

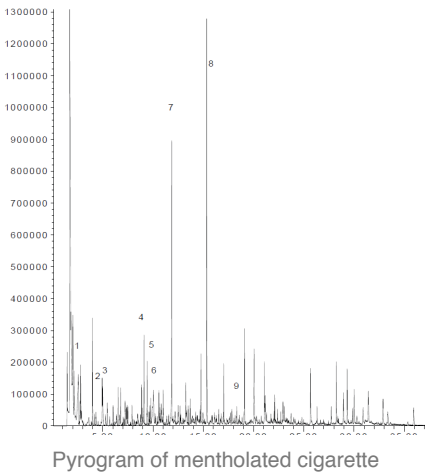
# A Practical Applications Guide for Analytical Pyrolysis - GC/MS

Tobacco



# Analysis of Menthol Cigarettes

The material used in cigarettes is a carefully formulated product of natural tobacco together with a variety of additives. Analytical pyrolysis can reveal both the materials produced from the tobacco at high temperatures as well as the volatile additives. Pyrolysis has also been applied to the study of the papers used in cigarette manufacture, as well as the filter material. A small (~250 µG) sample of tobacco from a mentholated cigarette was pyrolyzed at 700°C for 15 seconds. The resulting pyrogram shows a wide range of natural products, including nicotine and levoglucosan (a product of cellulose) as well as additives, including glycerin and menthol. Selected peaks from the pyrogram are identified in Table I.



## Pyroprobe Setting

Set-point: 700°C 15 sec  
Valve Oven: 300°C  
Transfer Line: 325°C

## GC/MS Setting

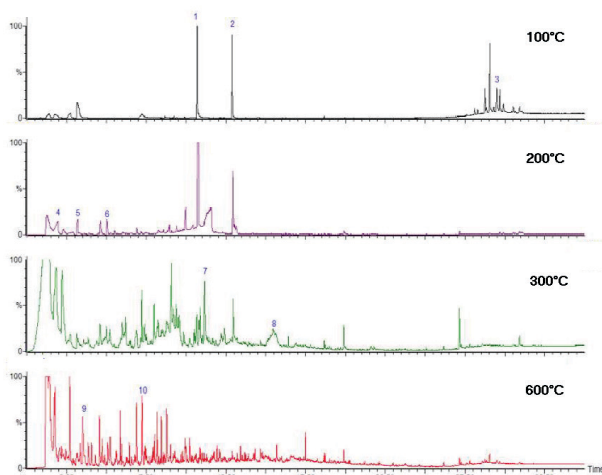
Column: 5% phenyl  
Carrier: Helium, 50:1 split  
Injector: 300°C  
Oven: 40°C for 2 min  
8°C/min to 300°C  
hold 12 min  
Mass Range: 35-550

Peak number	Compound
1	Acetic acid
2	Propylene glycol
3	Toluene
4	Limonene
5	Phenol
6	Glycerin
7	Menthol
8	Nicotine
9	Levoglucosan



# Multi-step Pyrolysis on Smokeless Tobacco

The tobacco tested here is a wintergreen flavored smokeless product. It is sampled using of 4 separate temperatures to examine both volatile compounds and pyrolysis products. At 100°C, nicotine and methyl salicylate, (wintergreen flavoring) are apparent. In addition, vitamin E, a natural product of tobacco is present. At 200°C, acetic acid and propylene glycol evolve, and tobacco begins to degrade, so pyrolysis products are also seen. At 300°C, degradation products of cellulose become significant, including furans and levoglucosan. Performing multiple thermal steps provides several advantages. Some of the minor constituents (like the vitamin E) would be difficult to identify if only performing single pyrolysis run. Secondly, it clear that the nicotine is quite volatile. Finally, additives are determined easily, apart from the products generated when tobacco is pyrolyzed.



- Peak Identification
1. Methyl salicylate
  2. Nicotine
  3. Vitamin E
  4. Acetic acid
  5. Propylene glycol
  6. 2-Furanmethanol
  7. Hydroxymethyl furan carboxaldehyde
  8. Levoglucosan
  9. Toluene
  10. Phenol

Analysis of wintergreen flavored smokeless tobacco at 100, 200, 300 and 600°C.

## Pyroprobe Setting

Interface: 100,200,300,600°C  
for 15 sec

Valve Oven: 300°C

Transfer Line: 325°C

## GC/MS Setting

Column: 5% phenyl

Carrier: Helium, 50:1 split

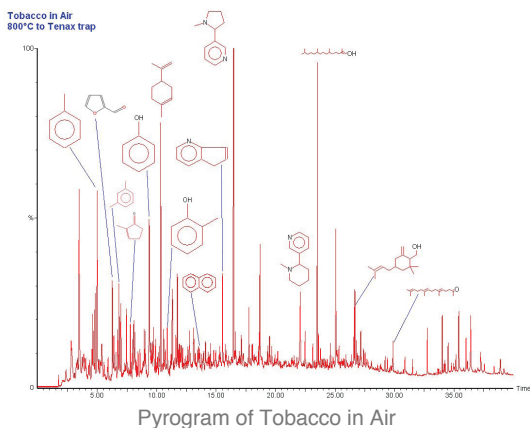
Injector: 300°C

Oven: 40°C for 2 minutes  
10°C/min to 300°C

Mass Range: 35-550

# Combustion Products

Using the CDS Model 6200 Pyroprobe, burning of tobacco can be studied. Tobacco can be pyrolyzed under a reactant gas, such as air, and the pyrolyzing reaction products collected onto a trap which is then desorbed to the GC/MS. When tobacco burns, the products include a wide range of compounds, some of which are pyrolysis products, some have been oxygenated, and some just desorbed. The largest peak, nicotine, is simply volatilized from tobacco by heating. Some of the other compounds are pyrolysis products of the cellulose, including furfural and methyl cyclopentenone. Aromatic hydrocarbons produced include toluene, xylene, naphthalene and many others, plus phenolic compounds including phenol and methyl phenol. Aliphatics, especially branched and unsaturated compounds are also generated, including limonene and long-chain alcohols. Because the heating rate, temperature and time for pyrolysis with the CDS Pyroprobe are all selectable, experiments may be designed to simulate the various burning processes involved when tobacco is smoked.



## Pyroprobe Setting

Pyrolysis:	800°C for 25 sec
Valve oven:	325°C
Interface:	300°C
Transfer line:	325°C
Trap rest:	40°C (Tenax)
Trap desorption:	325°C for 4 minutes
Reactant gas:	Air at 30 ml/minute

## GC/MS Setting

Column:	5% phenyl
Carrier:	Helium, 50:1 split
Injector:	300°C
Oven:	40°C for 2 minutes
Mass Range:	35-600 amu

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