

Table 2.10 Alkaline Decomposition of Riboflavin by Isothermal and by Several Nonisothermal Programs

Temperature program	Rate constant at 25°C	Activation energy (kcal/mole)	Reference
Isothermal	0.016	19.2	Cole and Leadbeater (1966)
Linear up	0.014	20.1	Guttman (1962)
Linear up	0.016	20.3	Rosenberg et al. (1984)
Log up	0.018	17.9	Madsen et al. (1974)
Log up ^a	0.015	20.9	Rosenberg et al. (1984)
Log down	0.015	18.9	Rosenberg et al. (1984)

^a Triplicate experiments.

Source: Table constructed from data published by Rosenberg et al. (1984).

bath. By inserting Eq. (2.59) into Eq. (2.58), the concentration profile in time becomes

$$\frac{C_0}{C} = Z \exp\left[-\frac{E_a}{R}(a - bt)\right] \quad (2.60)$$

or, logarithmically,

$$\begin{aligned} \ln\left[\frac{C_0}{C}\right] &= \ln[Z] - \frac{E_a}{R}(a - bt) \\ &= \left[\ln\{Z\} - \frac{aE_a}{R}\right] + \left(\frac{bE_a}{R}\right)t \end{aligned} \quad (2.61)$$

This gives rise to a linear plot when $\ln[C_0/C]$ is plotted versus t , and (since a and b are the constants for the program we have chosen for our temperature bath), the slope (divided by b/R) will give us the value of E_a ; and now $\ln[Z]$ can be obtained from the intercept.

The same procedure can be used for first-order reactions, although they are somewhat more complicated. In such a case a computer program is best, and curves can be generated to match the curve obtained experimentally.

Table 10 shows some of the investigations that have been carried out in the last 20 years, using this procedure.

7.3. Kinetic Mean Temperature

Since stability studies carried out in an industrial setting are isothermal, there has been a fair amount of discussion over the last 2 decades as to what the actual temperature of the study ought to be. Up to 1993, the FDA required stability studies to be carried out at 30°C for the approval of expiration periods. In contrast, the European community would consider the United States as an area where 25°C would be the appropriate temperature to require for isothermal testing.

The resolution of the problem in Europe came from by Futscher and Schumacher (1972), who established the climate zones, and Wolfgang Grimm (1985,