Chapter 13

Professional Reference Shelf

R13.1 Fitting the Tail of C(t)/E(t)

In a number of reaction systems the tail of the output from a pulse tracer test (see Figure R13.1-1) can be quite long, and truncating the curve can produce significant error in calculating the mean residence time and the variance. To overcome this difficulty, we fit the tail to an exponential decay beyond a given time t_t, that is,

$$E(t) = E_1(t) \quad \text{for } 0 < \underline{t} < t_t \qquad \text{(R13.1-1)}$$

$$E(t) = ae^{-bt} \quad \text{for } t > t_t \qquad \text{(R13.1-2)}$$

To obtain the constants a and b, we first choose a time t_t at which tail begins. Next we plot (ln E(t)) versus t as shown in Figure R13.1-2

$$\ln E(t) = \ln a - bt \quad t > t_t \qquad \text{(R13.1-3)}$$

From the slope of the line after t_t, we find the constant b.

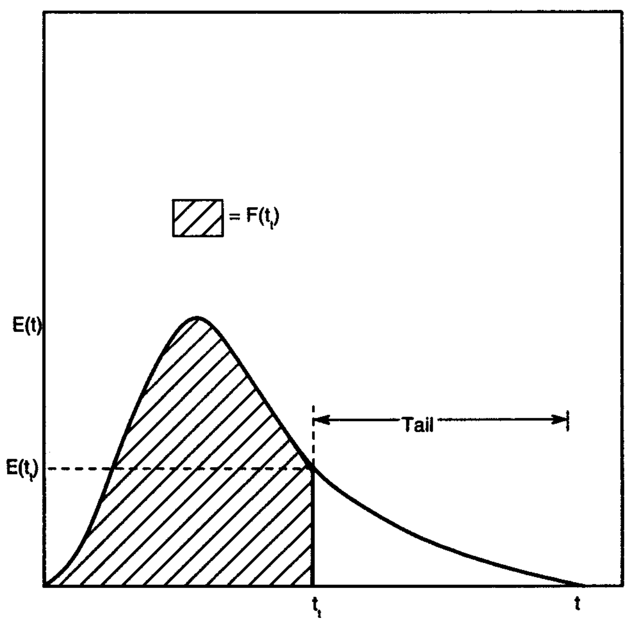

Figure R13.1-1

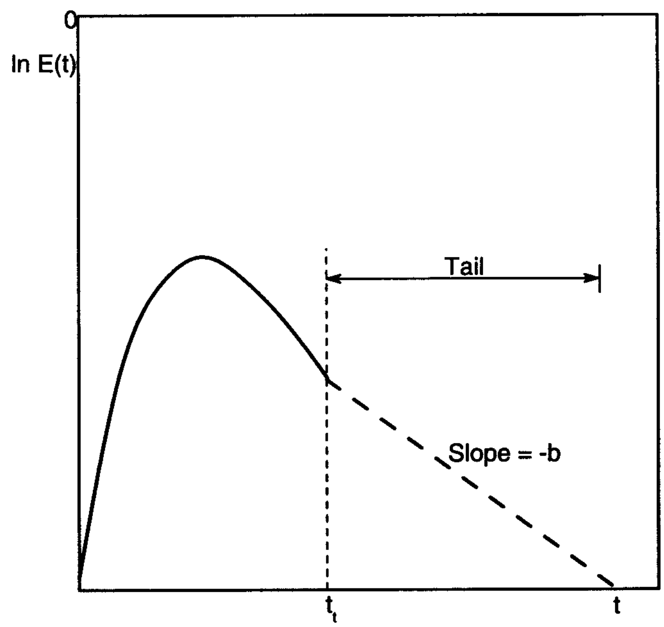

Figure R13.1-2

Since b_2 is known from Figure R13.1-2, we can calculate a using the cumulative distribution. The shaded area under the curve in Figure R13.1-1 is

$$\int_0^t E(t)dt = F(t) \qquad \text{(R13.1-4)}$$

$$\int_0^\infty E(t)dt = \int_0^{t_t} E(t)dt + \int_{t_t}^\infty ae^{-bt}dt = 1 \qquad \text{(R13.1-5)}$$

then

$$\frac{a}{b} e^{-bt_t} = 1 - \int_0^{t_t} E(t)dt = 1 - F(t_t) \tag{R13.1-6}$$

Solving for a

$$a = be^{bt_t} \left[1 - F(t_t)\right] \tag{R13.1-7}$$