



Volatile organic compounds and odor emissions from veneered particleboard coated with water-based lacquer detected by gas chromatography-mass spectrometry/olfactometry

Qifan Wang Jun Shen

(Submission ID 34)

Northeast Forestry University, Harbin, China (wangqifan66@163.com)

Part 1. Background & Topic

Background

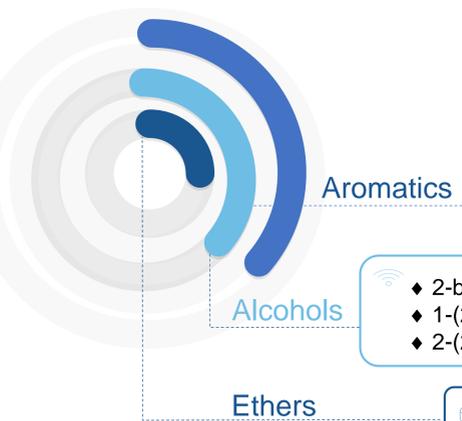
To reduce the problem of volatile organic compounds (VOCs) and odor emissions from veneered particleboards coated with lacquer, this study focused on identifying odorant compounds and exploring the potential influence of environmental factors on VOCs and odor emissions.

Topic

Particleboard coated with polyvinyl chloride (PVC) and melamine was studied via Gas Chromatography-Mass spectrometry/Olfactometry.

Part 3. Results

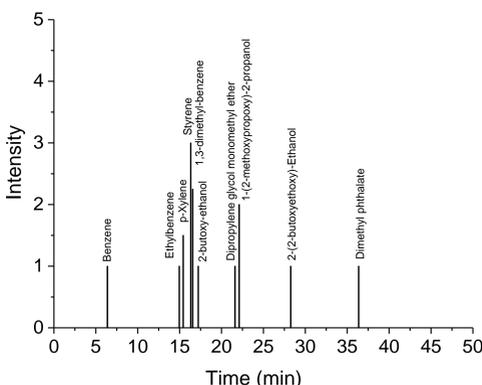
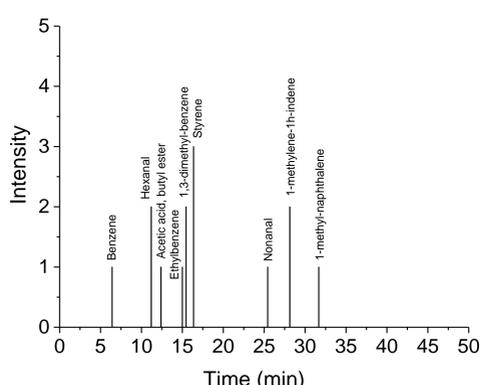
Characterization of odor-active compounds



- ◆ Benzene (Burnt-1.0)
- ◆ Ethylbenzene (Fragrant-1.0)
- ◆ p-Xylene (Fragrant-1.5)
- ◆ Styrene (Cream-3.0)
- ◆ 1,3-dimethyl-benzene (Fragrant, honey-2.25)
- ◆ Dimethyl phthalate (wormwood-1.0)

- ◆ 2-butoxy-ethanol (Leather, soybean paste-3.5)
- ◆ 1-(2-methoxypropoxy)-2-propanol (Unpleasant, mixed-2.0)
- ◆ 2-(2-butoxyethoxy)-Ethanol (Cucumber-1.0)

- ◆ Dipropylene glycol monomethyl ether (Alcohol-1.0)



Part 2. Materials and Method

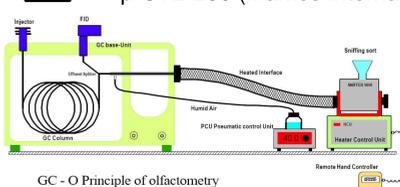


Particleboard, overlaid with *Fraxinus mandshurica* veneer and the water-based (60-mm diameter, with an exposed area of $5.65 \times 10^{-3} \text{ m}^2$)

