Thermochimica Acta, 93 (1985) 517-520
Elsevier Science Publishers B.V.. Amsterdam

ISOTHERMAL DEHYDROXYLATION OF MUSCOVITE MICA

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ABSTRACT

The isothermal thermogravimetric method was chosen as convenient one to determine the optimal conditions of the dehydroxylation of mica.

INTRODUCTION

Muscovite mica partly dehydroxylated and arranged in layers is the raw material for the production of the micaceous electroinsulting paper. The final properties of this paper are in certain measure the function of the dehydroxylation degree /1/. The DTA and TG methods are convenient to determine the characteristic temperature of the dehydroxylation of mica but they don't facilitate to fix an optimal heating schedule for various micas.

MEASURING METHODS

Isothermal gravimetric methods in two various arrangements were used to determine the required reaction degree α in the course of the dehydroxylation of muscovite micas from various Indian deposits: a) the intermittent dehydroxylation in the stationary atmosphere, b) the continuous dehydroxylation in the dynamic atmosphere.

ad a) The measuring was carried out with the mica plates of the square section 15x15 mm and about 1 mm thick. The sample was placed into a pre-heated tube furnace with the stationary atmosphere and it was weighted after fixed time of firing and cooling.

ad b) The measuring was carried out with the 20 mg sample in the form of circle by the diameter d ≐ 5 mm and about 1 mm thick. Air flew round the crucible at the rate 7 $cm^3\ min^{-1}$.

RESULTS AND DISCUSSION

The reaction degree α was calculated after the following equation:

$$\alpha = \frac{w}{w_o} \qquad (1)$$

Proceedings of ICTA 85 Bratislava

where w is the loss by ignition in time τ, w_o is the loss by ignition to the state of constant weight. An example of time dependences of α is in Fig.1

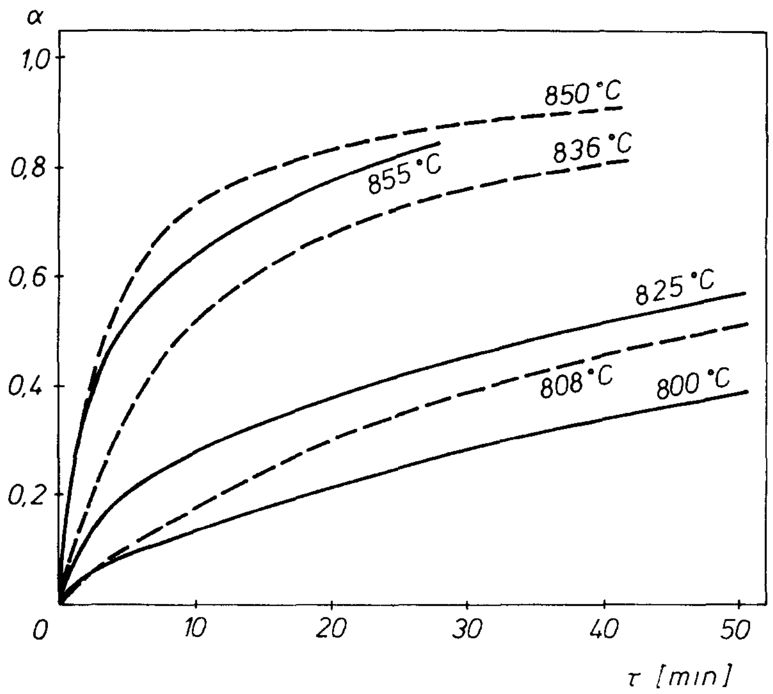

Fig.1. Time dependences of reaction degree for mica G.M.C/M sample. Solid lines are responsible to the method a); dashed lines are responsible to the method b).

These curves were described using the general equation /2/:

$$\alpha = 1 - \frac{1}{A + B\tau} \qquad (2)$$

where A,B are constants calculated after equations:

$$A = \frac{1 - B\tau_1(1 - \alpha_1)}{1 - \alpha_1} \qquad (3)$$

$$B = \frac{1 - \dfrac{1 - \alpha_2}{1 - \alpha_1}}{(1 - \alpha_2)(\tau_2 - \tau_1)} \qquad (4)$$

The limit values α_1, α_2 response to time τ_1, τ_2 respectively in the studied interval, see Tab.1.

Tab.1. The values of A,B responsible to the temperatures of the dehydroxylation and the values of reaction degree and time of firing in the course of interrupted dehydroxylation

Mica Sample	Constants		Time of firing		Reaction Degree		Temperature °C
	A	B	τ_1 min	τ_2 min	α_1	α_2	
G.M.C. /M/	1,111	0,159	2	-	0,30	-	855
			-	11	-	0,65	
	1,144	0,0226	10	-	0,27	-	825
			-	50	-	0,56	
	1,034	0,0116	20	-	0,21	-	800
			-	50	-	0,38	

Time of the dehydroxylation τ/s/ to reach required reaction degree α follows from the equation (2). It was corrected in the interval $\alpha \in (0{,}4;\ 0{,}6)$. The equation may be than written as:

$$\tau = 60\,\frac{1 + A\alpha - A}{B - B\alpha} \tag{5}$$

Temperature dependence of the dehydroxylation may be described using the first order kinetic equation /3/:

$$\ln(1 - \alpha) = A' e^{-Q/RT}\,\tau \tag{6}$$

where A' is constant, Q is activation energy, R is universal gas constant, T is temperature /K/. Following values of Q and A' were calculated using methods a) and b) respectively:

a) Q = 516,5 kJ/mol, $A' = -\ 2{,}028.10^{21}$

b) Q = 489 kJ/mol, $A' = -\ 1{,}207.10^{20}$

The equation (5) was made full use of to set the nomograms, see Fig.2:

CONCLUSIONS

Nomograms are used to determine temperature of the dehydroxylation for the fixed values of reaction degree α and time τ. Two methods described above give comparable results if the size of mica plates are the same.

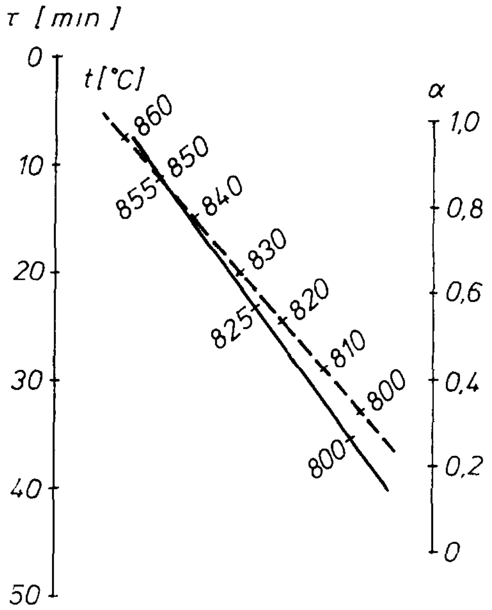

Fig.2. An example of nomograms which are used to determine temperature and time of the dehydroxylation for the required reaction degree. Solid line - method a), dashed line - method b).

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