Mathematics of Diffusion

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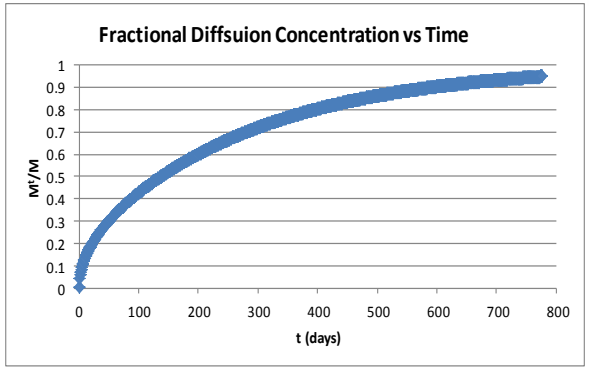
Diffusion is defined as mass transport caused by concentration gradients. The mathematical modelling of this process was explored using partial differential equations.

Visual demonstration of diffusion (mass transport)

Specific Investigations:

The diffusion concentration equation for a hydrogel membrane, characterized by Fickian plane sheet diffusion in one dimension, was rederived using separation of variables producing the functional solution.



Graph of the final equation for the hydrogel diffusion, assuming a diffusion coefficient (D=11.89 mm^2/ day*10^3) and length (L^2 5.76mm^2). Reasonably, the ratio levels at a value of one.

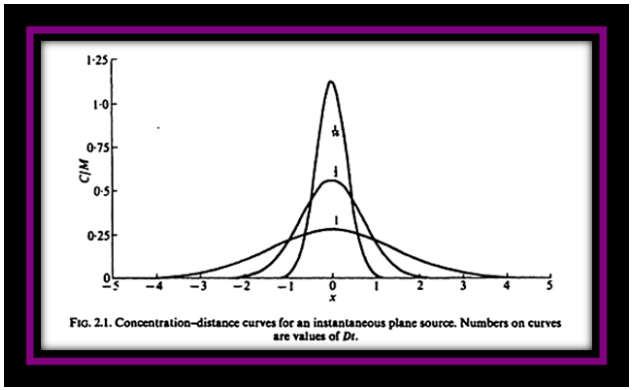


FIG. 2.1. Concentration–distance curves for an instantaneous plane source. Numbers on curves are values of Dt.

Diffusion distance curves for an instantaneous plane source, demonstrating the symmetrical nature of diffusion. (Crank)

Major Foci of Study:

- Differences in diffusion based upon geometry
- Manipulation Techniques in Partial Differential Equations
- Solution to the case of hydrogel membrane diffusion used in drug-delivery

Conclusion:

Understanding the diffusion process is vital to a wide range of disciplines. Typical modelling for hydrogel diffusion has relied upon empirical formulas, but this work begins to show the derivation of the fundamental mathematical relationships.

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