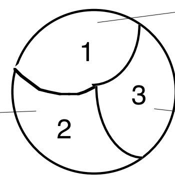
A B

TABLE 13-1 PHYSICAL INSIGHT FOR SEGREGATION MODEL

To obtain some physical insights into the segregation model, consider drops falling into a reactor. There are three equally sized reactors per drop, each reactor will spend a different amount of time in the reactor. The reaction A B is occurring in each reactor

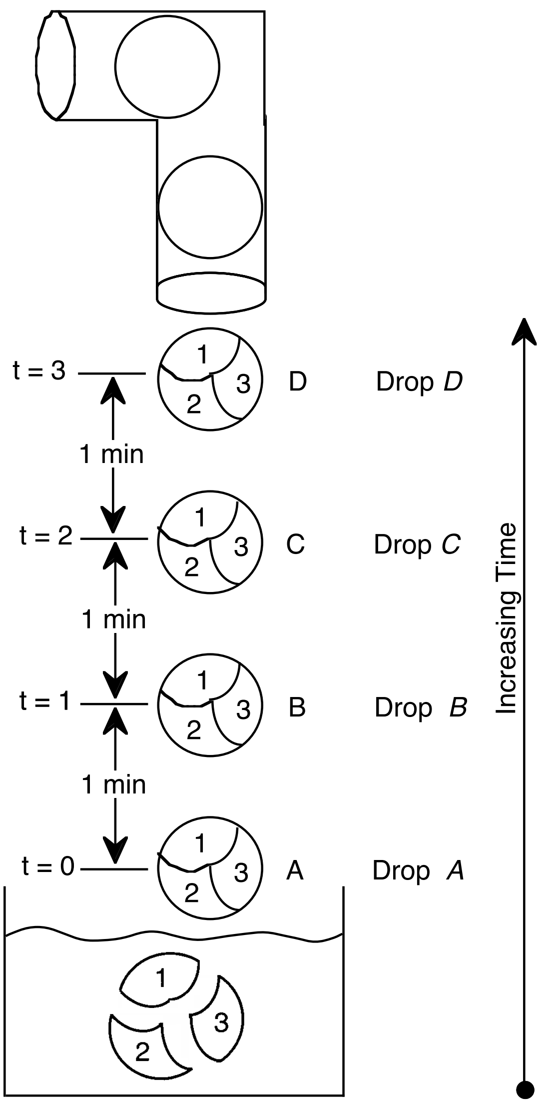
t_r = 1. This reactor (1) will spend 1 minute in the reactor

t_r = 2. This reactor (2) will spend 2 minutes in the reactor



t_r = 3. This reactor (3) will spend 3 minutes in the reactor

The drops will be spaced one minute apart as they leave the pipe on the way to the reactor. The reaction does not begin until the drop hits the reactor. To follow read up to t=3.



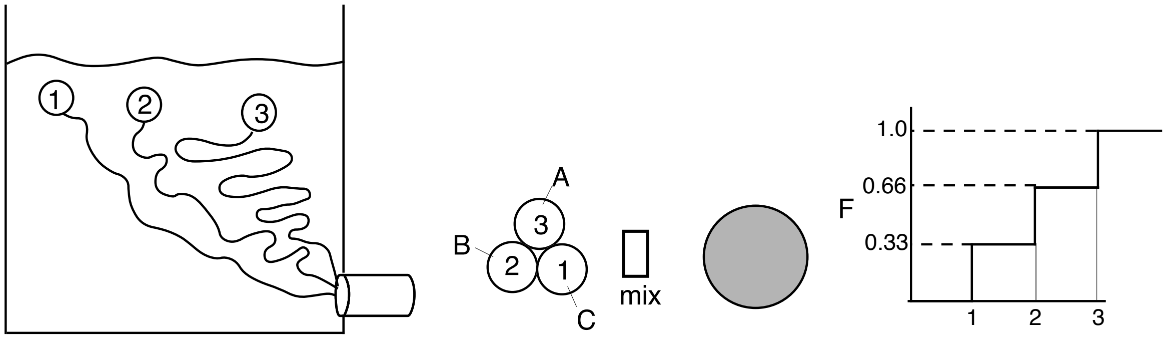
At t = 3 Drop D hits the fluid.
The reactor with residence time of 3 minutes (t_r = 3) from Drop *A* leaves the reactor
The reactor with residence time of 2 minutes (t_r = 2) from Drop *B* leaves the reactor
The reactor with residence time of 1 minute (t_r = 1) from Drop *C* leaves the reactor
All these reactors from A, B, and C will mix together as they exit.

At t = 2 Drop C hits the fluid
The reactor with residence time of 2 minutes (t_r = 2) from Drop *A* leaves the reactor
The reactor with residence time of 1 minute (t_r = 1) from Drop *B* leaves the reactor

At t = 1 Drop B hits the fluid
The reactor with residence time of 1 minute (t_r = 1) from reactor (drop) A leaves the reactor

At t = 0 Drop *A* hits the fluid in the reactor as soon as it hits the three reactors (1, 2, 3) separate but the molecules in each reactor remain together.

At the end of three minutes Reactor (1) from Drop *C* will leave along with Reactor (2) from Drop *B* and Reactor (3) from Drop A.



$$\bar{X} = \int_0 X(t)\;E(t)\;dt = \int_0^1 X\;dF$$

Let's say the reaction $A \rightarrow B$ is occurring in each of these little batch reactors. Because reactor 3 (*A*) will be in the reactor a longer time (3 min) it will have the highest conversion and reactor 1 (*C*) will be in the reactor the shortest time and have the lowest conversion. Lets say the conversion in reactor 1 is X_1=0.3, and reactor 2 is X_2=0.5, and reactor 3 is X_3=0.6. Each reactor represents one third of the total. The mean conversion is then

$$\bar{X} = \frac{1}{3}(0.3) + \frac{1}{3}(0.5) + \frac{1}{3}(0.6) = 0.47$$