

Investigation of Thermal Properties of Carboxylates with Various Structures

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Introduction

Thermal gravimetric analysis (TGA) is the analysis of the mass of a sample as it is exposed to temperature changes. This kind of analysis looks at the mass change of a sample as a function of temperature and reveals the thermal stability of the compound being tested. Different compounds will produce different thermograms from the TGA analysis based on the makeup of the compound.

The project looked in to finding a parameter to determine the TGA properties of carboxylate salts. I used three different carboxylate acids, an aliphatic organic acid: acetic acid, an aromatic organic acid: benzoic acid, and a hybrid of the two types: salicylic acid.

Methods

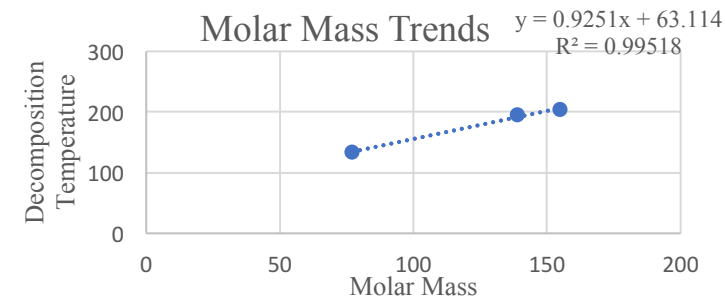
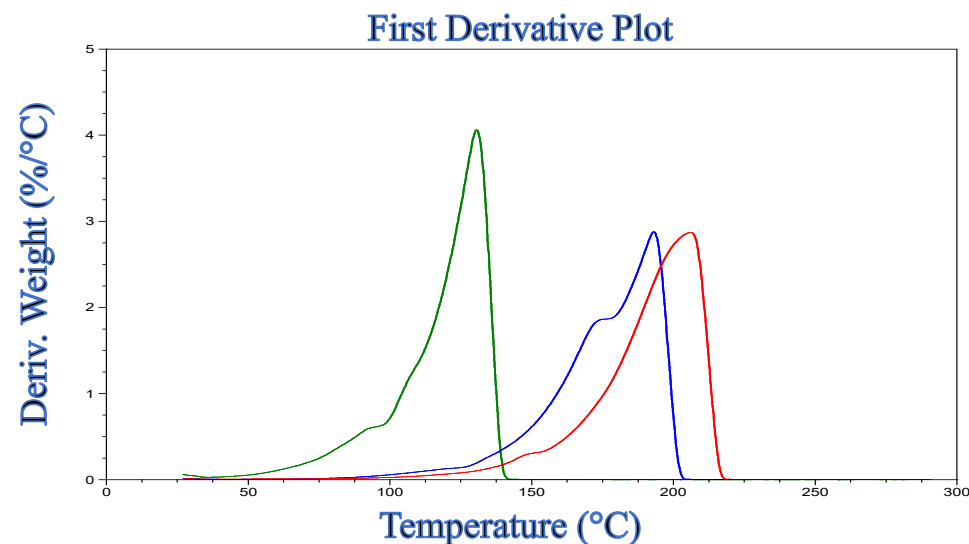
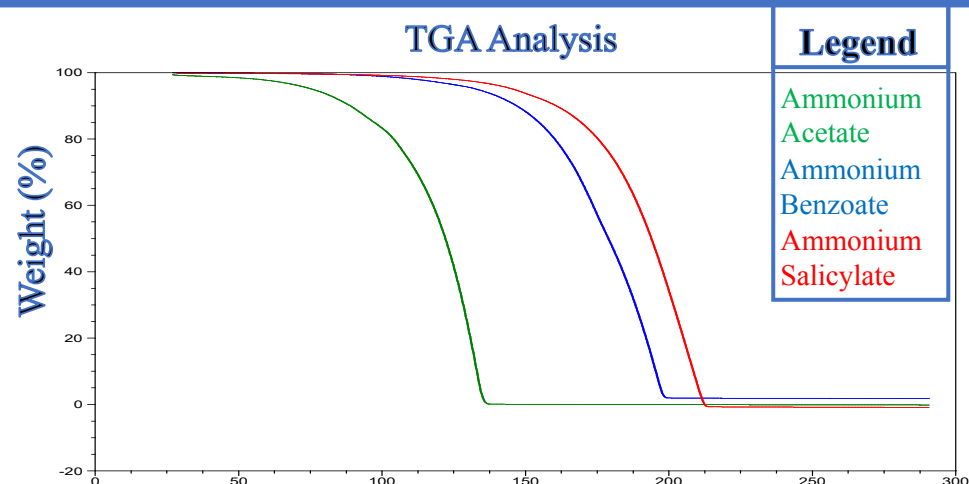
The ammonium salts of the three chosen carboxylate acids are already commercially available and were obtained for the project. The TGA instrument was then used to obtain thermal scans of benzoic acid and salicylic acid to establish a baseline for comparison.

The TGA analysis yielded the thermal properties for each salt tested. To compare these scans, a first derivative graph of the mass percent versus temperature scans was produced. The peak on these graphs is the point at which mass decrease is at its fastest, this was used as a comparison point for the salts tested.

References

- Erdey, L., et al. "Thermoanalytical Properties of Analytical-Grade Reagents." *Talanta*, vol. 11, no. 6, June 1964, pp. 913–940.
- Lavi, Avi, et al. "Volatility of Atmospherically Relevant Alkylammonium Carboxylate Salts." *The Journal of Physical Chemistry A*, vol. 119, no. 19, 2015, pp. 4336–4346.

Results



Conclusions

The highest peak on these first derivative plots is the point at which mass decrease is at its fastest, this was used as a comparison point for the salts tested. The ammonium benzoate salt peak temperature is 194.72°C with a mass loss of 88.4%. The ammonium acetate salt peak is 133.8°C with a mass loss of 94.16%. The ammonium salicylate peak is 204.23°C with a mass loss of 78.08%. Using this data, a trend was discovered between the molar mass of the salt and the peak temperature of its decomposition: the heavier the salt, the more stable it is based on its decomposition temperature. Future research can be done by synthesizing and testing more salts to solidify the trend for all salts.

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