**Low VOC Drying of Lumber and Wood Panel Products
(DE-FCO7-96IDI3439)**

DOE/ID/13439--T4

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Progress Report No. 6

January 1998

Summary

- RF pretreatment of lumber does not affect strength.
- The amount of pinene lost into the headspace during low-VOC RF-treatment of wood approximately corresponds to the amount of material lost from the wood.
- Virtually all the pinene can be removed from the low-VOC reactor with steam, suggesting that pinene can be collected when the small amount of steam released during low-headspace treatment is condensed.
- Temperature and moisture loss profiles for particle at 105°C has been modeled using experimental data at 130°C and 160°C.
- The VOC-temperature curve from dried particle shows a break at about 156°C, the boiling point of α -pinene, demonstrating that pinene boil-off occurs beyond this threshold.
- VOC release from dry particle has been successfully modeled.
- The transport of VOC from sapwood to the atmosphere for pine is faster than the corresponding movement from heartwood to sapwood.
- Seasonal variations in pine extractives are small.

Effect of RF-irradiation on strength (MSU/IPST)

Twenty five Southern pine 2" x 6" x 8' boards were machined into 2" x 4" pieces. Next, the 8' boards were cut in half into matched pairs. One of the two was irradiated with RF, while the other served as a control. Both sets were dried under a conventional temperature-time based schedule. The lumber was removed from the kiln when it reached an average dry-basis MC of 15%. After drying, the moisture was equalized to about 12%. Two boards from each charge warped during drying. The lumber was machined into test specimens, and tests were performed as per ASTM Section D-143 and Appendix Q. Temperature and other changes are recorded in Table 1. Tables 2 and 3 compare strengths of the control and irradiated boards, respectively. Tensile measurements were made on two samples cut from each board; the data are separated into stronger and weaker groups respectively.

Paired T-tests (single-tail) with $\alpha=0.5$ showed minor differences in shear, MOE, and MOR. A test of hypotheses and a test through confidence intervals also showed that the null hypotheses ($H_0: \mu = \mu_0$) for both MOE and MOR were rejected; i.e. the control and sample were significantly different. However, range and a sample mean control charts showed a possibility of a Type I error (H_0 rejected when H_0 is true), since the process was on both sides of the process

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norm. Although there was one point in the range control chart which was outside the upper 3σ limit for MOE, and there were 3 points in the sample mean chart outside the 3σ limit for MOR, we cannot conclude that the process is out of control since nearly every other point crossed the center line. The results for tests of confidence intervals were different to the test of hypotheses. The null hypotheses were not rejected in any of the strength tests. Hence, our overall conclusion is that RF-treatment does not significantly affect strength.

Table 1: Changes in temperature and other properties during RF irradiation

ID	time to reach 100°C	ave. interior temp (°C)	ave. surf. temp (°C)	max int. temp (°C)	green density (g/cm ³)	wt. loss (%)
T-1	9	111.9	98.8	117.9	0.843	5.0
T-2	14	102.8	96.2	104	0.833	6.5
T-3	6	104	91.1	111.4	1.021	5.6
T-4	9	106.8	95.8/	120	0.749	6.5
T-5	11	106.9	99.4	113.1	0.883	6.5
T-6	9	105.5	97.4	110.4	0.867	4.6
T-7	9	101.3	97.6	102.4	0.870	3.9
T-8	7	101.6	98.5	103.5	0.951	6.2
T-9	7	102.2	97.4	105.9	0.730	9.7
T-10	15	109.3	97.8	123.7	0.716	8.6
T-11	9	102.9	95.3	111.2	0.916	4.8
T-12	8	108.1	96.9	117.8	0.837	5.7
T-13	7	101.4	98.1	103.1	0.826	8.0
T-14	6	108.4	97.5	124.0	0.649	7.4
T-15	5	107.8	95.5	115	0.902	4.1
T-16	11	105.5	95.7	110	0.792	4.7
T-17	7	105.8	95.7	112.8	0.854	4.9
T-18	10	103.7	98.4	106.4	0.758	5.0
T-19	14	102.8	97.6	104.2	0.982	6.2
T-20	6	107.0	96.8	112.3	0.674	8.3
T-21	7	104.6	96.8	109.9	0.787	7.2
T-22	6	115.9	96.1	121.7	0.596	6.8
T-23	9	102.7	94.7	108.4	0.744	7.8
average	8.7	105.6	96.7	111.7	0.817	6.3

Table 2: Strength and other properties for the control boards

ID	moisture content %	density g/cc	max com- press ¹	MOE ¹	MOR ¹	shear ¹	tensile ¹	
							A	B
1	0.114504	0.532732	6518	1130953	10276	1872.08	9202.956	6359.909
2	0.112345	0.408346	6457	1033942	7870	1439.556	11333.48	6573.03
3	0.113962	0.527279	7209	1808622	13956	1741.248	15168.25	11363.64
4	0.099662	0.39199	5938	1255213	8913	1065.408	12178.21	10288.99
5	0.124312	0.573609	7906	1297280	11377	1897.736	11400.21	8318.356
6	0.113213	0.483118	5274	1425754	9296	1772.791	11449.35	10348.82
7	0.113332	0.472256	8056	2005898	13061	1149.152	18753.78	7973.286
8	0.121182	0.532034	7521	1593309	12337	1524.273	14584.96	12446.28
9	0.119167	0.519489	5115	1526608	13109	1673.813	14588.34	10520.85
10	0.124318	0.535968	7703	1662529	9716	1689.654	8602.821	8376.34
11	0.114518	0.439987	6614	1925055	14409	1168.043	21357.38	17577.84
12	0.114047	0.374444	5213	1407793	7765	1003.252	7431.457	6902.441
13	0.113931	0.455027	6691	1671271	10320	1280.291	16010.82	13410.95
14	0.116891	0.428513	5571	1396905	7994	1425.498	14478.11	11360.45
15	0.116844	0.525122	7733	1826089	14515	1878.147	14455.42	11416.46
16	0.115561	0.437717	5874	946760.7	6855	1390.597	16512.7	13463.59
17	0.122389	0.580965	6962	1265623	11078	1788.158		
18	0.116959	0.452948	7672	1713040	12302	1596.186	12490.03	10937.28
19	0.113961	0.4929	5253	1247911	11048	1438.935	10944.01	8933.442
20	0.117054	0.469042	6777	1732571	9256	1437.734	17895.55	11251.19
21	0.11551	0.44103	6063	1548263	9801	1347.579	8300.477	8210.93
22	0.114286	0.483786	6268	1698877	11092	1423.899	9836.066	9582.097
23	0.12106	0.502143	6791	1633473	9633	1314.523	16468.77	8121.313

¹psi

Table 3: Strength and other properties for the irradiated boards

ID	moisture content %	density g/cc	max com- press ¹	MOE ¹	MOR ¹	shear ¹	tensile ¹	
							A	B
1	0.111227	0.504484	7332	1561537	10815	916.162	17832.45	13102.12
2	0.113507	0.462842	8850	1397661	10815	1635.332	16366.11	14624.22
3	0.113536	0.502658	7839	1773954	10815	1465.452	11854.58	11809.32
4	0.099637	0.443459	4269	1208551	10815	1420.062	7608.537	6578.282
5	0.118528	0.509069	5578	1100718	10815	1618.901	8671.613	6147.837
6	0.120452	0.419697	6070	1255932	10815	1277.532	9501.916	9364.607
7	0.118848	0.43621	7020	1639839	10815	1319.964	15059.35	14184.4
8	0.107062	0.462889	6016	1411309	10815	1442.882	13694.25	8555.275
9	0.113911	0.385506	4687	1231071	10815	1267.051	8221.851	7849.966
10	0.106176	0.434905	4058	720276.9	10815	1263.338	7465.021	7340.647
11	0.112117	0.563902	7405	1596414	10815	1692.25	17958.44	16582.75
12	0.118521	0.486986	6773	1434073	10815	1531.074	10804.87	7097.603
13	0.115029	0.633826	6768	1410910	10815	1731.866	17169.27	11301.14
14	0.113504	0.424917	5226	1202880	10815	1584.054	10629.53	9824.755
15	0.123926	0.548787	6581	1826034	10815	1656.952	15850.35	15789.7
16	0.112245	0.45891	5468	1400957	10815	960.2		
17	0.112195	0.456512	6306	1462204	10815	1433.403	13114.17	11312.73
18	0.113475	0.409249	5523	1618265	10815	1021.698	9643.135	9142.948
19	0.1239	0.541905	8082	1331700	10815	1702.843	17622.75	13173.59
20	0.105401	0.454253	5058	1174138	10815	1073.299	12966.12	12717.25
21	0.107702	0.421954	6146	1264709	10815	1702.735	11338.44	11214.42
22	0.090307	0.429721	4790	1197173	10815	1244.104	12029.71	8481.592
23	0.118041	0.373116	4873	1140749	10815	1235.231	9428.073	7273.685
psi								

RF pretreatment of pine lumber (IPST)

Lumber (pine) and its associated sawdust was collected from the G-P sawmill in Warrenton, GA on 10/13/97. The original pieces were trimmed to 1 7/8" x 3 1/4" x 48" in order to fit into our tube. The wood was irradiated for 30 min, with the power being cycled to keep the surface at 100°C. Emissions during irradiation were collected in 200 mL of iced methanol. In one case, emissions were collected in two stages of 5 and 11 minutes, respectively. Particle was used in place of lumber in one experiment. Weight loss data and the amount of turpentine collected from 9 separate pieces are listed in Table 4. Four of the pieces (the RFE series in Table 4) were then cut longitudinally as shown in Figure 1. Samples taken from the marked zones in Figure 1, were both solvent-extracted (acetone), and heated for 1 hour at 130°C with the emissions monitored by FIA. Controls (without irradiation) were run from a section taken from the same piece of wood. The results presented in Table 5 show that the difference in pinene content between control and radio frequency treated wood (307 µg/g) compares favorably with the average quantity (225 µg/g) of turpentine collected from RFE-1,2,3,4 in Table 4. Hence, the quantity of pinene collected corresponds approximately to that lost from the wood. The RF10-31-1A/B entries in Table 4 show that the bulk of the emissions emerge during the first 5 minutes of irradiation. Also, emissions from particle are of the same magnitude as those from the boards.

Figure 1. Location of samples taken from lumber after irradiation.

Table 4: RF treatment of lumber		
ID	weight loss (%)	turpentine collected (µg/g, wet basis)
RF10-22-1	5.4	265
RF10-24-1	3.4	351
RF10-24-2	5.3	185
RF10-24-3	7.7	129
RF10-27-1 (RFE-1)	5.8	103
RF10-27-2 (RFE-2)	4.1	159
RF10-29-1 (RFE-3)	6.9	272
RF10-29-2 (RFE-4)	4.8	366
RF10-29-3 (RFSD-01) ¹	5.4	196
RF10-31-1A (first 5 min.)		118
RF10-31-1B (next 11 min.)	5.2	65
average	5.4	214
¹ 2,789 g of particle used		

Table 5: FIA emissions of sub-samples from RF-treated lumber (µg/g)						
ID	control (no RF)		I1	I2	II1	II2
<i>total VOCs released during heating at 130°C for 1 hour</i>						
RFE-1	489	346	307	281	318	256
RFE-2	402	559	154	474	287	528
RFE-3	1287	445	422	725	441	712
RFE-4	644	1068	1359	888	1207	874
average	653		578			
RFSD-01 ¹	743		616			
<i>pinene in acetone extracts</i>						
RFE-1	1028	532	472	504	2320	485
RFE-2	735	570	162	680	268	632
RFE-3	2723	1515	588	1466	1286	661
RFE-4	1283	1711	1626	1230	1811	1085
average	1262		955			
RFSD-01 ¹	1227		720			
¹ particle						

Table 6: Recovery of pinene with steam				
ID	pinene added (g.)	g. pinene/g. water in 1st condensate lot	g. pinene/g. water in 2nd condensate lot	recovery (%)
STP-1	0.85	0/158.2		0
STP-2	2.57	1.29/92.5	0/80.1	50.2
STP-3	12.87	9.01/130.7	2.87/300.3	92.3

Recovery of pinene with steam (IPST)

One option for recovering the VOCs released from wood during low-headspace RF treatment is by condensing the small amount of steam released. In order to determine pinene recovery with steam, α -pinene was injected into a 3.5" x 12" polyethylene cylinder containing saturated steam at 100.5°C. The cylinder then vented to a water-cooled Graham condenser, and the steam collected in two lots. Sodium chloride was added to the condensate, and the pinene separated out. No pinene was found (by gc) in the water condensed in the cylinder, indicating that all the pinene was removed by the steam. The recovery data listed in Table 6 show that virtually all the pinene can be recovered when the amount of pinene added is appreciable.

Modeling moisture emissions from wood (IPST)

Numerous mathematical models exist for moisture emissions from wood. The model in this report differs from existing models in the way the wet line and temperature are approached. Moisture, VOC emissions, moisture content, and temperatures at various points are used to develop the differential equations and boundary conditions necessary to get instantaneous emission rates. An activation energy is estimated, and used to model both moisture emission curves at different temperatures, and the internal temperature of the wood. Vectors are normally used to solve instantaneous equations. However, vectors must have the same size in order to be able to perform certain algebraic operations. Since higher

temperature runs have shorter vectors than those at lower temperature, equations were developed to achieve the same size vectors. Interpolating functions were used to stretch the smaller vectors, and other equations were developed to reduce the time intervals. Softwood particle was used as the substrate since its nearly spherical shape removes simplifies modeling. OSB flakes were used for measuring the instantaneous surface temperature in a constant temperature furnace.

This report contains a brief description of the procedures used to model:

1. moisture emissions, at a given furnace temperature, from emissions data obtained at *different* temperatures;
2. temperature based data collected at other temperatures;
3. internal temperature based on moisture emission and surface instantaneous temperature; and
4. VOC emissions from dry particle.

The following assumptions were made for developing a physical model for green particle.

- Free water diffusion occurs while the surface temperature is at or below the boiling point of water.
- When the temperature rises above the boiling point of water, bound water diffuses to the receding wet line and then evaporates.
- Heat diffuses into the wood at a faster rate than water diffuses out. Vapor pressure builds up in the wood interior.
- Steam moves at a faster rate to the surface than the bound water to the wet line.
- The surface temperature of a green flake increases at the same rate as that for green particle.
- The first point of inflection in the moisture emission curve is assumed to be the point at which the free water is depleted, since the moisture content at the moisture peak is at approx. 30% (fsp).

Governing equations and boundary conditions

Differential equations:

$$-\frac{dC_A}{dt} = k_b C_A \quad (1)$$

$$\frac{dC_R}{dt} = k_b C_A - k_f C_R \quad (2)$$

$$\frac{dC_S}{dt} = k_b C_R \quad (3)$$

Boundary Conditions:

$$\begin{aligned} C_A &= C_{A0} \\ C_R &= C_{R0} \\ C_S &= 0 \end{aligned}$$

where

$$C_{A0} + C_{R0} = C_A + C_R + C_S \quad (4)$$

Integration provides both the bound and free water instantaneous emission coefficient rates

$$k_b = \frac{\ln (C_{Ro} / C_R)}{t_b} \quad (5)$$

$$k_f = \frac{\ln (1 - (C_S - C_{Ro} / C_{Ao}))}{t_f} \quad (6)$$

C = moisture

k = instantaneous emission coefficient rate

t = time

subscripts:

A = bound water

R = free water

S = surface moisture

o = initial

b = bound (used for coefficient)

f = free

The Arrhenius equation is then used to solve for the activation energy (Ea) and for the frequency factor (A)

$$k_s = Ae^{(-Ea/RT_s)} \quad (7)$$

Model for internal temperature

The internal temperature can be found for the period of bound water movement by subtracting the logarithmic form of both the surface and internal coefficients. Figure 2 shows the instantaneous temperature profile for the experimental surface, and a model of the internal temperature for the initial period (where the surface temperature is less than the boiling point of water) and free water diffuses to the surface to the point of depletion. The furnace was set at 130°C, and the wood dried for 60 minutes. The green flake surface temperature was used to model the interior temperature, and the sawdust was used to obtain the transport rate coefficients. In later experiments we have measured the internal and surface temperature of wood, which allows us (by using similar equations) to model the emission rate of the bound water. The model below shows that the internal temperature remains cooler for a period of time (temperature below boiling point) and then increases to above the boiling point of water a few minutes after free water depletion.

Moisture emission curve model at different temperatures

The activation energy (which was found to be about 9 Kcal/mole) was used to solve for the interpolated coefficient, k_i , which was substituted into equation (9). Equation (9) was then interpolated back to the original time interval to get the moisture emission curve model at 160°C from a 130°C experimental data.

$$k_i = \exp[-Ea (1/T_i - 1/T_2) + \ln k_2] \quad (8)$$

$$C_{Ri} = C_{Ro} e^{-k_i t_i} \quad (9)$$

Figure 2: Model of internal temperature from green flakes' experimental surface temperature during free water diffusion.

Figure 3: Comparison of experimental and modeled moisture emission profiles at 160°C

The above equations were used only for the first phase (up to free water depletion), in this case for the first 10 minutes. Similar equations were used for the second part of this model. The main differences are the equations used to reduce the time intervals. Figure 3 shows the comparison between the experimental and the modeled profiles.

105°C Temperature modeling

Table 7 and Figure 4 show the results for modeling flake surface temperature at 105°C for data collected from green flakes at oven set temperatures of 130°C and 160°C.

Table 7: Model for 105°C temperature data.			
minutes	model # 1	model # 2	model avg
0.5	30.7	35	32.85
3	62.8	57.5	60.15
6	64.6	58.7	61.65
9	66.4	60.65	63.525
12	71	63.35	67.175
15	81.6	66.8	74.2
18	92	71	81.5
21	101	75.95	88.475
24	102.9	81.65	92.275
27	104.3	88.1	96.2
30	104.9	95.3	100.1
33	105	103.2	104.125
36	105	104.2	104.625
39	105	104.7	104.88
42	105	104.9	104.97
45	105	105	105

Figure 3: 105°C temperature models from 130°C and 160°C experimental temperature data.

Moisture Profile Modeling at 105°C

Moisture profiles at 105° were modeled by using: (a) the 105°C instantaneous surface temperature, model # 2, and (b) the green particle's moisture model calibrated at 130°C (which was also applied to the above 160°C model). Inevitably the curve of a model which has been made out of two other models will not be as smooth as the curve generated with the experimental data as can be seen in figure

Figure 4: Comparison of modeled and experimental moisture profile curves at 105°C.

Figure 5: Comparison of experimental moisture profile curves at 105°C.

4. However, the 105°C moisture curve is not as reproducible as the higher temperature curves, as can be seen in figure 5 where a comparison between two experimental moisture profile curves is made. In view of the nature of the 105°C moisture curve, the fit is good.

Assumptions for the development of a physical model for VOC release from particle

Assume that initially the wood is completely saturated. Since wood is hygroscopic then the organic compounds are depleted initially by evaporation from the surface area while the water is temporarily held. This causes the sharp rise of the VOC's first peak and the beginning of the gradual water peak. As the temperature increases (rapidly) during the first few minutes, water diffuses from the surface.

It appears that VOC follows the liquid-diffusion-controlled-evaporation where during the transient period the more volatile component is depleted from the surface area while the water

undergoes selective diffusivity (water molecule is smaller than organic components). During the quasi-steady period, water in the form of droplets transport the VOC from the droplet core to the surface layer at an almost constant rate.

As drying continues the surface layer becomes depleted of organics, the surface layer becomes nearly impermeable to diffusion causing reduction of drying rates and increasing retention of organic components due to their lower diffusivity. As the droplet size decreases, diffusion is no longer dominant, and pinene/VOC becomes depleted from droplet volume. Pinene/VOC evaporates through the pit openings that adjoin interior fibers creating internal pressure.

While the heat continues to rise, it creates more internal energy in the liquid, continuing the process of evaporation. If the droplet interior reaches the boiling point before pinene/VOC has had a chance to escape (and before the droplet has reached the surface layer) then the droplet may burst. The accuracy of the model can be assessed by process of elimination when applying the experimental data to the chosen equations.

Modeling VOC emissions from dry sawdust (IPST)

At 5% moisture, liquid flow is impossible. Below the fiber saturation point, the drying is controlled by bound water diffusion and water vapor movement. Temperature gradient, moisture content, time gradient and emission concentrations are taken into consideration for modeling VOC emissions. Softwood particle was dried for 60 minutes to about 5% moisture content, under oven set temperatures of 130°C, 160°C and 200°C. Both Method 25A emissions and sawdust surface temperatures were measured continuously. The following observations were made.

- The VOC signal is temperature-dependent, increasing in intensity with increasing temperature; the first peak emerges more rapidly with increasing temperature.
- VOC emissions at 130°C, 160°C and 200°C peak when the surface temperature reaches its highest point. In other words, surface temperature and VOC emissions peak simultaneously.
- The initial VOC emissions are directly proportional to the sawdust surface temperature.
- After the initial peak, the VOC emissions decrease gradually while the temperature remains nearly constant.
- More VOC is removed after the peak than before the peak at all the temperatures used.
- VOC emissions increase with increasing temperature. Figure 6 shows a break at about 156°C, the boiling point of α -pinene. This suggests that the pinene is not chemically bound to the wood structure or to other species, since otherwise, a higher temperature would be necessary.

Assumptions:

- Particle is spherical.
- At time = 0, there is no VOC on the surface.
- All the VOC is released from below the surface.
- There is still some bound water left.

Figure 6: Sawdust particles at different temperatures.

- Pressure can be built up due to evaporation

A preliminary emission model constructed under the above assumptions at 160°C is compared to the experimental profile in Figure 7.

Figure 7: Comparison of modeled and experimental profiles for VOC emission at 160°C

Diffusion of α -pinene through heartwood and softwood upon drying (IPST)

Shavings (10-15 g.) taken from the heartwood and sapwood of a piece of green pine, were Soxhlet extracted with 150 mL of acetone for 5 hours, with the extracts analyzed for α -pinene by gc. Corresponding samples were dried at 120°C under an airflow of 2.3 lpm, and were similarly extracted. The overall MC of both pieces was 105%. The heartwood MC was 43%; that of sapwood was 121%. The results in Table 8 show that proportionately more pinene is lost from sapwood than from heartwood; i.e. pinene moves to the atmosphere from sapwood faster than it is replenished from heartwood.

Table 8: Pinene in wood ($\mu\text{g/g.}$)			
	before drying	after drying	percent loss
set 1			
heartwood	3910	2003	
	1600	554	
	1230	307	
average:	2250	955	58
sapwood	1523	316	
	1092	285	
	2130	368	
average:	1580	323	80
set 2			
heartwood	1900	1141	
	722	624	
	759	294	
average:	1130	686	39
sapwood	549	241	
	572	231	
	539	227	
average:	553	233	58

Seasonal variation of monoterpenes and resin acids in Loblolly Pine (MSU)

Samples were collected from twelve loblolly pines located in Moorehead Bottom on the MSU forest on a monthly basis. A twelve inch increment borer with a core diameter of 0.200 inches was used to collect cores at a height of approximately 42 inches. Each core was divided into three sections approximately four inches in length and labeled as outside, middle and inside sections. Each sample was extracted with methylene chloride and the sample extract was analyzed for monoterpenes and resin acids by gas chromatography with flame ionization detection. Target compounds were α -pinene, camphene, β -pinene, limonene, fenchyl alcohol, borneol, 4-allylanisole, methyl eugenol, pimaric acid, isopimaric acid, levopimaric acid, dehydroabietic acid, abietic acid and neoabietic acid. The amount of each compound was calculated on a dry sample weight basis. The trees under study were inadvertently harvested in September 1997, and the measurements were continued with adjacent trees. The results shown in Figure 8 demonstrate that seasonal variations are small. Raw data collected during this period are attached in Tables 9-14.

Figure 8: Seasonal variation of extractives from pine

Table 9: Percent extractives in June 1997 samples

	1-inside	1-middle	1-outside	2-inside	2-middle	2-outside	3-inside	3-middle	3-outside	4-inside	4-middle	4-outside
A-Pinene	0.36848	0.08031	0.18738	1.43052	0.65802	0.11448	4.44756	0.12063	0.08608	0.20052	0.09509	0.07995
Camphene	0.00451	0.00087	0.00257	0.01798	0.01214	0.00131	0.13030	0.00149	0.00085	0.00000	0.00092	0.00032
B-Pinene	0.24019	0.06147	0.04852	0.06427	0.03858	0.00500	2.14228	0.03879	0.02681	0.05882	0.03425	0.03324
Myrcene	0.01676	0.00813	0.00567	0.02612	0.02955	0.00268	0.26775	0.00239	0.00317	0.00477	0.00621	0.00273
Limonene	0.01332	0.00184	0.00948	0.01365	0.00728	0.00070	0.15936	0.00157	0.00082	0.00815	0.00475	0.00289
Fenchyl Alcohol	0.00093	0.00000	0.00043	0.00000	0.00000	0.00000	0.01536	0.00000	0.00000	0.00000	0.00000	0.00000
Borneol	0.00208	0.00000	0.00054	0.00095	0.00035	0.00000	0.01803	0.00000	0.00000	0.00000	0.00000	0.00000
4-Allylanisole	0.02772	0.01267	0.01377	0.01453	0.00049	0.00020	0.12087	0.01419	0.02126	0.00823	0.01460	0.02140
Methyl Eugenol	0.00000	0.00000	0.00016	0.00000	0.00000	0.00000	0.00000	0.00000	0.00020	0.00000	0.00000	0.00000
Pimaric Acid	0.01798	0.01675	0.02942	0.16119	0.05741	0.02386	0.14082	0.01825	0.01142	0.02922	0.02177	0.01734
Iso-Levo Pi-maric Acid	0.06999	0.03198	0.04791	0.16515	0.02644	0.04733	0.16688	0.05408	0.01709	0.05113	0.01889	0.02698
Dehydroabietic Acid	0.12593	0.03634	0.04594	0.27887	0.06155	0.01394	0.45744	0.02486	0.00505	0.09157	0.05462	0.01025
Abietic Acid	0.24549	0.05403	0.08983	0.57021	0.23084	0.04491	0.89512	0.04422	0.01824	0.09211	0.04094	0.01945
Neoabietic Acid	0.08259	0.02697	0.03352	0.22040	0.07365	0.02507	0.28387	0.03724	0.02335	0.03683	0.02342	0.02191
	5-inside	5-middle	5-outside	6-inside	6-middle	6-outside	7-inside	7-middle	7-outside	8-inside	8-middle	8-outside
A-Pinene	1.11443	0.16368	0.15970	0.34595	0.08502	0.92023	1.93815	0.18409	0.14688	0.00195	0.27249	0.07221
Camphene	0.02695	0.00162	0.00175	0.01551	0.00113	0.01607	0.03385	0.00213	0.00158	0.00002	0.00381	0.00075
B-Pinene	0.07572	0.01759	0.01109	0.09316	0.10499	0.07918	0.16676	0.03452	0.03235	0.00092	0.15995	0.03327
Myrcene	0.04656	0.00848	0.00629	0.00402	0.00263	0.03113	0.06556	0.00379	0.00300	0.00002	0.00309	0.00093
Limonene	0.04729	0.00130	0.00145	0.06502	0.00633	0.06324	0.13319	0.00930	0.00727	0.00006	0.00811	0.00147
Fenchyl Alcohol	0.01299	0.00000	0.00000	0.01447	0.00000	0.00515	0.01085	0.00000	0.00000	0.00001	0.00000	0.00000
Borneol	0.01642	0.00000	0.00000	0.01534	0.00000	0.00646	0.01361	0.00000	0.00000	0.00001	0.00000	0.00000
4-Allylanisole	0.11823	0.00415	0.00457	0.12378	0.00144	0.04618	0.09727	0.00485	0.00576	0.00014	0.00449	0.01101
Methyl Eugenol	0.00000	0.00000	0.00000	0.00057	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Pimaric Acid	0.13453	0.02684	0.02702	0.07174	0.01972	0.08695	0.18312	0.00595	0.03322	0.00028	0.04461	0.01816
Iso-Levo Pi-maric Acid	0.38183	0.03150	0.05851	0.11729	0.03716	0.15307	0.32239	0.03015	0.02642	0.00105	0.04608	0.01701
Dehydroabietic Acid	0.42471	0.05548	0.03809	0.12596	0.05338	0.26642	0.56112	0.07995	0.03725	0.00068	0.09273	0.01444
Abietic Acid	1.27757	0.05219	0.03953	0.32952	0.06969	0.48938	1.03070	0.07193	0.05548	0.00120	0.17868	0.03863
Neoabietic Acid	0.28443	0.02805	0.02516	0.21493	0.07506	0.00825	0.01737	0.03468	0.03375	0.00034	0.05368	0.02125
	9-inside	9-middle	9-outside	10-inside	10-middle	10-outside	11-inside	11-middle	11-outside	12-inside	12-middle	12-outside
A-Pinene	0.28674	0.18358	0.20229	0.92600	0.09640	0.10852	1.81787	0.37466	0.10458	1.82002	1.29136	0.17853
Camphene	0.01020	0.00523	0.00274	0.01725	0.00074	0.00120	0.05188	0.00522	0.00119	0.02731	0.02773	0.00237
B-Pinene	0.12111	0.09518	0.16078	0.26679	0.02225	0.02654	1.08000	0.18493	0.03548	0.82786	0.77924	0.06190
Myrcene	0.00255	0.00308	0.00326	0.01183	0.00158	0.00214	0.08718	0.00969	0.00292	0.02742	0.05287	0.00451
Limonene	0.04617	0.00051	0.01623	0.15371	0.01199	0.01104	0.10574	0.01056	0.00211	0.04647	0.04461	0.00458
Fenchyl Alcohol	0.00856	0.00292	0.00000	0.00000	0.00000	0.00000	0.00530	0.00000	0.00000	0.00102	0.00000	0.00000
Borneol	0.00865	0.00343	0.00000	0.00000	0.00000	0.00000	0.00579	0.00000	0.00000	0.00132	0.00021	0.00000
4-Allylanisole	0.08204	0.02979	0.00376	0.02450	0.00330	0.00925	0.04554	0.00763	0.00713	0.02405	0.06279	0.01586
Methyl Eugenol	0.00000	0.00042	0.00157	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00017
Pimaric Acid	0.06064	0.01909	0.04698	0.13878	0.01944	0.02149	0.18941	0.05833	0.01959	0.28373	0.09533	0.02456
Iso-Levo Pi-maric Acid	0.02923	0.01365	0.08889	0.24032	0.02654	0.02172	0.05609	0.02160	0.03025	0.27150	0.06764	0.02855
Dehydroabietic Acid	0.08532	0.04279	0.04285	0.52387	0.05131	0.03972	0.44025	0.11158	0.02096	0.61914	0.27835	0.04240
Abietic Acid	0.24886	0.06880	0.14479	0.37016	0.04219	0.04484	0.80861	0.27139	0.05396	1.47279	0.44413	0.08519
Neoabietic Acid	0.05017	0.04711	0.14072	0.11893	0.01800	0.02475	0.20351	0.07631	0.02510	0.34437	0.09116	0.02831

Table 10: Percent extractives in July 1997 samples

	1-inside	1-middle	1-outside	2-inside	2-middle	2-outside	3-inside	3-middle	3-outside	4-inside	4-middle	4-outside
A-Pinene	1.33786	0.09373	0.16441	2.18431	2.81007	0.09924	2.31580	0.27337	0.15282	1.53660	0.15413	0.12622
Camphene	0.03177	0.00097	0.00179	0.10336	0.08129	0.00000	0.07688	0.00371	0.00188	0.08987	0.00166	0.00168
B-Pinene	1.18719	0.07814	0.06293	0.41511	0.23095	0.00639	1.22786	0.03973	0.02741	0.24194	0.05382	0.04565
Myrcene	0.17475	0.01087	0.00572	0.23016	0.17504	0.00283	0.16124	0.00834	0.00515	0.07695	0.00908	0.00772
Limonene	0.06236	0.00278	0.00690	0.06431	0.05076	0.00000	0.08159	0.00273	0.00153	0.20770	0.00752	0.00579
Fenchyl Alcohol	0.00418	0.00000	0.00000	0.00000	0.00000	0.00000	0.00369	0.00000	0.00000	0.02992	0.00000	0.00000
Borneol	0.00520	0.00000	0.00000	0.00054	0.00095	0.00000	0.00403	0.00000	0.00000	0.04220	0.00000	0.00000
4-Allylanisole	0.11426	0.02122	0.01261	0.24655	0.22952	0.00458	0.09400	0.01682	0.02386	0.17415	0.01309	0.02249
Methyl Eugenol	0.00000	0.00000	0.00000	0.00049	0.00487	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Pimaric Acid	0.10075	0.00931	0.01670	0.06554	0.05097	0.00777	0.06469	0.01345	0.01356	0.10287	0.01143	0.02207
Iso-Levo Pimaric Acid	0.51357	0.05796	0.11474	0.34435	0.30432	0.05536	0.24708	0.09748	0.11317	0.79158	0.08058	0.18160
Dehydroabietic Acid	0.22394	0.02497	0.02524	0.08578	0.06302	0.00276	0.06894	0.03266	0.04876	0.07495	0.03946	0.04456
Abietic Acid	0.46506	0.01119	0.03053	0.15876	0.15081	0.00421	0.06991	0.02726	0.02866	0.24546	0.01602	0.04649
Neoabietic Acid	0.12822	0.00880	0.02439	0.51960	0.06234	0.00872	0.06168	0.01773	0.02372	0.03756	0.01182	0.02988
	5-inside	5-middle	5-outside	6-inside	6-middle	6-outside	7-inside	7-middle	7-outside	8-inside	8-middle	8-outside
A-Pinene	0.68000	0.45303	0.19512	0.82763	0.20084	0.17816	2.36499	0.28171	0.31076	1.91362	1.07913	0.12792
Camphene	0.00771	0.00518	0.00198	0.04846	0.00563	0.00249	0.07964	0.00365	0.00395	0.09938	0.01966	0.00103
B-Pinene	0.08284	0.04795	0.01953	0.14405	0.15612	0.16242	0.37655	0.04301	0.04832	0.66668	0.31121	0.05831
Myrcene	0.03145	0.02373	0.00862	0.01812	0.00414	0.00542	0.15181	0.00906	0.01090	0.03142	0.01109	0.00140
Limonene	0.01285	0.00518	0.00397	0.21633	0.02414	0.00937	0.27793	0.01521	0.01622	0.14756	0.00129	0.00373
Fenchyl Alcohol	0.00000	0.00000	0.00000	0.04016	0.00479	0.00000	0.01817	0.00000	0.00000	0.03623	0.00403	0.00000
Borneol	0.00000	0.00000	0.00000	0.03883	0.00531	0.00000	0.02383	0.00000	0.00000	0.04321	0.00437	0.00000
4-Allylanisole	0.01010	0.00868	0.00976	0.03136	0.02939	0.01501	0.01912	0.00646	0.01133	0.06452	0.02582	0.00793
Methyl Eugenol	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Pimaric Acid	0.02080	0.02317	0.01144	0.06107	0.04227	0.01698	0.06494	0.02197	0.04180	0.04387	0.03136	0.01670
Iso-Levo Pimaric Acid	0.09551	0.17864	0.09832	0.12023	0.16324	0.10752	0.26532	0.12862	0.27223	0.18176	0.09117	0.11224
Dehydroabietic Acid	0.11356	0.04669	0.01884	0.05714	0.11379	0.02994	0.04724	0.04322	0.05802	0.03684	0.09935	0.02258
Abietic Acid	0.06632	0.05453	0.01327	0.07849	0.10207	0.02708	0.12364	0.02677	0.07312	0.11173	0.23589	0.04115
Neoabietic Acid	0.02392	0.02002	0.00976	0.04827	0.09139	0.04619	0.02702	0.01875	0.04557	0.01432	0.02268	0.02771
	9-inside	9-middle	9-outside	10-inside	10-middle	10-outside	11-inside	11-middle	11-outside	12-inside	12-middle	12-outside
A-Pinene	1.21057	1.26188	0.25990	0.62327	1.28511	0.10519	1.63863	0.53732	0.12165	0.44570	0.20570	0.20222
Camphene	0.03197	0.03705	0.00300	0.00807	0.02354	0.00092	0.03035	0.00737	0.00120	0.00523	0.00251	0.00239
B-Pinene	0.60845	1.11954	0.17239	0.13001	0.43467	0.03187	0.65739	0.24640	0.04179	0.16322	0.08488	0.06293
Myrcene	0.01988	0.03838	0.00576	0.00871	0.03620	0.00140	0.03412	0.01430	0.00341	0.00854	0.00576	0.00515
Limonene	0.15640	0.11987	0.02089	0.08404	0.22837	0.01221	0.07053	0.01466	0.00234	0.01119	0.00492	0.00403
Fenchyl Alcohol	0.02038	0.00257	0.00000	0.00064	0.00000	0.00000	0.01160	0.00000	0.00000	0.00000	0.00000	0.00000
Borneol	0.02059	0.00181	0.00000	0.00064	0.00000	0.00000	0.01204	0.00000	0.00000	0.00000	0.00000	0.00000
4-Allylanisole	0.11447	0.03367	0.00216	0.01151	0.05074	0.00818	0.02157	0.02005	0.00821	0.01126	0.00734	0.01657
Methyl Eugenol	0.00000	0.00295	0.00000	0.00000	0.00106	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Pimaric Acid	0.02524	0.07701	0.02305	0.02664	0.09305	0.00800	0.04055	0.04353	0.01553	0.03185	0.01644	0.01418
Iso-Levo Pimaric Acid	0.11674	0.21954	0.10276	0.13109	0.55391	0.05965	0.14978	0.27635	0.11547	0.15422	0.10215	0.10055
Dehydroabietic Acid	0.06535	0.12573	0.00468	0.07095	0.36451	0.00714	0.04055	0.05612	0.02885	0.06271	0.03687	0.01179
Abietic Acid	0.05372	0.20850	0.03517	0.07889	0.35274	0.01050	0.21366	0.14523	0.04116	0.08562	0.03900	0.03434
Neoabietic Acid	0.04441	0.13606	0.05126	0.02441	0.07581	0.00873	0.04564	0.04712	0.01755	0.03781	0.01597	0.01486

Table 11: Percent extractives in August 1997 samples

	1-inside	1-middle	1-outside	2-inside	2-middle	2-outside	3-inside	3-middle	3-outside	4-inside	4-middle	4-outside
A-Pinene	2.21491	0.11643	0.16333	3.22780	2.39409	0.16116	2.25018	0.16845	0.14743	0.26724	0.66614	0.12329
Camphene	0.03356	0.00090	0.00082	0.11808	0.08444	0.00000	0.08075	0.00083	0.00073	0.00234	0.00764	0.00000
B-Pinene	1.25296	0.09133	0.06379	0.42739	0.21902	0.03556	1.25097	0.03004	0.02591	0.05510	0.21740	0.03494
Myrcene	0.24368	0.01152	0.00452	0.28276	0.20416	0.00494	0.16750	0.00377	0.00298	0.00778	0.03818	0.00444
Limonene	0.06446	0.00117	0.00564	0.07003	0.04991	0.00000	0.09572	0.00075	0.00000	0.01284	0.03029	0.00258
Fenchyl Alcohol	0.00755	0.00000	0.00000	0.00000	0.00000	0.00000	0.00994	0.00000	0.00000	0.00000	0.00000	0.00000
Borneol	0.00938	0.00000	0.00000	0.00424	0.00212	0.00000	0.01097	0.00000	0.00000	0.00094	0.00000	0.00000
4-Allylanisole	0.17024	0.01818	0.01238	0.24448	0.20729	0.00665	0.11136	0.01358	0.02700	0.02061	0.03675	0.01364
Methyl Eugenol	0.00000	0.00000	0.00000	0.00000	0.00171	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Pimaric Acid	0.17829	0.01611	0.01448	0.13117	0.09137	0.01602	0.11488	0.01011	0.00757	0.07084	0.03893	0.01210
Iso-Levo Pi-maric Acid	1.00061	0.10014	0.09664	0.71112	0.45697	0.10546	0.48569	0.07789	0.04977	0.09651	0.28444	0.09545
Dehydroabietic Acid	0.23827	0.00729	0.00700	0.24517	0.13241	0.00504	0.22806	0.00377	0.00000	0.00300	0.05043	0.00403
Abietic Acid	0.55263	0.00828	0.00952	0.58660	0.49201	0.01007	0.44089	0.00453	0.00000	0.03289	0.05764	0.00807
Neoabietic Acid	0.17523	0.01656	0.02114	0.15482	0.10822	0.02145	0.13955	0.01472	0.01026	0.02202	0.04120	0.01598
	5-inside	5-middle	5-outside	6-inside	6-middle	6-outside	7-inside	7-middle	7-outside	8-inside	8-middle	8-outside
A-Pinene	1.12553	0.19789	0.15930	1.60717	0.16773	0.14657	1.89913	0.22356	0.22692	0.35399	0.11664	0.00000
Camphene	0.01998	0.00080	0.00076	0.04533	0.00163	0.00096	0.02680	0.00167	0.00110	0.00450	0.00000	0.03960
B-Pinene	0.09453	0.03752	0.02049	0.91210	0.13593	0.09944	0.17646	0.02956	0.03154	0.11720	0.05357	0.00000
Myrcene	0.04791	0.01036	0.00971	0.03666	0.00240	0.00259	0.05043	0.00456	0.00598	0.00131	0.00079	0.00148
Limonene	0.03010	0.00080	0.00076	0.00207	0.01566	0.00566	0.09513	0.00889	0.00993	0.01252	0.00267	0.00000
Fenchyl Alcohol	0.00820	0.00000	0.00000	0.02775	0.00078	0.00000	0.00339	0.00000	0.00000	0.00082	0.00000	0.00000
Borneol	0.01050	0.00000	0.00000	0.02901	0.00093	0.00000	0.00328	0.00000	0.00000	0.00180	0.00000	0.01331
4-Allylanisole	0.07288	0.00169	0.00879	0.05142	0.00636	0.01277	0.03756	0.00411	0.00791	0.01039	0.00707	0.00000
Methyl Eugenol	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.01019
Pimaric Acid	0.07397	0.01221	0.01414	0.15488	0.01349	0.01373	0.02410	0.01922	0.01756	0.02742	0.01280	0.07470
Iso-Levo Pi-maric Acid	0.38376	0.08943	0.11864	0.22853	0.04707	0.09426	0.07898	0.01144	0.11236	0.13071	0.08679	0.00700
Dehydroabietic Acid	0.22371	0.00964	0.00994	0.10987	0.01163	0.00768	0.05617	0.01667	0.00552	0.04412	0.01186	0.01253
Abietic Acid	0.49558	0.00803	0.00841	0.31630	0.01318	0.00864	0.02937	0.01467	0.00644	0.09977	0.01461	0.01268
Neoabietic Acid	0.14122	0.01197	0.01475	0.18351	0.03373	0.03916	0.02235	0.01478	0.01683	0.02955	0.01445	0.01268
	9-inside	9-middle	9-outside	10-inside	10-middle	10-outside	11-inside	11-middle	11-outside	12-inside	12-middle	12-outside
A-Pinene	0.00977	0.93904	0.29421	1.43997	1.66411	0.10950	1.17112	0.10764	0.15613	1.80122	0.19834	0.23050
Camphene	0.00025	0.01918	0.00258	0.02983	0.03553	0.00060	0.02288	0.00000	0.00066	0.02432	0.00091	0.00150
B-Pinene	0.00592	0.62383	0.21299	0.15877	0.80590	0.02575	0.47859	0.05219	0.06988	0.63602	0.08027	0.07810
Myrcene	0.00018	0.01911	0.00498	0.02025	0.06949	0.00060	0.02582	0.00081	0.00271	0.03982	0.00319	0.00387
Limonene	0.00143	0.11113	0.02541	0.21159	0.44259	0.01210	0.05254	0.00236	0.00475	0.04582	0.00346	0.00379
Fenchyl Alcohol	0.00014	0.00667	0.00000	0.00843	0.00000	0.00000	0.00895	0.00000	0.00000	0.00000	0.00000	0.00000
Borneol	0.00015	0.00730	0.00000	0.00913	0.00537	0.00000	0.00978	0.00000	0.00000	0.00000	0.00000	0.00000
4-Allylanisole	0.00025	0.02057	0.00302	0.01271	0.09993	0.01180	0.02148	0.00505	0.00911	0.03845	0.00474	0.01642
Methyl Eugenol	0.00000	0.00203	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Pimaric Acid	0.00047	0.04483	0.03154	0.07044	0.08953	0.00984	0.04398	0.01433	0.00772	0.04544	0.01321	0.01721
Iso-Levo Pi-maric Acid	0.00142	0.10859	0.14573	0.28918	0.51404	0.08095	0.16422	0.09282	0.06480	0.24476	0.08154	0.11742
Dehydroabietic Acid	0.00061	0.02400	0.00453	0.21261	0.31423	0.00948	0.04992	0.00733	0.00759	0.10684	0.01467	0.01587
Abietic Acid	0.00191	0.08655	0.00915	0.42924	0.27087	0.00960	0.10892	0.01221	0.01307	0.29316	0.01658	0.01998
Neoabietic Acid	0.00097	0.08204	0.06531	0.07504	0.06776	0.00972	0.04436	0.01848	0.01293	0.06322	0.01394	0.01808

Table 12: Percent extractives in October 1997 samples

	1-inside	1-middle	1-outside	2-inside	2-middle	2-outside	3-inside	3-middle	3-outside	4-inside	4-middle	4-outside
A-Pinene	1.96583	0.18108	0.31120	1.80705	0.57431	0.37594	1.06927	0.61584	0.35964	1.32856	0.41994	0.54244
Camphene	0.08540	0.00272	0.00683	0.08567	0.02198	0.00621	0.03760	0.03384	0.00687	0.05981	0.00943	0.01566
B-Pinene	1.31456	0.05206	0.13519	1.37389	0.30697	0.08598	0.23868	0.46710	0.12620	0.55196	0.20376	0.38969
Myrcene	0.09976	0.00326	0.00895	0.10620	0.02101	0.00663	0.02064	0.03975	0.00881	0.05132	0.01004	0.01787
Limonene	0.48218	0.00531	0.04113	0.66183	0.06546	0.01205	0.20196	0.20255	0.05406	0.58405	0.03338	0.10225
Fenchyl Alcohol	0.01616	0.00000	0.00142	0.05464	0.00448	0.00000	0.02575	0.01610	0.00000	0.05832	0.00000	0.00318
Borneol	0.01838	0.00000	0.00133	0.05014	0.00444	0.00000	0.02687	0.01515	0.00000	0.05579	0.00000	0.00287
4-Allylanisole	0.00000	0.00689	0.02108	0.10298	0.03598	0.01452	0.15775	0.02920	0.02133	0.08783	0.01713	0.03417
Methyl Eugenol	0.00000	0.00000	0.00021	0.00104	0.00000	0.00000	0.00000	0.00019	0.00000	0.00000	0.00022	0.00000
Pimaric Acid	0.14778	0.00733	0.01284	0.23732	0.07384	0.01014	0.05961	0.06562	0.01558	0.13164	0.02238	0.03096
Iso-Levo Pi-maric Acid	0.10354	0.01932	0.04215	0.29721	0.01205	0.02913	0.02806	0.02528	0.02256	0.06056	0.09638	0.07051
Dehydroabietic Acid	0.04012	0.03652	0.01671	0.03780	0.02548	0.06206	0.06734	0.00987	0.00497	0.02375	0.02452	0.01448
Abietic Acid	0.05260	0.00616	0.01359	0.00478	0.05805	0.01128	0.04714	0.02316	0.01069	0.06110	0.02261	0.01647
Neoabietic Acid	0.04891	0.01435	0.02239	0.04518	0.00231	0.01952	0.03361	0.02544	0.01816	0.04794	0.03116	0.01963
	5-inside	5-middle	5-outside	6-inside	6-middle	6-outside	7-inside	7-middle	7-outside	8-inside	8-middle	8-outside
A-Pinene	1.08841	0.38134	0.31687	0.57124	0.36092	0.34025	1.18809	0.33548	0.17071	1.06037	0.36370	0.31563
Camphene	0.05786	0.00700	0.00464	0.01358	0.00673	0.00545	0.04936	0.00924	0.00352	0.03511	0.00820	0.00438
B-Pinene	1.06209	3.07726	0.18221	0.09739	0.12380	0.06667	0.06385	0.03305	0.01921	0.18061	0.04451	0.02399
Myrcene	0.05756	0.01049	0.00747	0.00733	0.01068	0.00733	0.04176	0.01313	0.00632	0.02229	0.00072	0.00502
Limonene	0.00354	0.05238	0.02204	0.10370	0.10244	0.05093	0.55045	0.21564	0.09996	0.08095	0.02242	0.01530
Fenchyl Alcohol	0.07741	0.00248	0.00000	0.00638	0.00000	0.00000	0.02913	0.00188	0.00000	0.01111	0.00131	0.00000
Borneol	0.07119	0.00181	0.00000	0.00676	0.00000	0.00000	0.03379	0.00212	0.00000	0.01265	0.00159	0.00000
4-Allylanisole	0.05661	0.01439	0.01933	0.01004	0.01091	0.01614	0.05997	0.02442	0.01704	0.05649	0.00670	0.01518
Methyl Eugenol	0.00436	0.00000	0.00023	0.00000	0.00000	0.00000	0.00145	0.00000	0.00000	0.00000	0.00000	0.00000
Pimaric Acid	0.11482	0.01719	0.00937	0.01566	0.02280	0.01620	0.02142	0.01577	0.00535	0.06872	0.04172	0.01123
Iso-Levo Pi-maric Acid	0.08988	0.03034	0.02911	0.03935	0.04831	0.03513	0.02297	0.07156	0.03761	0.02935	0.04906	0.06215
Dehydroabietic Acid	0.02921	0.06723	0.05163	0.00000	0.02980	0.00719	0.02349	0.02363	0.00603	0.02217	0.02128	0.00535
Abietic Acid	0.05838	0.02167	0.01357	0.01939	0.01550	0.01126	0.03524	0.01988	0.01294	0.03465	0.01177	0.02376
Neoabietic Acid	0.04285	0.02206	0.01836	0.01730	0.02428	0.02127	0.02447	0.02056	0.02158	0.03060	0.01150	0.04159
	9-inside	9-middle	9-outside	10-inside	10-middle	10-outside	11-inside	11-middle	11-outside	12-inside	12-middle	12-outside
A-Pinene	0.41133	0.21141	0.24146	1.38876	0.34075	0.22939	1.72312	0.30063	0.24819	2.10780	0.77905	0.41285
Camphene	0.00582	0.00303	0.00355	0.03463	0.00755	0.00321	0.06603	0.01267	0.00419	0.12694	0.05526	0.02152
B-Pinene	0.19812	0.10465	0.09552	0.35123	0.08964	0.04045	1.51068	0.14858	0.14483	0.95781	0.52453	0.39543
Myrcene	0.00645	0.00442	0.00489	0.02317	0.00623	0.00347	0.06414	0.00690	0.00719	0.11109	0.03028	0.02913
Limonene	0.03323	0.01979	0.01781	0.11798	0.02371	0.00947	0.25983	0.04350	0.02450	0.29729	0.10106	0.07987
Fenchyl Alcohol	0.00000	0.00000	0.00000	0.01775	0.00240	0.00000	0.03907	0.01051	0.00000	0.05700	0.02407	0.01389
Borneol	0.00000	0.00000	0.00000	0.01719	0.00234	0.00000	0.03370	0.01117	0.00000	0.06147	0.02510	0.01311
4-Allylanisole	0.01615	0.00812	0.03292	0.06113	0.02939	0.02006	0.06881	0.01761	0.03075	0.07365	0.03558	0.02467
Methyl Eugenol	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00160	0.00207	0.00234
Pimaric Acid	0.01051	0.01063	0.00853	0.04955	0.01271	0.00266	0.03859	0.04708	0.00475	0.12238	0.03017	0.03201
Iso-Levo Pi-maric Acid	0.01195	0.07720	0.04483	0.04017	0.02328	0.02740	0.08421	0.16788	0.04058	0.28370	0.01772	0.08747
Dehydroabietic Acid	0.05069	0.01785	0.00349	0.03683	0.01724	0.00347	0.01788	0.01172	0.00153	0.02813	0.01140	0.00382
Abietic Acid	0.01295	0.02669	0.01472	0.05232	0.01841	0.01170	0.05942	0.02448	0.01359	0.06119	0.01733	0.01697
Neoabietic Acid	0.01859	0.05352	0.02927	0.04388	0.01782	0.01962	0.05588	0.01937	0.02889	0.05249	0.01356	0.01640

Table 13: Percent extractives in November 1997 samples

	1-inside	1-middle	1-outside	2-inside	2-middle	2-outside	3-inside	3-middle	3-outside	4-inside	4-middle	4-outside
A-Pinene	1.44762	0.19164	0.23168	2.66164	0.63320	0.19255	0.00909	0.60265	0.29501	1.28614	0.57787	0.31403
Camphene	0.07960	0.00282	0.00440	0.11921	0.03335	0.00296	0.00035	0.03552	0.00563	0.10631	0.02146	0.00523
B-Pinene	0.99875	0.04529	0.09051	2.01460	0.44711	0.04505	0.00256	0.47856	0.10306	0.87500	0.40205	0.12676
Myrcene	0.07320	0.00341	0.00554	0.11539	0.03452	0.00314	0.00021	0.04710	0.00719	0.08220	0.02033	0.00629
Limonene	0.40371	0.00597	0.01806	0.72961	0.11658	0.00592	0.00213	0.26559	0.04047	0.82247	0.11073	0.01578
Fenchyl Alcohol	0.02525	0.00000	0.00038	0.06197	0.00549	0.00000	0.00025	0.01500	0.00000	0.06439	0.00445	0.00000
Borneol	0.02650	0.00000	0.00041	0.05809	0.00571	0.00000	0.00025	0.01442	0.00000	0.06408	0.00463	0.00000
4-Allylanisole	0.04155	0.00622	0.01325	0.14449	0.06427	0.00862	0.00027	0.05073	0.01999	0.12992	0.03936	0.01410
Methyl Eugenol	0.00053	0.00000	0.00015	0.00000	0.00021	0.00037	0.00000	0.00011	0.00013	0.00035	0.00000	0.00000
Pimaric Acid	0.15477	0.00565	0.01089	0.25595	0.09595	0.01167	0.00105	0.10426	0.01133	0.20745	0.00704	0.01450
Iso-Levo Pi-maric Acid	0.35158	0.04642	0.03918	0.15330	0.02067	0.04035	0.00063	0.00206	0.04485	0.06032	0.04376	0.04577
Dehydroabietic Acid	0.11875	0.00462	0.01085	0.14645	0.04501	0.00084	0.00057	0.03474	0.02140	0.03653	0.03020	0.00771
Abietic Acid	0.16627	0.01514	0.01804	0.17120	0.03588	0.01454	0.00109	0.04741	0.01613	0.11229	0.04512	0.02790
Neoabietic Acid	0.13428	0.03671	0.03023	0.15304	0.04357	0.02926	0.00080	0.04911	0.02889	0.09289	0.04638	0.04453
	5-inside	5-middle	5-outside	6-inside	6-middle	6-outside	7-inside	7-middle	7-outside	8-inside	8-middle	8-outside
A-Pinene	0.97441	0.28334	0.22362	0.62584	0.19799	0.19343	0.98280	0.73509	0.13666	1.07363	0.13613	0.25093
Camphene	0.03838	0.00843	0.00417	0.01376	0.00324	0.00309	0.25719	0.06099	0.00307	0.05351	0.00431	0.00354
B-Pinene	0.74389	0.23911	0.15168	0.13865	0.06131	0.03330	0.06829	0.22236	0.01307	0.23984	0.02745	0.02198
Myrcene	0.03136	0.00878	0.00648	0.01144	0.00524	0.00454	0.03508	0.07206	0.00538	0.02951	0.00356	0.00404
Limonene	0.00125	0.05369	0.01761	0.00086	0.05093	0.03692	0.39387	0.61687	0.00000	0.12388	0.01144	0.01053
Fenchyl Alcohol	0.04478	0.00704	0.00000	0.00447	0.00000	0.00000	0.02440	0.00905	0.00000	0.03248	0.00212	0.00000
Borneol	0.04114	0.00624	0.00000	0.00482	0.00000	0.00000	0.02617	0.01049	0.00000	0.03329	0.00325	0.00000
4-Allylanisole	0.33802	0.01228	0.01540	0.01006	0.00785	0.02040	0.04212	0.13842	0.01289	0.04182	0.00819	0.00013
Methyl Eugenol	0.00000	0.00000	0.00013	0.00000	0.00000	0.00000	0.00000	0.00059	0.00000	0.00000	0.00011	0.00000
Pimaric Acid	0.01361	0.02370	0.01331	0.04430	0.01129	0.00969	0.05708	0.06157	0.00360	0.11029	0.00453	0.00839
Iso-Levo Pi-maric Acid	0.22639	0.03009	0.05597	0.16403	0.05874	0.04609	0.07678	0.02826	0.02259	0.03263	0.08252	0.04577
Dehydroabietic Acid	0.16155	0.01947	0.01495	0.13607	0.03611	0.01714	0.05411	0.04892	0.00194	0.05959	0.01328	0.01739
Abietic Acid	0.28778	0.03213	0.02870	0.08189	0.01998	0.01530	0.09393	0.03181	0.00791	0.11591	0.02754	0.01651
Neoabietic Acid	0.25354	0.02785	0.03836	0.09625	0.03150	0.02817	0.06646	0.03394	0.01327	0.10713	0.02419	0.02769
	9-inside	9-middle	9-outside	10-inside	10-middle	10-outside	11-inside	11-middle	11-outside	12-inside	12-middle	12-outside
A-Pinene	1.38374	0.19285	0.20751	0.01630	0.83952	0.17450	0.73771	0.46016	0.29134	1.86269	0.46628	0.30891
Camphene	0.06622	0.00405	0.00318	0.00125	0.06742	0.00245	0.05955	0.03507	0.00683	0.14533	0.03067	0.00980
B-Pinene	0.29422	0.09810	0.09740	0.01046	0.55420	0.04113	0.48645	0.41732	0.21015	0.83256	0.39276	0.19730
Myrcene	0.03581	0.00370	0.00463	0.00080	0.05368	0.00280	0.06239	0.03714	0.00931	0.10110	0.01913	0.00926
Limonene	0.14991	0.01632	0.01812	0.00538	0.26054	0.00897	0.35981	0.16034	0.03194	0.27266	0.07891	0.02444
Fenchyl Alcohol	0.03796	0.00144	0.00000	0.00098	0.02872	0.00000	0.07367	0.01797	0.00160	0.04713	0.02192	0.00295
Borneol	0.03813	0.00161	0.00000	0.00096	0.03292	0.00000	0.08166	0.01795	0.00178	0.05107	0.02217	0.00314
4-Allylanisole	0.04778	0.01607	0.01247	0.00252	0.21721	0.00760	0.05265	0.08841	0.02552	0.09150	0.02000	0.01565
Methyl Eugenol	0.00000	0.00000	0.00000	0.00000	0.00071	0.00000	0.00045	0.00037	0.00000	0.00147	0.00217	0.00119
Pimaric Acid	0.00798	0.01750	0.00507	0.00031	0.14186	0.00260	0.07444	0.01370	0.02255	0.10898	0.03519	0.02234
Iso-Levo Pi-maric Acid	0.11405	0.03360	0.02119	0.00046	0.28214	0.04570	0.26838	0.19286	0.02975	0.30405	0.00219	0.02577
Dehydroabietic Acid	0.01068	0.01104	0.00046	0.00056	0.05031	0.01460	0.03448	0.03133	0.01653	0.05004	0.02466	0.01269
Abietic Acid	0.05452	0.01227	0.00712	0.00140	0.05466	0.01899	0.08811	0.03226	0.02035	0.11656	0.05358	0.02791
Neoabietic Acid	0.05242	0.01553	0.01458	0.00107	0.04645	0.03273	0.06924	0.03869	0.03075	0.08830	0.03700	0.03785

