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Note

SOME ASPECTS OF THE DECOMPOSITION OF REFUSE STUDIED BY DSC

NEIL D. JESPERSEN and GEORGE DESTEFANO

Chemistry Department, St. John's University, Jamaica, NY 11439 (U.S.A.)

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In using differential scanning calorimetry to study the heat content of fuels made from processed refuse, it was observed that the thermograms showed characteristic changes which seem to depend solely upon sample preparation. Previously, thermal analysis has been used on coal samples [1, 2]. Since DSC is a rapid, convenient calorimetric method, which may gain wide usage in refuse analysis, the results are presented to aid in further investigations.

EXPERIMENTAL

A DSC-1B from Perkin Elmer was used for all analyses. Typical runs were at 10 K min^{-1} from 400 to 775 K. All samples were run in covered pans in an oxygen atmosphere. Although covering the pans hinders oxidation, it significantly increases the thermal contact and reproducibility of each run.

Crude samples of refuse are very heterogeneous and wet homogenization was used to obtain uniformity. Initially samples were ground for about 1/2 h in a blender and then an aliquot was homogenized for several hours thereafter. Slurries from both steps were filtered through a buchner funnel and the resultant mat was dried in air or in a 383 K oven. An office hole punch was used to obtain samples from the dried mats.

RESULTS AND DISCUSSION

Table 1 summarizes the results of approximately 10 analyses upon each type of sample. The related thermograms are illustrated in Figs. 1 and 2. Each curve shows a major peak at approximately 585 K. Samples which have been air dried show a peak at about 500 K while oven dried samples do not. A high temperature peak at 650 K seems to be dependent upon the degree of sample homogenization.

The presence of a low temperature peak in the air dried samples (curves A and B) but not in the oven dried samples (curves C, D and E) is due solely to the fact that the former were air dried and not oven dried. Although the region where the low temperature peak is expected to occur is above the

TABLE 1

Relation of sample size and preparation to specific thermogram curves

Curve	Fig.	Ave. wt. of samples (mg)	No. of homogenizations	Type of drying
A	1	9.64	1	Air
B	1	1.88	2	Air
C	1	1.92	2	Oven
D	2	<10	1	Oven
E	2	>10	1	Oven

378 K drying temperatures, it is apparent that some component of the system is slowly oxidized with prolonged (ca. 12 h) oven drying. This peak accounts for approximately 5% of the total curve area.

The presence or absence of the high temperature peak is not as easily rationalized. It appears in both the oven dried and air dried samples. However, it is less pronounced, or even absent, depending on the degree of homogenization of the sample. Samples which have been homogenized twice (curves B and C) show little or no evidence of this peak while those samples which were homogenized once show a pronounced peak at 650 K. In sample E the sharp spike is presumably ignition. One possible explanation of this feature would be delayed oxidation due to the larger mass of the particles present.

Peaks at 550—600 K are seen in all samples and represent the main oxidation process. Sample weight also has an effect on these peaks. With less than 8 mg, these peaks are well defined and simple (curves A—D). When the mass is about 10 mg (curve E) the peak broadens and looks truncated. Larger weights (ca. 15 mg) show this peak splitting into two distinct peaks. The

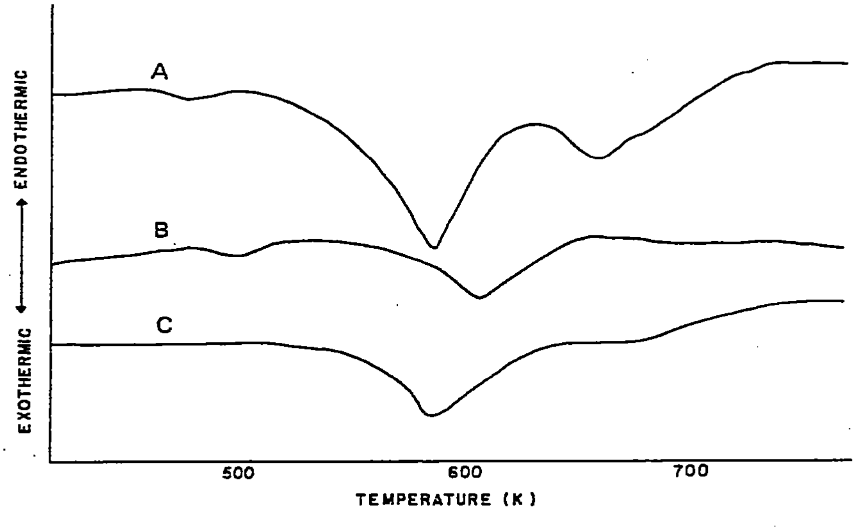

Fig. 1. Thermograms for the decomposition of refuse. Curve letters correspond to those in Table 1.

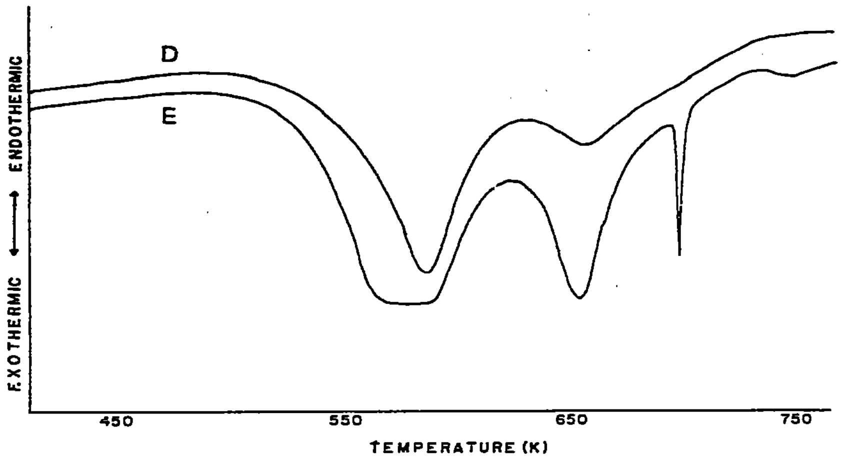

Fig. 2. Thermograms for decomposition of refuse. Curves correspond to those listed in Table 1.

cause of this is not known but is obviously directly related to sample mass. One possible reason for this behavior would be the depletion of the oxygen supply around the sample, causing the reaction to slow down and then start again as more oxygen became available. This would be particularly true since crimped pans are used and rapid oxidation will evolve CO_2 and H_2O, keeping oxygen from entering the system.

CONCLUSIONS

In observing the oxidation of processed refuse many factors are involved in producing the characteristic curve shape. These can be rationalized on the basis of prior heating or homogenization of the sample or the availability of oxygen for the reaction process. Most of these considerations have only a minor effect on the total curve area. However, it is important to note that the missing low temperature peak, in the oven dried samples, will produce an error of approximately 5% in the results. In certain situations this may be significant.

REFERENCES

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2 W.W. Wendlandt, Thermal Methods of Analysis, Wiley, New York, 1974, 2nd edn.