KINETICS OF THERMAL DECOMPOSITION OF METAL ACETATES

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The acetates of magnesium, nickel, copper, manganese, sodium and barium were subjected to thermal decomposition by means of thermogravimetric techniques (TG) under a constant flow of nitrogen. The decompositions occurred in steps and the kinetics of every set of reactions was determined by the Coats and Redfern method. These results were analysed to establish the decomposition kinetics and hence to calculate activation energies. The activation energies were also determined by applying the Horowitz-Hugh method, which yielded similar results.

Thermogravimetric analysis (TG) has come into widespread use in the past decade for rapid assessment of the thermal decompositions of various substances. The thermal decomposition of metal acetates have been well documented [1-7]. Little information is available, however, on the kinetics of thermal decomposition of these metal acetates. In the present investigations, the orders of reaction \(n\) and the activation energies \(E\) of decomposition of the acetates of magnesium, nickel, copper, manganese, sodium and barium are determined.

The use of thermogravimetric data to evaluate the kinetic parameters of solid-state reactions involving weight loss has been investigated by a number of workers [8-11]. Determination of the order of reaction and activation energy with the above-mentioned methods suffered from a number of disadvantages. Therefore, an attempt was made to calculate the kinetic parameters by employing the Coats and Redfern method [12]. The activation energies were also calculated by employing the Horowitz method [11]. The acetates were chosen on the basis that decomposition occurs in steps; from the percentage weight losses, the volatile species were investigated and the kinetics of every set of reactions was determined.
Experimental

All metal acetate samples were of analar grade and were used as such. Mg(CH₃COO)₂·4H₂O, Ni(CH₃COO)₂·4H₂O, Cu(CH₃COO)₂·H₂O, Mn(CH₃COO)₂·4H₂O and Ba(CH₃COO)₂ were all from E. Merck, whereas CH₃COONa·3H₂O was supplied by Riedel.

The TG curves were recorded on the Shimadzu TG-31 system with a temperature-programmed furnace (fitted with a voltage stabilizer), a thermocouple and an R-122T recorder. The heating rate employed was 10 deg / min. Since small sample weights of 10–15 mg were used, it was possible to operate at a heating rate of 10 deg/min without loss of resolution. All experiments were performed under a flow of nitrogen at a flow rate of 40 ml/min.

Results and discussion

The TG curves of various metal acetates are shown in Fig. 1. A computer program in Basic language was applied for the equations [12]. The value of $n$ was first changed to calculate the data, followed by plotting on a computer with the "ENEG" graphic system for each value of $n$. The best straight line was chosen with a low value of variance, and a computational approach was also made to select the value of $n$ which gave the best straight line through

![Fig. 1 TG curve of (I) Mg(CH₃COO)₂·4H₂O (II) Ni(CH₃COO)₂·4H₂O (III) Cu(CH₃COO)₂·H₂O (IV) CH₃COONa·3H₂O (V) Mn(CH₃COO)₂·4H₂O (VI) Ba(CH₃COO)₂.](Image)