Experimental Scheme

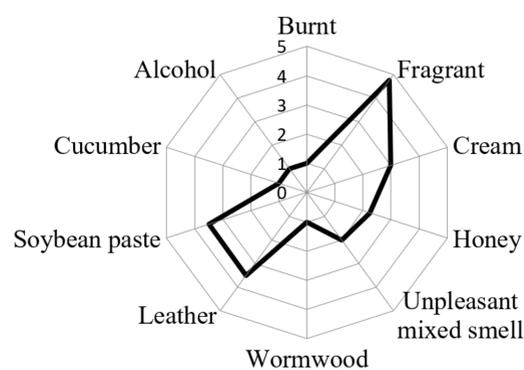
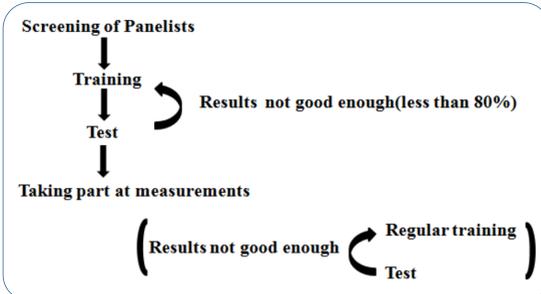
Experimental Scheme	Research Direction	Temperature (°C)	Relative Humidity (%)	Air Exchange Rate to Loading Factor Ratio (m ³ ·m ⁻² ·h ⁻¹)
A	Standard environment	23	40	0.5
B	Influence of the temperature	23, 30, 40	40	0.5
C	Influence of the relative humidity	23	40, 60	0.5
D	Influence of the ratio of air exchange rate & loading factor	23	40	0.2, 0.5, 1.0

• Sampling devices---The Micro-Chamber/Thermal Extractor μ -CTE 250 (Markes International Inc., UK)



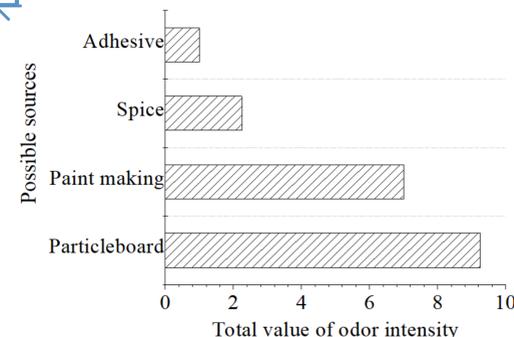
• Analytical devices---The Unity thermal analysis desorption unit (Markes International Inc., UK); DSQ II series GC-MS (Thermo Scientific, Germany); Sniffer 9100 Olfactory Detector (Brechtbühler, Switzerland)

Law No. 91: Offensive Odor Control Law (1971): 0 = none, 1 = very weak, 2 = weak, 3 = moderate, 4 = strong, and 5 = very strong.

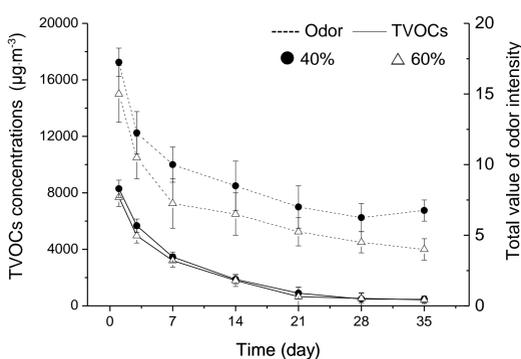
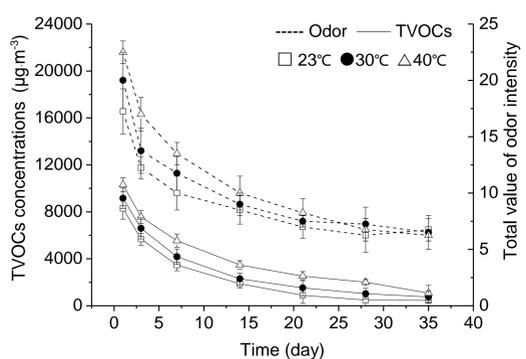


Most odors were detected in 15 to 23 min and reached a maximum odor intensity value at 17.22 min; odors from particleboard mainly were detected within 10 to 35 min. "benzene, ethylbenzene, p-xylene, styrene, acetic acid, butyl ester, 2-butoxy-ethanol, 2-(2-butoxyethoxy)-ethanol, and dipropylene glycol monomethyl ether" are included in the list "VOCs from office furniture in greater than 10% of all products" from UL 2821 (2013), which merits attention.

