

HEAT FLOW AND PRESSURE EVOLUTION DURING THE THERMAL DECOMPOSITION OF PINENE UNDER VARIOUS ATMOSPHERES

INTRODUCTION

Turpentine is a renewable resource whose main components are α -pinene and β -pinene. Due to their chemical structure, which includes double bonds, these molecules are highly reactive with oxygen.

In the context of their potential use as fuels or energy additives, it is essential to evaluate their thermal stability and the risks associated with their oxidation in order to improve safety during storage, transportation, and use.

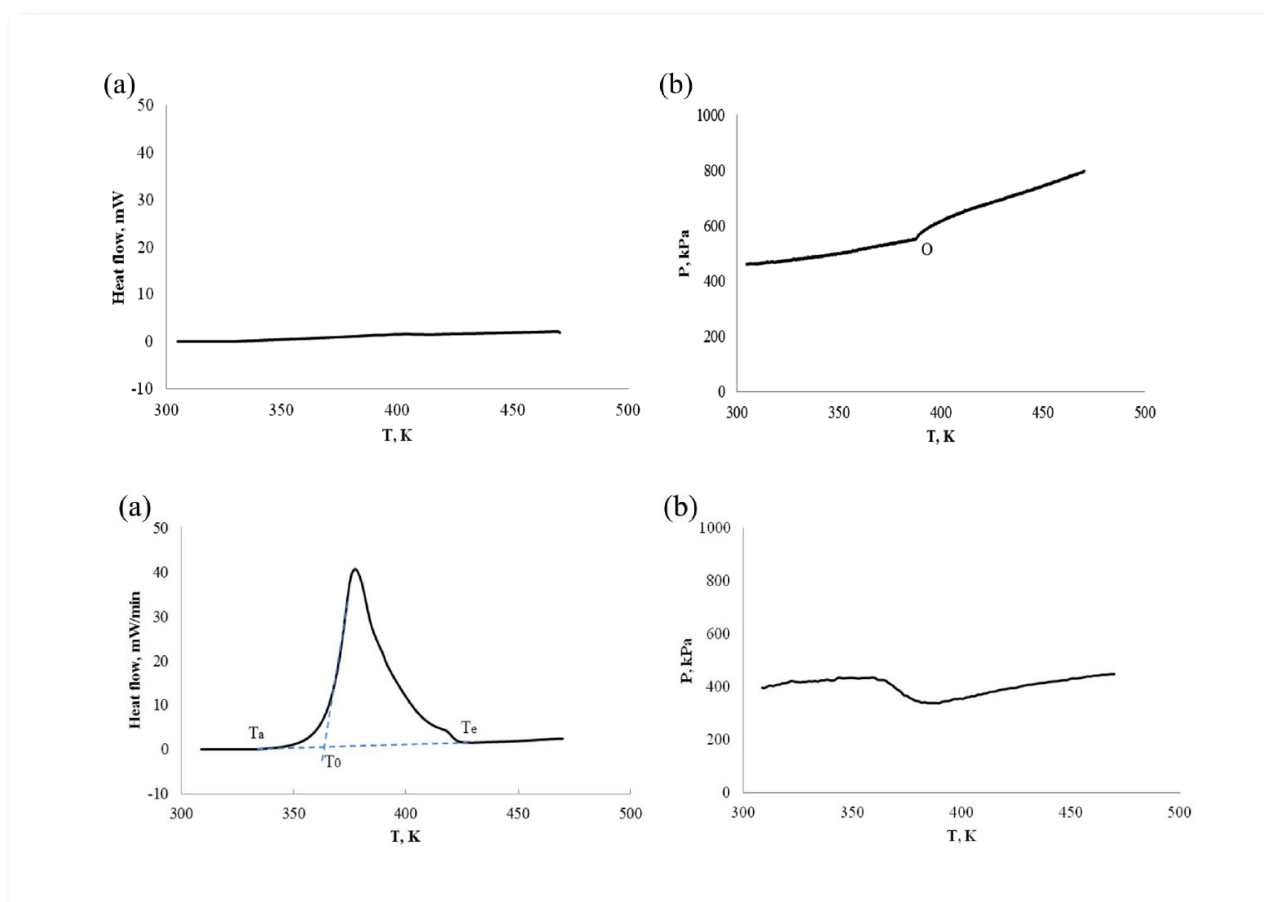


Figure – Heatflow (left) and Pressure (right) signals measured for alpha-pinene samples under nitrogen (top) and oxygen (bottom).

EXPERIMENT

The thermal properties were studied using a CALVET (formerly C80) calorimeter. Samples of approximately 0.1 g of α -pinene, β -pinene, and a mixture of the two compounds were analyzed during heating at a rate of 0.2 K/min from room temperature to 300 °C.

The tests were conducted under different atmospheres (nitrogen, air, and oxygen), while simultaneously monitoring heat flows and pressure changes within the cell in order to characterize the oxidation and decomposition processes.

RESULTS AND CONCLUSION

Measurements show that both terpenes are thermally stable in an inert atmosphere, with no significant reactions detected.

In contrast, in the presence of oxygen, exothermic reactions occur at temperatures ranging from 335 to 338 K (62 to 65 °C), accompanied by oxygen consumption and a significant release of energy ranging from 2.7 to 3.0 kJ·g⁻¹.

Analysis of the calorimetric curves reveals three successive stages: an induction phase, a main phase of highly exothermic oxidation, and then a decomposition phase producing gases.

These results demonstrate the value of the CALVET calorimeter in accurately quantifying the risks of thermal runaway and providing the data necessary for assessing the thermal hazards of processes involving terpene compounds.

Source : Xiongmin Liu et al, RSC Adv., 2021, 11, 20529.

INSTRUMENT

CALVET
Ambient to 300°C



HIGHEST HEAT MEASUREMENT ACCURACY
 3D sensor based on thermocouples with Joule effect calibration.

ISOTHERMAL OR TEMPERATURE SCANNING MODES
 for increased flexibility and replication of real life conditions.

CONVENIENT INTERCHANGEABLE CRUCIBLES AND CELLS
 to perform even the most demanding experiments:

- high pressure (1000bar) and high vacuum
- pressure measurement and control
- mixing/stirring experiments.

EXTERNAL COUPLING CAPABILITY
 designed to increase your research options in manometry, BET instrumentation, gas analyzers, humidity controllers and gas panels