,7 m x 2,82 m x 2,4 m).

Adjustable range of temperature in chamber 15 to 50 °C.

Regulation accuracy of temperature in chamber > 0,5 °C

Adjustable range of humidity in chamber 45 % to 55 %.

Regulation accuracy of temperature in chamber >2 %.

Air changing rate in chamber1 m^3 per 1 h.

Air speed over the tested samples 0,1 to 0,3 $m.s^{-1}$.

- short path thermal desorption, Silco treated, Thermal Desorption Tube 786090, inner diameter 4 mm, filled in with 100 mg of Tenax TA (Scientic Instrument Services Company) for collection of VOC emissions tested samples into the air in chamber;
- air sampler Gilian – LFS 113 SENSEDNE with air flow 6 $l.h^{-1}$,
- gas chromatograph Agilent GC 6790 with MS (mass spectrometer) detector 5973 with cryofocusation, thermal desorption and library of spectra NIS 0,5 type HP–5 (AGILENT ISA);
- olfactory detector outlet Sniffer 9000 based on sensor techniques, one the most sensitive and intelligent detector.

RESULTS

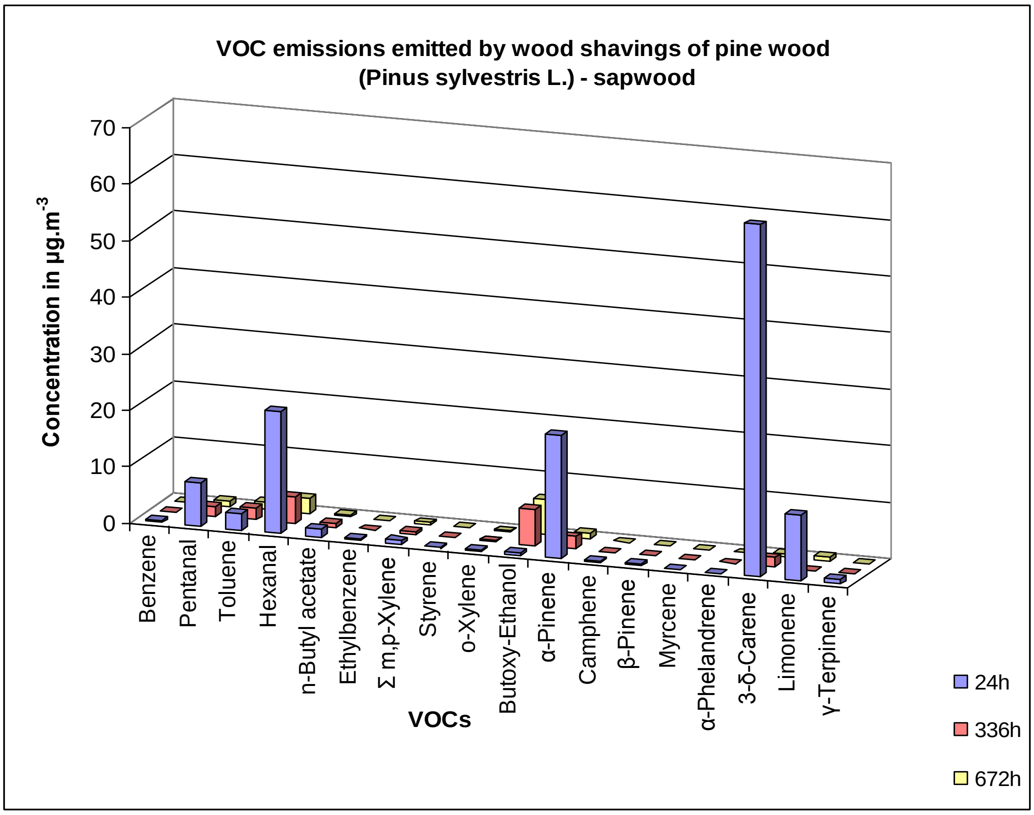

Fig. 1. VOC emissions emitted by wood shavings of pine wood – sapwood

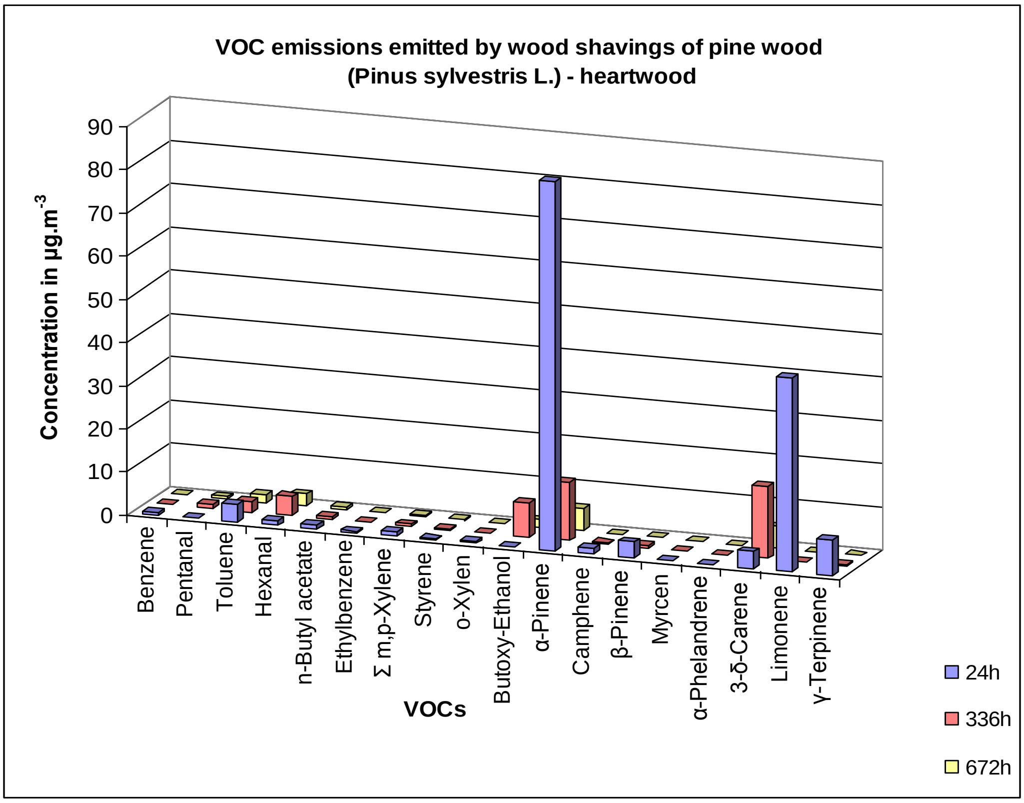

Fig. 2. VOC emissions emitted by wood shavings of pine wood – heartwood

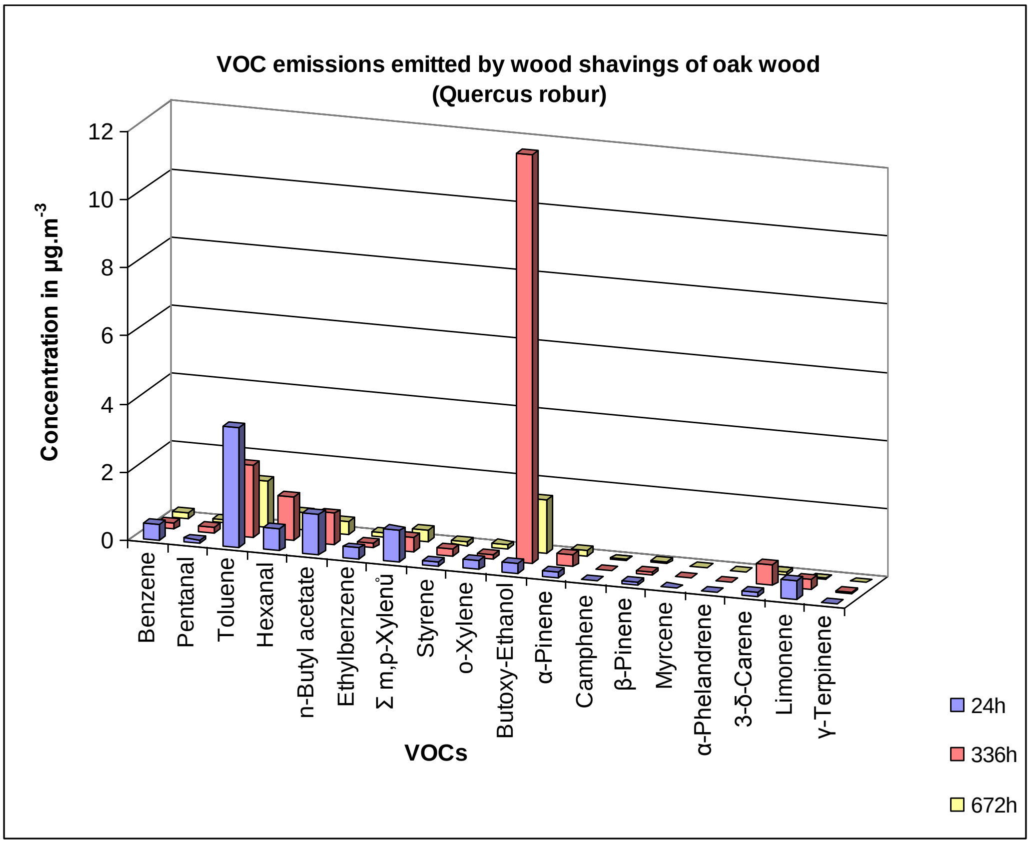

Fig. 3. VOC emission emitted by wood shavings of oak wood (Quercus robur)

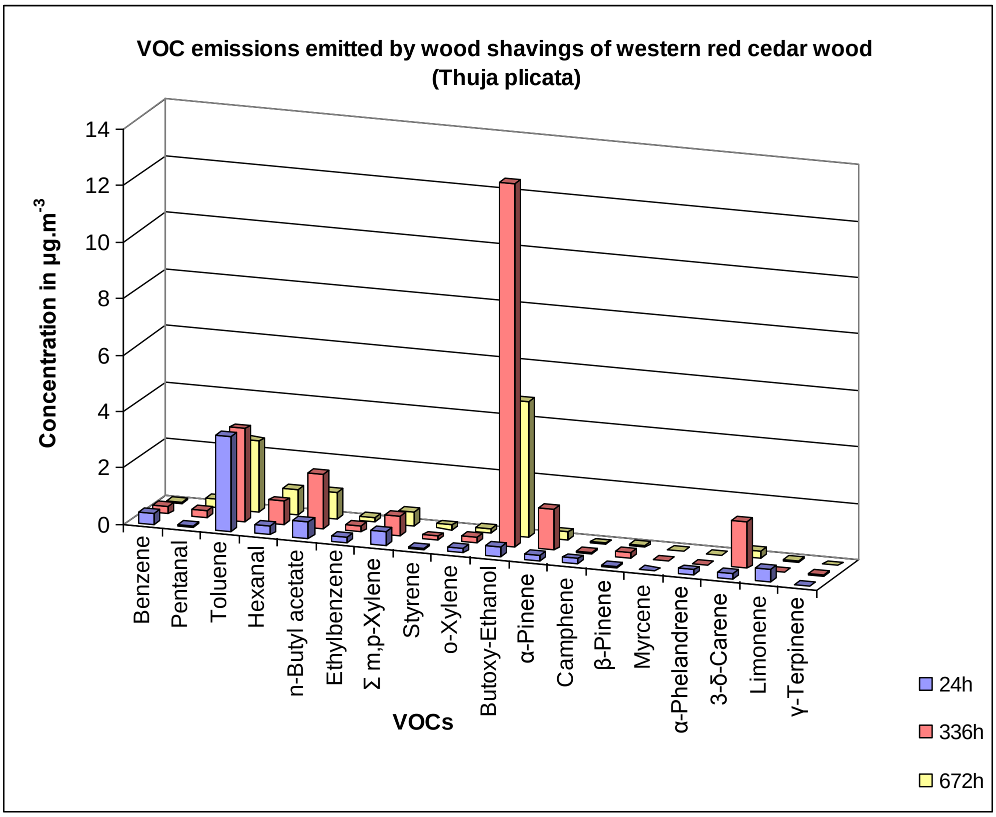

Fig. 4. VOC emissions emitted by wood shavings of west Red Cedar (Thuja plicata)

