

# Factors Influencing Pyrolysis and Smoke Release Characteristics of Tobacco Particles at Low Temperature

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## Introduction



Tobacco Flakes and Tobacco Cuts

Tobacco Particles

However, the research on the basic thermal properties and the release of key components of the smoke is mainly focused on tobacco flakes and cut tobacco. There are few reports on the low-temperature pyrolysis characteristics of tobacco particles, especially the smoke release characteristics.

The objective of study was to provide theoretical guidance for product development of tobacco particles.

## Samples and Methods



Sample	C <sub>0</sub>	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>
Glycerin Content / (%)	0	25	30	35

Sample	RH <sub>1</sub>	RH <sub>2</sub>	RH <sub>3</sub>	RH <sub>4</sub>
Relative Humidity / (%)	30	40	50	60

Sample	D <sub>1</sub>	D <sub>2</sub>	D <sub>3</sub>
Particle Size / (mm)	1.41	0.85	0.58

- The thermal conductivity: Thermal Conductivity Tester
- Pyrolysis: Thermal Gravimetric Analyzer (TGA)
- Smoke Release Characteristics: cone calorimeter (CONE)

## Conclusion

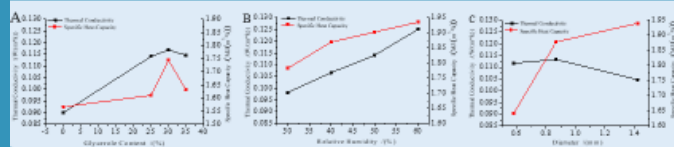
Moisture content has the greatest influence on thermal conductivity compared with glycerin content and particle size. Thermal conductivity of samples presented an increasing trend with the rising contents of glycerol and moisture and the decrease of particle sizes.

During the stage of major mass loss, glycerin content has the greatest influence on pyrolysis compared with moisture content and particle size. The maximum mass loss rate obviously increases with the rising of glycerin content and particle size, while the moisture content is otherwise. On the stage of pyrolysis at high temperature, the mass loss rate decreases with the rising of glycerin content, while the moisture content and particle size almost have no effect on it.

With the rising of glycerin content, the initial smoke produce rate and total smoke rate tend to increase, while have a slight decrease of sample with 35% glycerin content. Increasing moisture content, the process of smoke release overall delay and decrease total smoke release. Reducing particle size is beneficial to increase the smoke produce rate and total smoke release.

## Results and Discussion

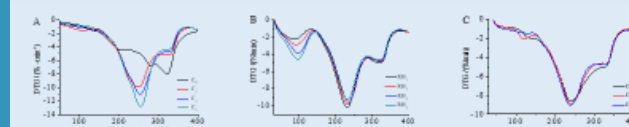
### 1. Thermal Conductivity and Special Heat Capacity



The thermal conductivity of samples presented an increasing trend with the rising contents of glycerol and moisture and the decrease of particle sizes.

The specific heat capacity showed a growth trend with rising of moisture content and reducing of particle size, while increased first then decreased with the rising of glycerol content.

### 2. Pyrolysis

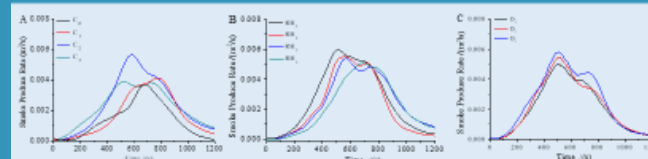


The addition of glycerol dramatically increased the percentage of mass loss and mass loss rate at low temperature range. The major mass loss stage changed from 220°C-300°C to 140°C-300°C.

The influence of moisture content on tobacco particle mass loss rate gradually weakened with the increasing temperature. Moisture content mainly effected the emission of dissociative water, glycerol and so on under low temperature.

The main process of mass loss of samples with lower particle size slightly translated to low-temperature region.

### 3. Smoke Release Characteristics



With increasing of glycerin content, the initial release time of smoke shortened and total smoke release rised, while sample of 35% glycerin content had a slight decreasing.

Lower moisture content and smaller particle size were all beneficial to shorten the initial release time of smoke, improve its release rate and make the total smoke rate on the rising.

Tab.1 Test results of physical and chemical indexes of different samples

Sample	Physical and Chemical Indicators		
	Moisture content / (%)	Glycerole content / (%)	D <sub>50</sub> / (mm)
C <sub>0</sub>	10.74	0	1.49
C <sub>1</sub>	10.88	23.50	1.51
C <sub>2</sub>	11.03	27.27	1.54
C <sub>3</sub>	10.67	32.42	1.61
RH <sub>1</sub>	9.84	22.72	1.51
RH <sub>2</sub>	12.96	22.68	1.51
RH <sub>3</sub>	14.98	22.70	1.51
RH <sub>4</sub>	19.16	22.63	1.51
D <sub>1</sub>	9.71	25.56	1.41
D <sub>2</sub>	10.09	24.22	0.86
D <sub>3</sub>	9.34	26.21	0.58

Tab.2 Percentage of mass loss and solid residue of tobacco particles (g)

Sample	First Stage	Second Stage	Third Stage	Solid Residue
C <sub>0</sub>	3.73	12.65	42.36	41.26
C <sub>1</sub>	5.94	49.05	11.15	33.86
C <sub>2</sub>	4.93	51.17	10.14	33.76
C <sub>3</sub>	3.96	54.42	9.27	32.35
RH <sub>1</sub>	8.83	42.95	15.68	32.54
RH <sub>2</sub>	11.18	41.56	15.03	32.23
RH <sub>3</sub>	14.04	39.92	14.88	31.16
RH <sub>4</sub>	16.66	39.19	14.36	29.79
D <sub>1</sub>	5.50	43.17	14.59	36.74
D <sub>2</sub>	6.11	41.99	13.86	38.04
D <sub>3</sub>	5.78	42.31	14.35	37.56

Tab.3 Total Smoke Rate of different samples

Sample	Total Smoke Rate (m <sup>2</sup> /m <sup>2</sup> )
C <sub>0</sub>	191.7
C <sub>1</sub>	243.5
C <sub>2</sub>	288.4
C <sub>3</sub>	263.9
RH <sub>1</sub>	316.5
RH <sub>2</sub>	285.8
RH <sub>3</sub>	281.1
RH <sub>4</sub>	267.8
D <sub>1</sub>	251.3
D <sub>2</sub>	206.4
D <sub>3</sub>	283.9