Problem: The system I am trying to replicate is a tube initially filled with liquid A. The tube has a radius r= R. The liquid is displaced by liquid B entering the tube under fully developed laminar flow. This displaces all the fluid A except for a small volume present at the outer radius (i.e. at the tube wall) that remains because at the outer radius flow velocity is very low and diffusion dominates. I would like to examine how the remaining solute in liquid A diffuses from the outer walls of a tube into the bulk, when the flow stops. I am of course looking for a solution to fick's second law, but I am a real novice when it comes to setting the boundary and initial conditions.

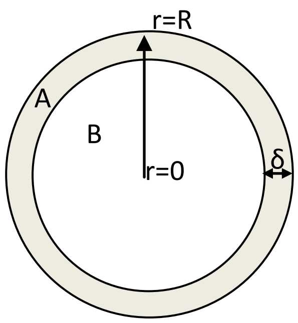
The concentration is homogenous along the direction of flow and the problem is reduced to 2 Dimensions (i.e. a circle with diffusion towards center). The volume of A is very small (δ<<R) compared to the bulk volume of B. There is conservation of mass and the total amount of solute is constant.

Initially the concentration of solute in A = C_1 and in B = 0

Initial conditions

R-δ < r < R $C = C_1$

< r < R-δ   C = 0



Boundary conditions

r = 0 $\frac{\partial C_i}{\partial r} = 0$

constant mass = $\int_{-\infty}^{\infty} C(r,t) 2\pi r \, \partial r$