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Note

ON THE DEHYDRATION OF $MgSO_4 \cdot 7\ H_2O$

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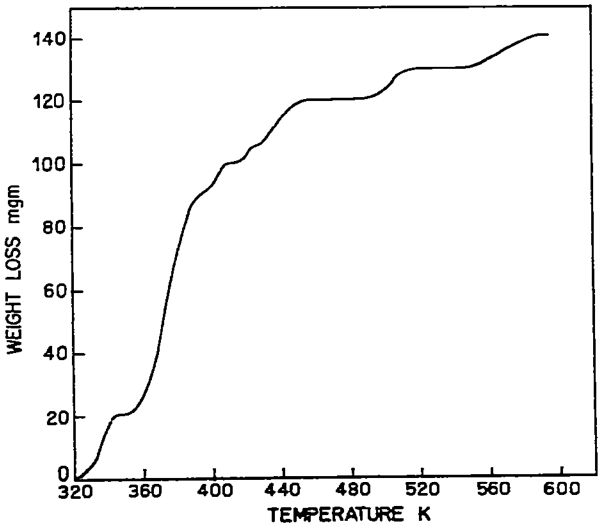
The dehydration of $MgSO_4 \cdot 7\ H_2O$ has been studied [1,2] by different thermal analysis techniques including EGA, X-ray diffraction, TG and DTA. However, the published data from these studies is conflicting. Hence, in the present investigation we have studied the dehydration by a simultaneous TG and DTA technique on the same sample and have been able to obtain as many as seven dehydration steps in TG (peaks in DTA) in air at 1 atmospheric pressure with a heating rate of 2°C min^{-1} both for TG and DTA (Figs. 1 and 2).

In the simple dehydration processes the separation of different water molecules by TG steps and DTA peaks are indicative of the fact that it depends upon the water vapour pressure build-up in and around the sample during the dehydration. The stability of these different intermediate metastable hydrates thus formed depends upon the water vapour pressure build-up during the process, i.e. the temperature interval between two steps may either increase or decrease (Table 1).



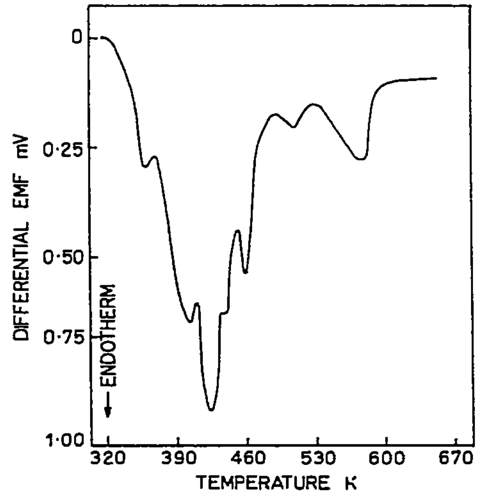


Fig. 1. TG curve for the dehydration of $MgSO_4 \cdot 7\ H_2O$ in air.

Fig. 2. DTA curve for the dehydration of $MgSO_4 \cdot 7\ H_2O$ in air.

TABLE 1

Dehydration of $MgSO_4 \cdot 7\ H_2O$

Sample size: 275 mg; particle size: 240 + 300 B.S.S; heating rate: 2°C min^{-1}; chart speed: 6 in. h^{-1}; sample crucible: platinum, cylindrieal, 18 mm diameter, 22 mm height; atmosphere: static air; total weight loss 140 mg.

Mode of dehydration			Temperature (K)			Temp. span, θ	Activation energy (kcal $mole^{-1}$) (η = 1)	
Step	Wt. loss (mg)	Composition *	Initial	Peak	Final		Coats and Redfern [3]	Dharwadkar and Phadnis [4]
I	20	1 H_2O	323	333	343	20	28.34	21.00
II	70	3.5 H_2O	353	378	393	40	37.00	22.11
III	10	0.5 H_2O	393	401	408	15	29.55	20.54
IV	5	0.25 H_2O	413	418	423	10	32.16	21.29
V	15	0.75 H_2O	423	443	453	30	28.54	20.48
VI	10	0.5 H_2O	493	506	513	20	28.31	21.00
VI	10	0.5 H_2O	548	583	593	45	40.05	22.00

* As observed from TG.

Although these different intermediate metastable hydrates are dependent upon the effect of water vapour pressure, the reaction mechanism does not change. The dehydration of different steps is found to obey first order reaction kinetics and also requires the same activation energy as the dehydration process (Table 1).

The kinetics are evaluated from TG data using the methods of Coats and Redfern [3] and Dharwadkar and Phadnis [4]. The scatter in the values from the Coats and Redfern method is due to the temperature span of each individual step and not to a different mechanism.

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