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## Note

# A METHOD TO EVALUATE THE "REACTION ORDER" OF HETEROGENEOUS DECOMPOSITIONS UNDER NON-ISOTHERMAL CONDITIONS

E. URBANOVICI and E. SEGAL

*Chair of Physical Chemistry and Electrochemical Technology, Faculty of Chemical Engineering, Polytechnical Institute of Bucharest, Bulevardul Republicii 13, Bucharest (Romania)*

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In the fundamental rate equation of non-isothermal kinetics [1,2]

$$\frac{d\alpha}{dT} = \frac{A}{\beta} f(\alpha)\, e^{-E/RT} \tag{1}$$

where all the notations have the known meanings, the "classical" conditions: $A = ct$; $E \doteq$ const.; $f(\alpha) = (1-\alpha)^n$, will be considered as fulfilled.

Let the value of the conversion degree at the temperature $T_i$, the sample being heated with the rate $\beta_1$, be $\alpha_{1_i}$. The corresponding value of the conversion degree at $T_i$ if the sample is heated with the rate $\beta_2$ will be denoted $\alpha_{2_i}$. The heating rates $\beta_1$ and $\beta_2$ will be chosen in such a way that $\beta_2 > \beta_1$.

Through variable separation and integration from eqn. (1) one obtains

$$\int_{\alpha_{1_i}}^{\alpha_{1k}} \frac{d\alpha}{(1-\alpha)^n} = \frac{A}{\beta_1} \int_{T_i}^{T_k} e^{-E/RT} dT \tag{2}$$

$$\int_{\alpha_{2_i}}^{\alpha_{2k}} \frac{d\alpha}{(1-\alpha)^n} = \frac{A}{\beta_2} \int_{T_i}^{T_k} e^{-E/RT} dT \tag{3}$$

By performing the integrations in the left-hand side of eqns. (2) and (3) and taking their ratio it turns out that

$$\frac{(1-\alpha_{2_i})^{1-n} - (1-\alpha_{2k})^{1-n}}{(1-\alpha_{1_i})^{1-n} - (1-\alpha_{1k})^{1-n}} = \frac{\beta_1}{\beta_2} \tag{4}$$

with

$$\beta_1 = \frac{T_k - T_i}{\Delta t_1} \tag{5}$$

and

$$\beta_2 = \frac{T_k - T_i}{\Delta t_2} \tag{6}$$

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$\Delta t_1$ and $\Delta t_2$ being the time intervals corresponding to the two heating rates. Relationships (4) is that searched for as it allows the "reaction order" to be evaluated.

The method was used for the dehydration of calcium oxalate monohydrate. The experimental data and the results were: $T_i = 433$ K, $T_k = 463$ K, $\beta_1 = 4.934$ K min$^{-1}$, $\beta_2 = 9.259$ K min$^{-1}$, $\alpha_{1_i} = 0.1833$, $\alpha_{1k} = 0.8542$, $\alpha_{2_i} = 0.1167$, $\alpha_{2k} = 0.6292$, $n = 0.89$. The value of $n$ is in fairly good agreement with those given in the literature [3–5].

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