Chemical Engineering 612

Reactor Design and Analysis

Lecture 8 4 Group Criticality Example



Spiritual Thought

"Historically, fear has often been used as a means to get people to take action. Parents have used it with their children, employers with employees, and politicians with voters. Experts in marketing understand the power of fear and often employ it... It is true that fear can have a powerful influence over our actions and behavior. But that influence tends to be temporary and shallow. Fear rarely has the power to change our hearts, and it will never transform us... People who are fearful may say and do the right things, but they do not *feel* the right things. They often feel helpless and resentful, even angry. Over time these feelings lead to mistrust, defiance, even rebellion."

Dieter F. Uchtdorf

Perfect Love Casteth Out Fear



Multigroup Reactor Equations (4 group)

Derive a 4-group reactor equation (using diffusion theory) for neutrons in a bare, homogenous, spherical reactor. This reactor is at steady-state but is not necessarily critical. The following assumptions should be used in this derivation:

- a. Fission neutrons are only born in the top two groups, i.e. groups 1 and 2.
- b. The fast neutron generation distribution is as follows: X1 = 0.75, X2 = 0.25
- c. Thermal neutrons only exist in the bottom group, i.e. group 4.
- d. Only thermal neutrons induce fissions.
- e. There are no up-scatterings in the thermal group (i.e. neutrons only lose energy)
- f. The absorption and scattering cross sections can be combined to form a "removal" cross section, ΣR .
- g. Scattered neutrons will only drop to adjacent energy levels. This means that the scattering cross section for group 1 represents neutrons scattered to group 2 only, or Σ s1,2, etc. h. Because cross sections are energy dependent, there is a separate cross section of each type for each energy group, indicated by the appropriate subscript. i. v is specific to each energy group... however, only one energy group undergoes fission...