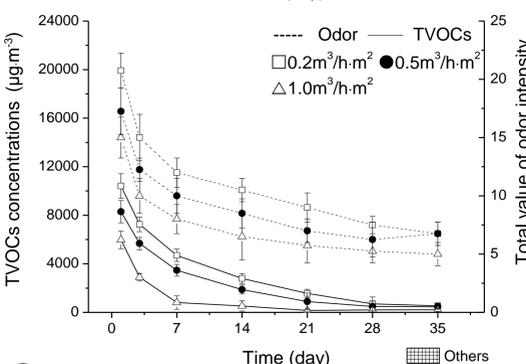
Fragrant was the dominant odor impression, with a rating of 4.75. Leather and soybean paste both have a rating of 3.5, followed by cream (3.0), honey (2.25), and unpleasant mixed smell (2.0). The attributes burnt (1.0), wormwood (1.0), cucumber (1.0), and alcohol (1.0) were rated with low intensities. The sample was evaluated as being generally comfortable. Particleboard (total intensity, 9.25) and paint (total intensity, 7.0) emissions were the primary sources of odor; spice and adhesive had intensities of 2.25 and 1, respectively.



Effect of environmental factors on VOCs and odor emissions

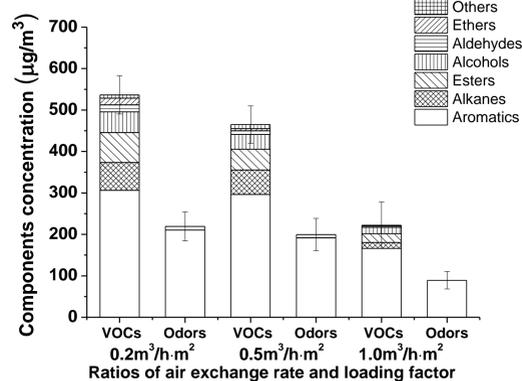
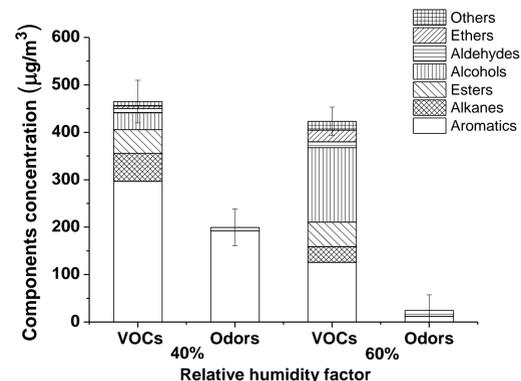
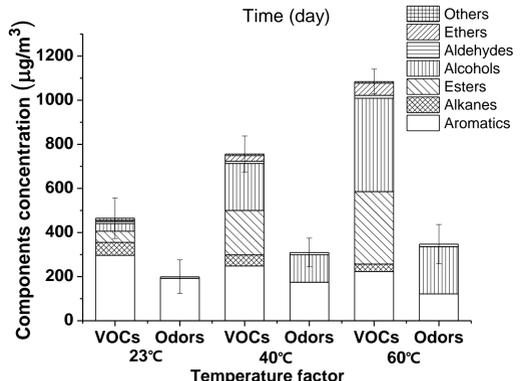


VOCs concentration and total odor intensity increased as the temperature increased but decreased as the ratio of relative humidity and the air exchange rate to the loading factor increased. Throughout the analysis, the ratio of the air exchange rate to the loading factor was shown to have a greater impact on the VOCs released from the veneered particleboard than either temperature or relative humidity



Effect of environmental factors on the components of VOCs and odor emissions in the equilibrium state

In a state of equilibrium, the main odor components were aromatics, alcohols, esters, and alkanes. Alcohols and esters increased with increasing temperature and relative humidity and decreased as the ratio of the air exchange rate to loading factor increased; however, emissions of aromatics and alkanes decreased when the temperature, relative humidity, and the air exchange rate to loading factor ratio increased.



Part 4. Conclusion

01 GC-MS/O can be used as a method to detect the odor from wood-based panels and furniture materials.

02 The predominant odor impressions of veneered particleboard coated with water-based lacquer were fragrant, leather, and soybean paste, and the main odorants were aromatics, alcohols, esters, and alkanes.

03 To accelerate the release of VOCs and odors before indoor use and to reduce their effect on humans in a fixed period of time, the optimum storage condition after production for veneered particleboard coated with water-based lacquer was found to be 40°C, 40% RH, and 1.0 m³·h⁻¹·m⁻² (ratio of air exchange rate to loading factor).

[Acknowledgments]

The author gratefully acknowledge the financial support of The National Key Research and Development Program of China (2016YFD0600706).