Diffusion Profile Derivation:

Mass Balance on the device reservoir:

$$dMr/Dt = -m,$$

where *m* is the rate of mass efflux and Mr is the mass in the reservoir.

$$dMr/dt = - A \cdot J,$$

where A is the area for flux and J is the flux as defined by Fick's law.

$$dMr/dt = A \cdot D \cdot dC/dx,$$

where C is the concentration in the reservoir and x is the direction normal to the interfacial area. Assume:The change in concentration that drives diffusion occurs over the thickness of the chip.

The concentration profile across the chip is linear (i.e. the time scale to achieve a linear profile is much less than the rate of mass efflux.) The external bath is large enough and replaced frequently enough such that it remains at sink conditions.

$$dMr/dt = -A \cdot D \cdot Mr/(l \cdot V),$$

where V is the volume of the reservoir and l is the thickness of the chip. Solving the first order ODE and applying the initial condition Mr(0) = M_o we get:

$$Mr/ M_o = \exp(-k \cdot t),$$

$$k = A \cdot D/(l \cdot V),$$

Mass Balance on the environment:

$$dM/dt = -dMr/dt,$$

where M is the mass released into the environment. Solving the ODE results in:

$$M = C-Mr,$$

where C is a constant of integration. Set the initial condition of M(0)= 0:

$$M(t) = 1-\exp(-k \cdot t),$$

$$k = A \cdot D/(l \cdot V).$$