Organic Micropollutant transport in Forward Osmosis: Influence of draw solute

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Introduction

- FO: researched for treatment of heavily polluted water, presence of organic micropollutants
- Compared to pressure-driven membrane systems, additional influence of draw solute on OMP transport

Objectives

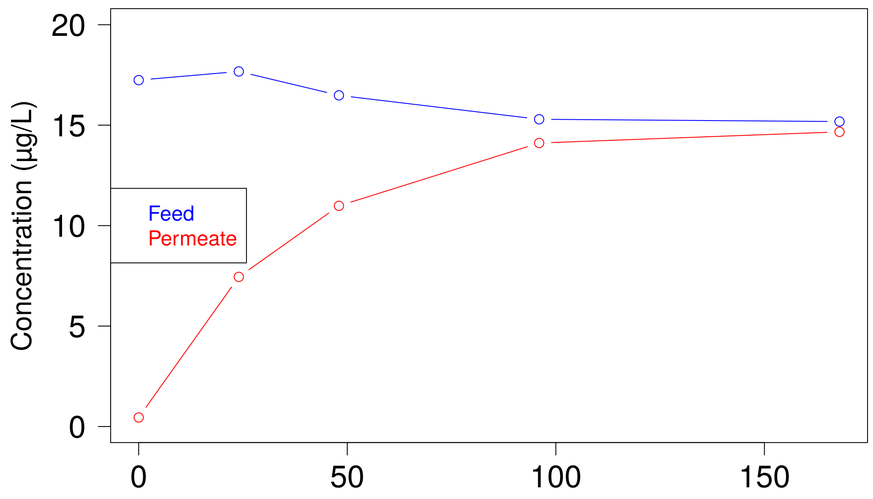
- Test influence of draw solutes (DS) on OMP rejection.
  Current hypothesis: high RSD = high OMP rejection
- Compare OMP transport: FO and simple diffusion
- Solution-diffusion model valid ?

Materials and Methods

- FO membrane: CTA membrane by HTI
- Draw solutes: NaCl, Na_2SO_4, $MgCl_2$, $MgSO_4$; DS membrane permeability determined in FO tests
- OMPs: 30 compounds, common pharmaceuticals and pesticides
- FO: For each DS: 5 OMP rejection tests at different J_w, with draw solution re-concentration
- Diffusion: diffusion across membrane during 7 days, intermittent sampling, no salts nor J_w present

Example diffusion results:

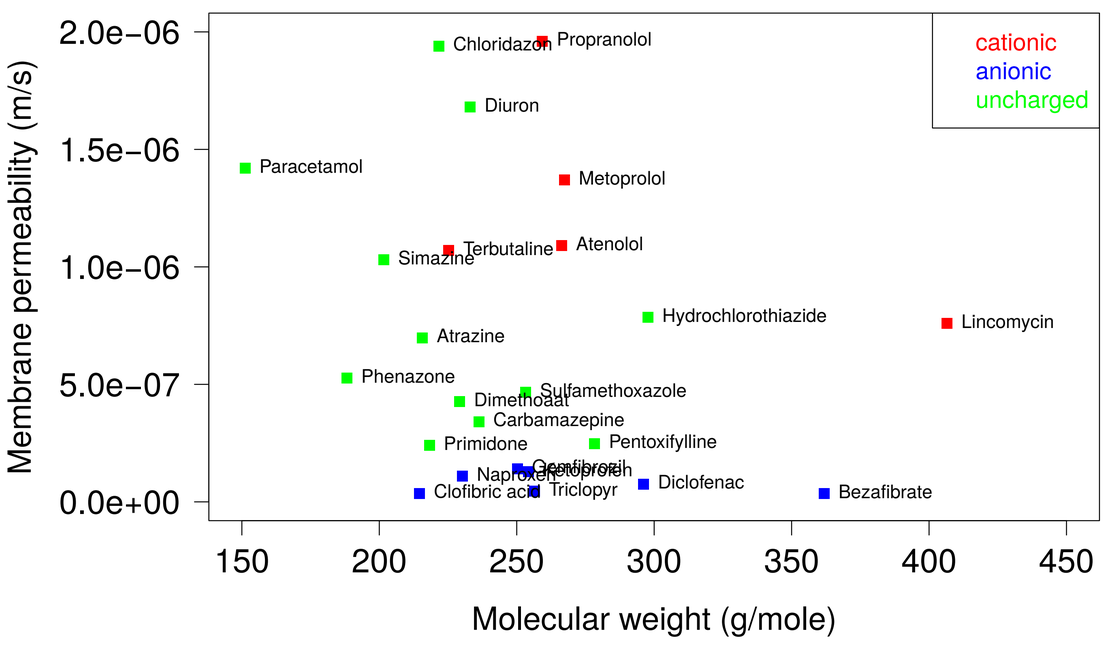
atrazine



Results

Diffusion:
OMP cations diffuse fast, anions slow: permeability differs on average by factor of 15
Mechanism: Electrostatic repulsion/attraction, CTA membrane has small negative charge

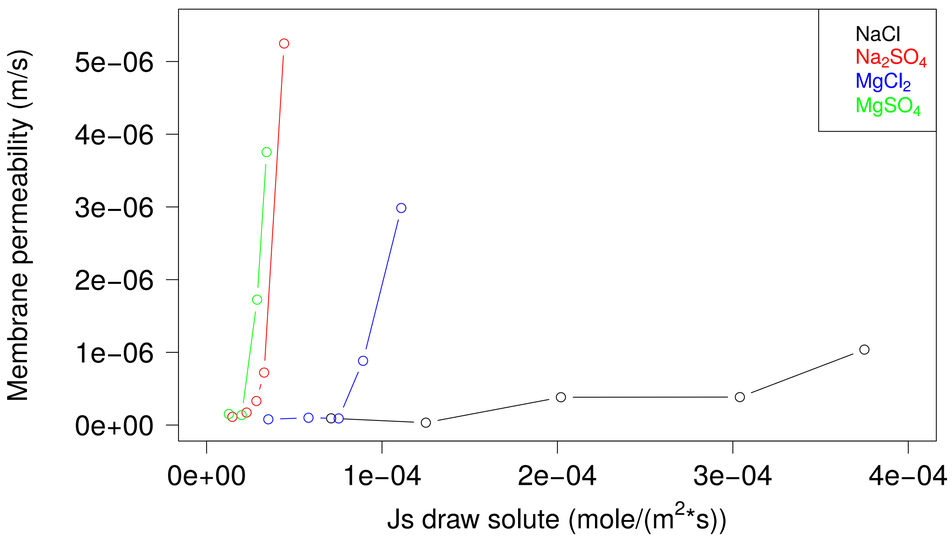
Diffusion OMP membrane permeability:



Forward Osmosis :

- Charged OMPs: declining rejection/increasing membrane permeability at higher salt concentrations
  Strong effect of draw solute valence!

FO OMP membrane permeability, function of RSD: **lincomycin**



- High rejection of both anionic and cationic OMPs, higher rejection for cationic OMPs
  Hypothesis: Donnan potential: in draw solute, higher diffusion coefficient of anions compared to cations

FO OMP rejection with 0.5M NaCl DS: