Turpentine (more than paint thinner!)

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Turpentine oil is the natural product obtained by distilling pine tree materials and is familiar to most of us as a solvent our grandfathers used for oil based paints. The real value of turpentine however is as a source of starting materials for the synthesis of a variety of products. Industrially, turpentine is further distilled into individual components. Turpentine is predominantly α-pinene and β-pinene, which are used as starting materials for the synthesis of other aroma and specialty chemicals. Typical examples are the large scale production of geraniol from β-pinene and linalool from α-pinene.

The composition of the oil, especially the amount of α-pinene and β-pinene, varies depending on a variety of factors including the species of the tree and the region from where the tree was harvested. These amounts must be determined prior to distillation. Figures 1 and 2 are chromatograms of turpentine obtained with DB-WAX and DB-XLB. With both phases, the α− and β-pinene are well resolved from other turpentine components. DB-WAX provides a better overall separation of the remaining components in the sample. The key components of turpentine are noted in Figure 1.

Many of the compounds contained in turpentine are chiral, including α-pinene and β-pinene. The enantiomeric ratio is also dependent on the source of the pine trees. This ratio is important to know as the chirality of the starting pinene determines the chirality of the end product. The enantiomers of both α-pinene and β-pinene are well resolved by GC with a CycloSil-B column. Figure 3 shows this separation with the enantiomers of both α and β-pinene. CycloSil-B is an excellent general purpose column for chiral separations and allows for quick determination of enantiomeric purity.
Figure 2. Turpentine Oil on DB-XLB

Column: DB-XLB
30 m x 0.25 mm I.D., 0.25 µm
J&W P/N: 122-1232
Carrier: Hydrogen at 45 cm/sec, measured at 80°C
Oven: 70-200°C at 3°C/min
Injector: Split 1:60, 220°C
Detector: FID, 250°C

1. α-Pinene
2. Camphene
3. β-Pinene
4. 3-Carene
5. α-Phellandrene
6. α-Terpinene
7. Limonene
8. β-Phellandrene
9. γ-Terpine
10. p-Cymene
11. Terpinolene
12. Caryophyllene
13. Terpinen-4-ol
14. α-Terpineol

Figure 3. Turpentine Oil on CycloSil-B

Column: CycloSil-B
30 m x 0.25 mm I.D., 0.25 µm
J&W P/N: 112-6632
Carrier: Helium at 35 cm/sec, measured at 70°C
Oven: 60°C for 5 min
60-95°C at 3°C/min, no hold
95-200°C at 20°C/min
Injector: Split 1:50, 250°C
0.5% turpentine oil in acetone
Detector: FID, 250°C

1. (-)-α-Pinene
2. (+)-α-Pinene
3. (+)-β-Pinene
4. (-)-β-Pinene
5. α-Phellandrene
6. α-Terpinene
7. Limonene
8. β-Phellandrene
9. γ-Terpine
10. p-Cymene
11. Terpinolene
12. Caryophyllene
13. Terpinen-4-ol
14. α-Terpineol

Gay Sun and husband Dario at Machu Picchu.