Abstract Submitted
for the MAR09 Meeting of
The American Physical Society

Optimization of Ramified Flow Networks MARTIN SINGLETON, ALFRED HUBLER, Department of Physics, UIUC, GREGOR HEISS, Institut fuer physikalische Chemie, Ludwig Maximilians Universitaet Muenchen — A class of Ramified graphs (RG) is introduced as Iterated Function Systems (IFS) to optimally design networks for efficient reverse osmosis desalination in deep seawater. Ramified flow networks of absorbers, ranging from simple structures with constant weights, branch angles, and branch ratios, to fully optimized binary networks are considered. A contracting IFS with fixed overall length is presented for the generation of RG's which serve as candidates for optimality in terms of desalination performance criteria. Using the analogy to electrostatics, the diffusion equation is solved for the desalination systems under three different boundary conditions, i) all nodes having the same pressure difference across the absorbers, ii) all nodes producing permeate at identical rates, and iii) each node having the same salinity. Optimal branching angles and branch length ratios will be found by phase-space methods for each boundary condition, which either maximize production of permeate or minimize expenditure of energy for different fixed numbers of absorbers. For constant salinity absorbers, we give the total water production rate as functions of branching angle and branching ratio for up to 10 branching generations. Both optimal angle and optimal ratios are found to be decreasing functions of generation for constant salinity absorbers.

Martin Singleton
Department of Physics, UIUC

Date submitted: 21 Nov 2008 Electronic form version 1.4