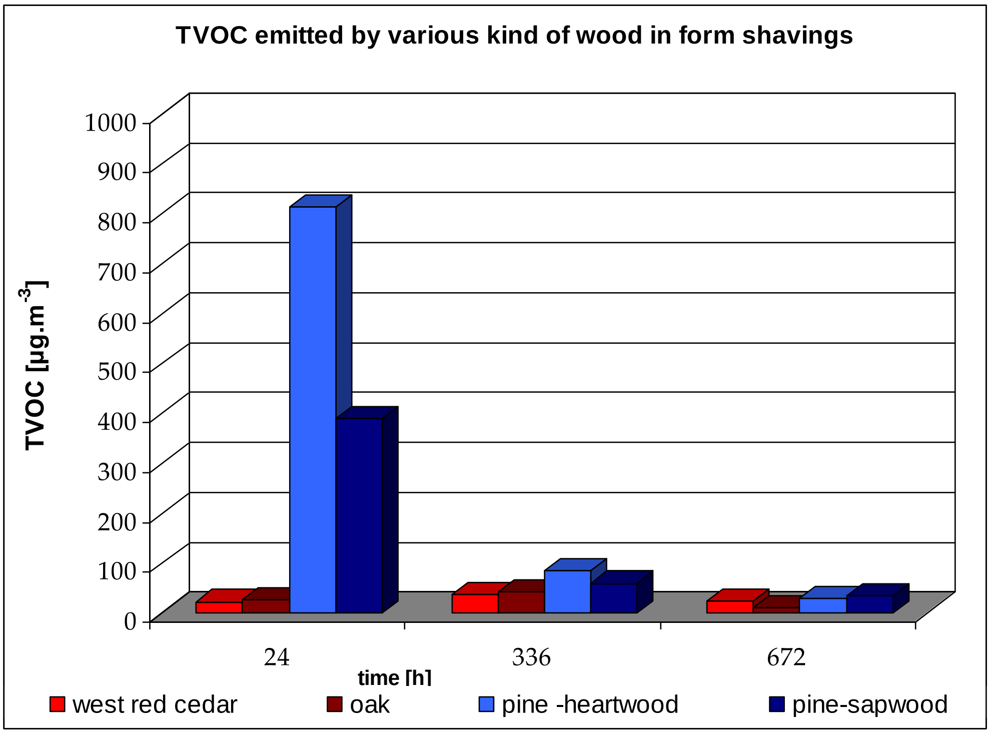

Fig. 5. TVOC emitted by various kind of wood in form shavings

Table 1. Hedonic tone and intensity of odour

VOC	Pine – heartwood			Pine – sapwood			Red cedar			Oak		
after plating (h)	24	336	672	24	336	672	24	336	672	24	336	672
Toluene	-2	-1	-2	-1	1	2	1	1	2	2	2	-2
Σ m,p-Xylene	-1	-2	-	-2	-2	-2	1	-	1	1	-1	1
α-Pinene	-2	-2	-	1	-1	1	-	-	-3	1	-	-
β-Pinene	-2	-	-1	-	-3	-3	-2	-3	-2	2	-3	-4
3-δ-Carene	-2	-	-	3	-1	-	-	-	-	-	-	-
Limonene	1	-	-	1	-	-	-1	1	-	-	-	-

DISCUSSION

The measured values of emission VOC emitted by wood shavings of different kinds of wood: pine (Pinus sylvestris) sapwood, (Pinus sylvestris) heartwood, English oak (Quercus robur), western red cedar (Thuja plicata) are predicative about it, that the most amount were emitted by heartwood of Pinus sylvestris, namely first terpenes: (α-Pinene:85,4 µg.m^{-3}, limonene: 44,8 µg.m^{-3}), next sapwood of Pinus sylvestris (3-δ-Carene: 62,4 µg.m^{-3}, α-Pinene: 21,9 µg.m^{-3}) namely 24 hours after planning of wood shavings. Thuja plicata and Quercus robur were emitted the most of Butoxy-Ethanol (Thuja plicata: 12,8 µg.m^{-3}, Quercus robur: 12,0 µg.m^{-3}) 336 hour after planning. The most amount of TVOC emitted by heartwood of Pinus sylvestris (814 µg.m^{-3}), 24 hours after planning of wood shavings.

CONCLUSIONS

The great volume of VOC emissions emitted the shavings of heartwood of pine with the greatest odour impact from the tested samples of wood.

Limonene, α-Pinene, β Pinene, Camphene, 3-δ-Carene has the great odour impact in the blend of VOC emissions emitted by tested kinds of wood.

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