

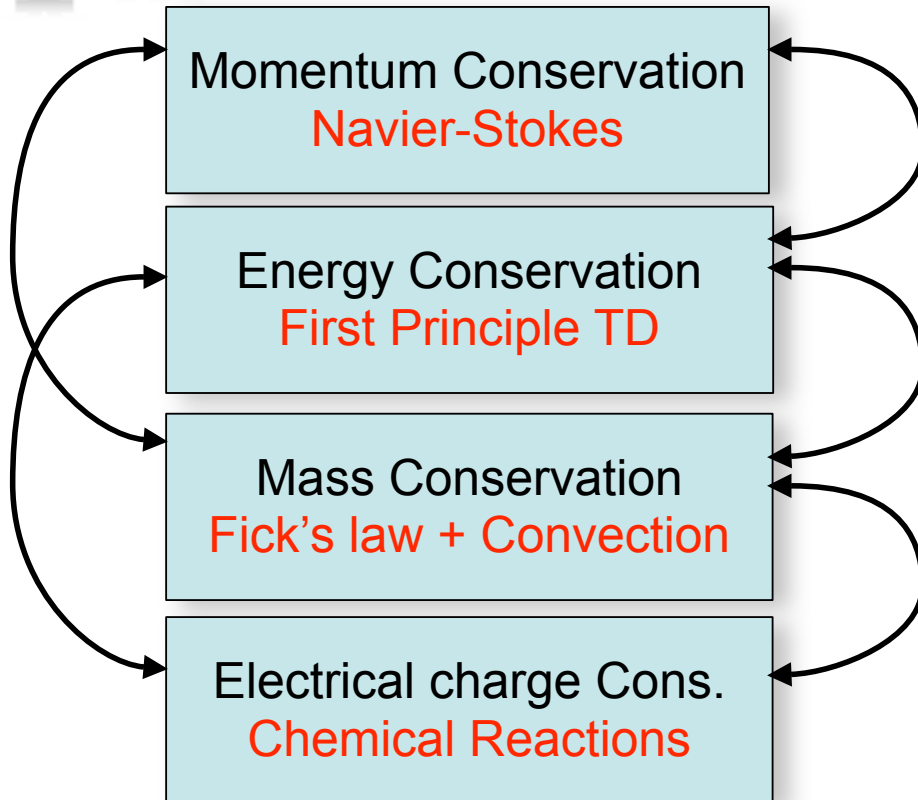


Modeling of EP

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Modeling of EP



- Navier-Stokes equations for the fluid model with **viscosity dependent on Temperature and Nb concentration**. (v, T, c)
- Convection and conduction thermal equations. (T, v)
- Convection and **diffusion** for mass balance due to the chemical reactions. (c, T, v)
- **Diffusion of charged species** due to electric field and electrochemical reaction.

In addition one needs to apply these equations to rather complex geometry and possibly add the rotation to a 2D model to keep the calculation time within reasonable time scale



Modeling of EP



- DESY: electrical model using commercial software
- CEA: Diffusion and convective flow using multi-physics software (correct?)
- J-Lab: is collaborating with Virginia Tech
- FNAL: Thermal-fluid modeling in the process of adding diffusion

The main issue here is use the correct set of material properties to obtain a realistic simulation.

Among others in my opinion we should perform comparative experiments to define viscosity as a function of Nb concentration and temperature.

Finding a way to describe the diffusion coefficient may help.