Table 14: Percent extractives in December 1997 samples

	1-inside	1-middle	1-outside	2-inside	2-middle	2-outside	3-inside	3-middle	3-outside	4-inside	4-middle	4-outside
A-Pinene	1.49667	0.54298	0.21809	1.60416	0.67650	0.27818	0.91588	0.56086	0.28728	1.11449	0.39586	0.24481
Camphene	0.06614	0.01985	0.00328	0.06553	0.02887	0.00415	0.04099	0.02882	0.00469	0.04794	0.01153	0.00444
B-Pinene	1.02033	0.19097	0.05161	1.22164	0.44612	0.07291	0.31329	0.45147	0.08001	0.73103	0.25813	0.08962
Myrcene	0.07944	0.01666	0.00387	0.07995	0.03056	0.00463	0.02977	0.03130	0.00593	0.04746	0.01370	0.00494
Limonene	0.33199	0.03873	0.00601	0.00121	0.09907	0.00861	0.28268	0.20894	0.03045	0.47207	0.07764	0.01247
Fenchyl Alcohol	0.00568	0.00466	0.00000	0.00406	0.00417	0.00000	0.00210	0.00123	0.00000	0.03495	0.00058	0.00000
Borneol	0.02560	0.00507	0.00000	0.04860	0.00405	0.00000	0.04400	0.01745	0.00000	0.03471	0.00260	0.00000
4-Allylanisole	0.00227	0.01107	0.00688	0.07218	0.05830	0.01169	0.03860	0.03227	0.05603	0.06219	0.03124	0.01195
Methyl Eugenol	0.00000	0.00046	0.00000	0.00071	0.00029	0.00089	0.00000	0.00109	0.00029	0.00000	0.00000	0.00018
Pimaric Acid	0.11350	0.00410	0.00666	0.18617	0.06128	0.00921	0.02479	0.02235	0.00821	0.04600	0.03727	0.00997
Iso-Levo Pi-maric Acid	0.06786	0.04465	0.05879	0.05682	0.03769	0.04339	0.23797	0.17802	0.03989	0.23043	0.02270	0.04018
Dehydroabietic Acid	0.05288	0.04280	0.01298	0.04663	0.03114	0.00000	0.03306	0.02285	0.00605	0.02849	0.01565	0.01022
Abietic Acid	0.11585	0.05680	0.01882	0.08317	0.02289	0.01644	0.10414	0.05808	0.01534	0.08503	0.03481	0.02077
Neoabietic Acid	0.10251	0.05517	0.04148	0.07491	0.03198	0.03035	0.06869	0.04934	0.02839	0.07337	0.03705	0.03440
	5-inside	5-middle	5-outside	6-inside	6-middle	6-outside	7-inside	7-middle	7-outside	8-inside	8-middle	8-outside
A-Pinene	0.77501	0.25357	0.24388	1.01480	0.18085	0.22355	1.10440	0.48989	0.17475	1.14300	0.73251	0.24485
Camphene	0.02385	0.00453	0.00398	0.01861	0.00413	0.00388	0.03962	0.02516	0.00323	0.05284	0.04771	0.00355
B-Pinene	0.37261	0.20312	0.13560	0.25856	0.07463	0.05366	0.07867	0.10643	0.01628	0.43571	0.54375	0.02252
Myrcene	0.02299	0.00684	0.00592	0.02055	0.00650	0.00547	0.04559	0.03763	0.00501	0.03961	0.04679	0.00413
Limonene	0.22077	0.03018	0.01389	0.21910	0.06121	0.04118	0.64541	0.40633	0.06636	0.19402	0.18775	0.01088
Fenchyl Alcohol	0.04055	0.00090	0.00000	0.00306	0.00000	0.00000	0.02092	0.00855	0.00000	0.03121	0.02168	0.00000
Borneol	0.03743	0.00077	0.00000	0.00381	0.00000	0.00000	0.02226	0.00467	0.00000	0.04631	0.03134	0.00000
4-Allylanisole	0.02532	0.00745	0.01339	0.01495	0.00755	0.01221	0.07667	0.00413	0.01440	0.03092	0.03771	0.01229
Methyl Eugenol	0.00000	0.00000	0.00022	0.00000	0.00000	0.00000	0.00056	0.00033	0.00000	0.00042	0.00131	0.00037
Pimaric Acid	0.01303	0.01911	0.01210	0.03647	0.01993	0.01076	0.05044	0.05045	0.00255	0.04589	0.02793	0.00788
Iso-Levo Pi-maric Acid	0.17215	0.05550	0.04863	0.15035	0.05024	0.05585	0.05691	0.01190	0.02257	0.29220	0.19193	0.05512
Dehydroabietic Acid	0.04232	0.02258	0.00875	0.06285	0.01832	0.01349	0.03443	0.02778	0.00353	0.03876	0.01899	0.00785
Abietic Acid	0.11002	0.04062	0.02516	0.05283	0.01684	0.01832	0.07309	0.01365	0.00776	0.10021	0.04442	0.02093
Neoabietic Acid	0.08079	0.04223	0.03538	0.06277	0.02666	0.03362	0.05384	0.03585	0.01245	0.08478	0.04004	0.03606
	9-inside	9-middle	9-outside	10-inside	10-middle	10-outside	11-inside	11-middle	11-outside	12-inside	12-middle	12-outside
A-Pinene	1.42322	0.34521	0.21357	1.51675	0.22728	0.14291	1.36653	0.83473	0.16243	1.85284	0.80167	0.51568
Camphene	0.03325	0.00714	0.00348	0.05681	0.00738	0.00267	0.04609	0.04864	0.00264	0.10245	0.05656	0.02036
B-Pinene	0.94744	0.18774	0.10529	0.83663	0.06232	0.04529	1.18198	0.81185	0.09511	0.68164	0.43234	0.46551
Myrcene	0.03625	0.00684	0.00489	0.05459	0.00467	0.00315	0.06232	0.06358	0.00498	0.09080	0.04194	0.02607
Limonene	0.11625	0.03454	0.01906	0.24456	0.02521	0.00000	0.31242	0.20336	0.02094	0.27300	0.13275	0.07592
Fenchyl Alcohol	0.01570	0.00493	0.00000	0.03051	0.00414	0.00000	0.03570	0.00051	0.00000	0.00305	0.01889	0.00946
Borneol	0.01745	0.00533	0.00000	0.04268	0.00407	0.00000	0.03520	0.00015	0.00000	0.00954	0.02212	0.01343
4-Allylanisole	0.04545	0.01534	0.03185	0.13329	0.02011	0.01253	0.08864	0.05997	0.01497	0.06651	0.03995	0.04777
Methyl Eugenol	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00050	0.00026	0.00000	0.00150	0.00056	0.00431
Pimaric Acid	0.05409	0.03211	0.01933	0.01959	0.01949	0.00310	0.01911	0.07337	0.00484	0.12734	0.03407	0.04136
Iso-Levo Pi-maric Acid	0.07475	0.12929	0.06050	0.06920	0.02186	0.04735	0.02430	0.19587	0.06646	0.35030	0.41821	0.13102
Dehydroabietic Acid	0.03918	0.02001	0.01022	0.05130	0.01800	0.01095	0.02864	0.02928	0.01028	0.02949	0.04993	0.01253
Abietic Acid	0.06267	0.01953	0.02133	0.11899	0.03424	0.01895	0.06989	0.04711	0.02405	0.09437	0.09948	0.04864
Neoabietic Acid	0.07532	0.02306	0.04159	0.10465	0.03343	0.03472	0.07044	0.06412	0.05162	0.07304	0.07466	0.05318