

# Effect of lacquer decoration on VOCs and odor release from *P. neurantha* (Hemsl.) Gamble

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## Research background and significance

With the widespread use of lacquered solid wood materials in the interior, the problem of "odor" caused by solid wood and its lacquer finish is becoming more and more serious. Studying the VOCs and odor characteristic compounds released from lacquer wood can improve the environmental protection level of products and help to solve the odor problem of furniture.

## Research method

### GC-MS/O:

Gas chromatography–mass spectroscopy olfactometry (GC-MS-O) is improved from the GC-MS by combining the separation ability of GC-MS with the sensitive olfactory ability of humans

## Results and discussion

The Release increase rate of TVOC and components under different paints

Types of Paints	TVOC/%	Aromatic /%	Olefins/%	Alkanes/%	alcohols/%	Aldehydes/%	others/%
Polyurethane Coatings	227.9	553.74	-90.59	41.13	1.45	-7.79	-37.52
Waterborne Acrylic Coatings	51.78	-47.7	-95.63	-42.75	1251.71	-9.88	-72.26
UV coating	9.95	175.95	-95.53	37.1	-39.28	-26.49	-76.52

1. Research showed that the olefins from *P. neurantha* were inhibited by these three types of lacquers (the inhibition rate was more than 90%)
2. PU lacquer could inhibit aldehydes, ketones, and other compounds, but the release of aromatic hydrocarbons increased sharply. Among them, 1,3-dimethylbenzene, *o*-xylene, and butyl acetate increased most significantly
3. The lowest amount of VOCs were released from *P. neurantha* varnished with UV (they only increased about 10%). However, the release of toluene from *P. neurantha* varnished with UV increased sharply
4. waterborne-lacquered could inhibit the release of aromatic hydrocarbons, olefins, alkanes, aldehydes, and ketones, but the release of alcohols increased by 12.5 times, and it released  $526.25 \mu\text{g}\cdot\text{m}^{-3}$  of esters.

## Conclusion

1. After being decorated with one of the three lacquers, the release of VOCs from the solid wood could be inhibited by the surface lacquer; however, at the same time, the lacquer material would release some other compounds. The TVOC release of *P. neurantha* (Hemsl.) Gamble increased after one of the three types of lacquer coatings was applied, and the increase of *P. neurantha* (Hemsl.) Gamble with PU lacquer decoration was the most significant. The VOCs released from unpainted *P. neurantha* (Hemsl.) Gamble mainly consisted of aromatic hydrocarbons and olefins. Aromatic hydrocarbons and esters were the main components of PU lacquer-coated *P. neurantha* (Hemsl.) Gamble. Esters were the main components of waterborne lacquer-coated *P. neurantha* (Hemsl.) Gamble. The aromatic hydrocarbons were the main components of *P. neurantha* (Hemsl.) Gamble decorated with UV lacquer.
2. The three lacquers had strong inhibitory effects on the release of olefins from *P. neurantha* (Hemsl.) Gamble and could reduce olefins by more than 90%. PU lacquer could release numerous esters and aromatic hydrocarbons, but it could inhibit aldehydes and ketones. Waterborne lacquer also released numerous esters, resulting in a sharp increase in the release of alcohols after lacquering. However, the aromatic hydrocarbons, olefins, alkanes, aldehydes, and ketones released by *P. neurantha* (Hemsl.) Gamble were inhibited to some extent. UV lacquer had the greatest inhibitory effect on olefins, alcohols, aldehydes, ketones, and other compounds in *P. neurantha* (Hemsl.) Gamble and did not release esters or other compounds, but its toluene release increased sharply.
3. Ten characteristic odor compounds were released from unpainted *P. neurantha* (Hemsl.) Gamble, among which benzaldehyde, toluene, and 1,3-dimethylbenzene played a decisive role in overall odor formation. PU lacquer had a completely closed effect on benzene and benzaldehyde but enhanced the odor intensity of ethylbenzene and 1,3-dimethylbenzene significantly. Waterborne lacquer had a good inhibitory effect on hexanal, 1,3-dimethylbenzene, and ethylbenzene. However, the VOCs released enhanced the odor intensity of benzene, benzaldehyde, 2-ethyl-1-hexanol, decanal, and nonanal. UV lacquer had a good sealing effect on odor compounds except for decanal, benzene, and toluene.
4. The overall odor composition of unpainted *P. neurantha* (Hemsl.) Gamble was mainly aromatic. After finishing with PU lacquer, the overall odor intensity of *P. neurantha* (Hemsl.) Gamble was significantly enhanced, and the overall odor was mainly fruity and aromatic. The types of odor compounds released by waterborne lacquer-coated *P. neurantha* (Hemsl.) Gamble were similar to those of unpainted *P. neurantha* (Hemsl.) Gamble. The overall odor of *P. neurantha* (Hemsl.) Gamble with UV lacquer was basically aromatic.

## Test instrument

### Sampling devices:

- (i) The Micro-Chamber/ Thermal Extractor  $\mu$ -CTE 250
- (ii) Tenax TA tube (Markes International Inc., UK)

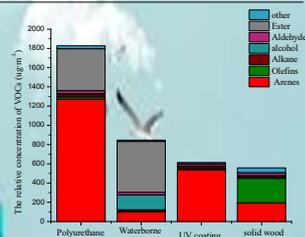
### Analysis devices:

- (i) The Unity thermal analysis desorption unit
- (ii) DSQ II series GC-MS (Thermo Scientific, Germany)
- (iii) Sniffer 9000 Olfactory Detector (Brechtbühler, Switzerland)

## Test materials *P. Neurantha* (Hemsl.) Gamble

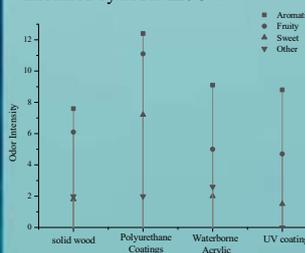
The diameter of the disc was 60 mm, and the thickness is 15 mm.

The test base material was coated uniformly with lacquers of Polyurethane coatings (PU), waterborne coatings and UV curable coatings (UV)



Relative concentration of VOCs from *P. neurantha* (Hemsl.) Gamble with three lacquer coatings

1. The major constituents of *P. neurantha* were aromatics and olefins. A few alkanes, alcohols, aldehydes, and other compounds were also found, but esters compounds were not detected.
2. After decoration, the release of VOC components from solid wood changed drastically. Aromatic hydrocarbons and esters were the main constituents of PU-lacquered *P. neurantha*, compared with the primary compounds of esters from waterborne-lacquered *P. neurantha*, and main components of aromatic hydrocarbons (accounting for 87.7% of the TVOC) from UV-lacquered *P. neurantha*.
3. It was remarkable that the VOC concentration increased greatly after PU lacquer decoration and the TVOC increased by about 227.9%.



Relation diagram of odor concentration and odor intensity of four boards

1. Aromatic was the dominant odor impression of *P. neurantha* followed by fruity
2. The overall odor intensity of PU-lacquered *P. neurantha* was the highest among the three lacquered boards, with a total intensity of 32.7. Aromatic (12.4) and fruity (11.1) were the main odors
3. The waterborne lacquer had little influence on the overall odor characteristics of *P. neurantha*, but the overall odor intensity was enhanced slightly.
4. Aromatic was the key characteristic odor of the whole odor of *P. neurantha* varnished by UV lacquer. Toluene was the main odor contributing compound.