Experiments to describe the resistive behavior of the acid mix



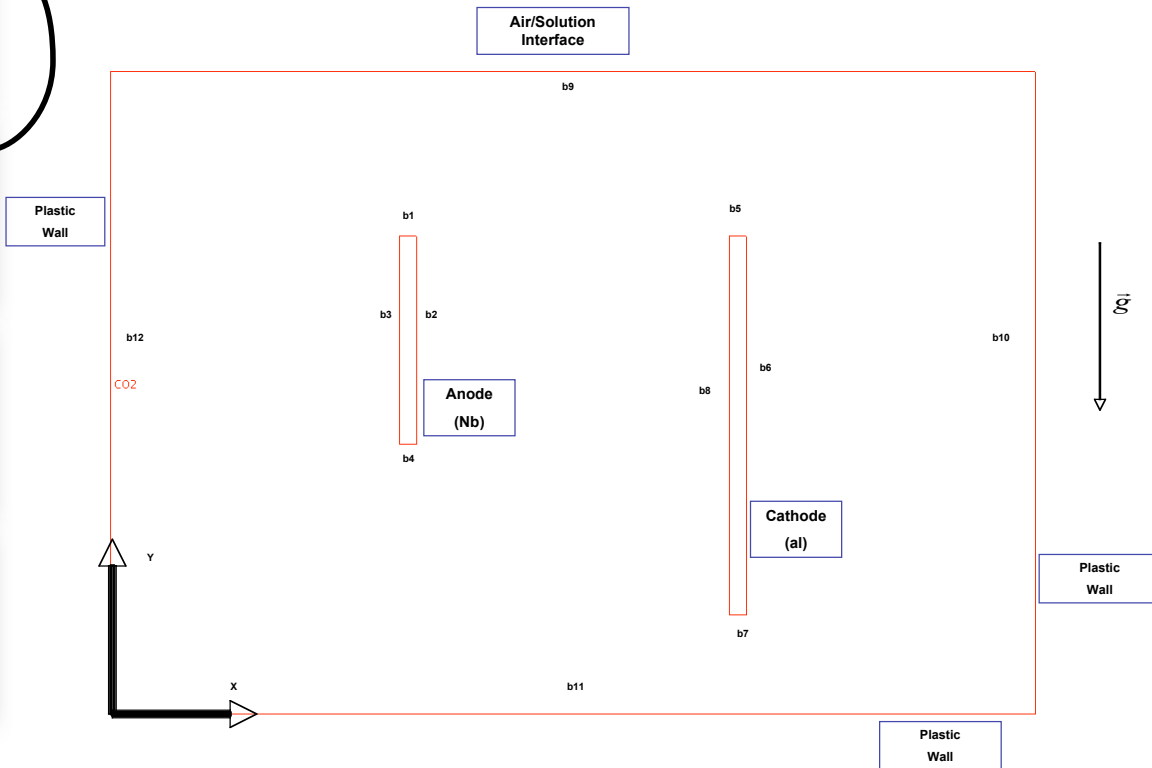
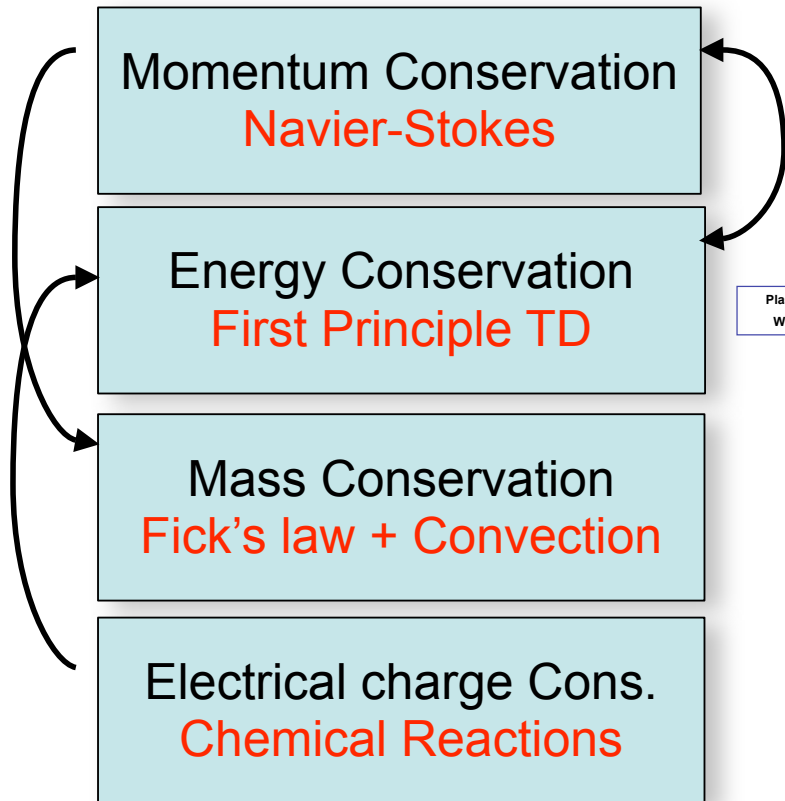
Plan at Fermilab



- We had a Theoretical Physicist (Student) at FNAL for 3 months who spent most of his time trying to familiarize with the EP process and start understanding the physics behind the process
- He wrote down the major equations governing the system
- He familiarized with the multi-physics software we intend to use for simulation by repeating simulations performed by others
- Now we need to perform the right experiments to define the fundamental properties of the acid mix as a function of temperature and concentration of diffused species.

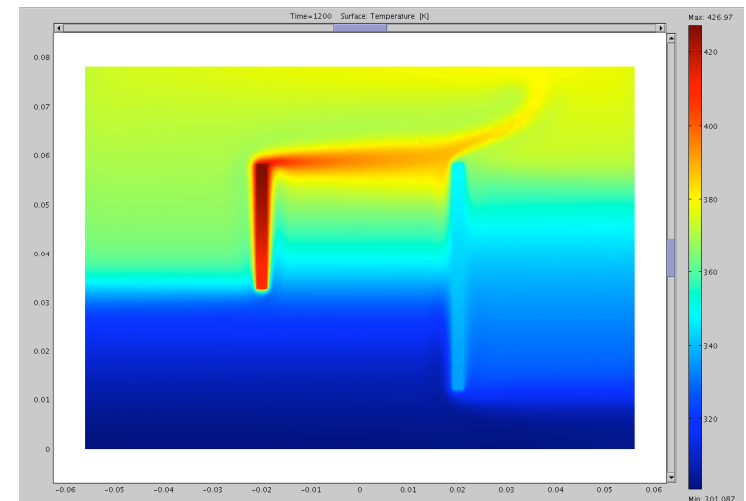
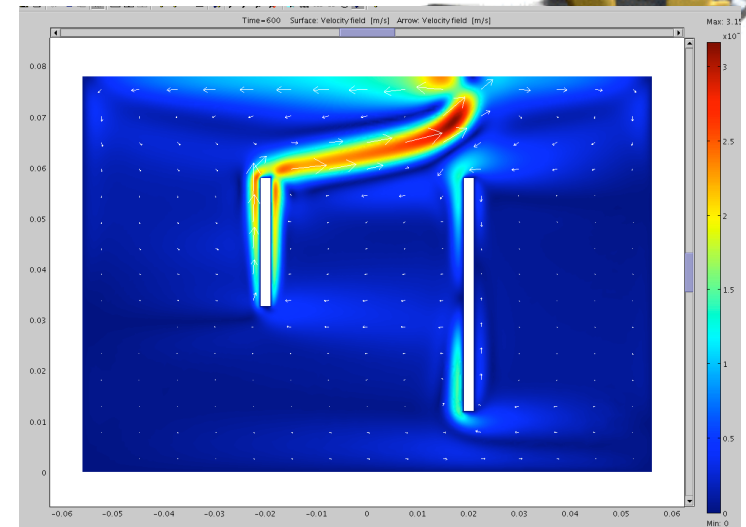
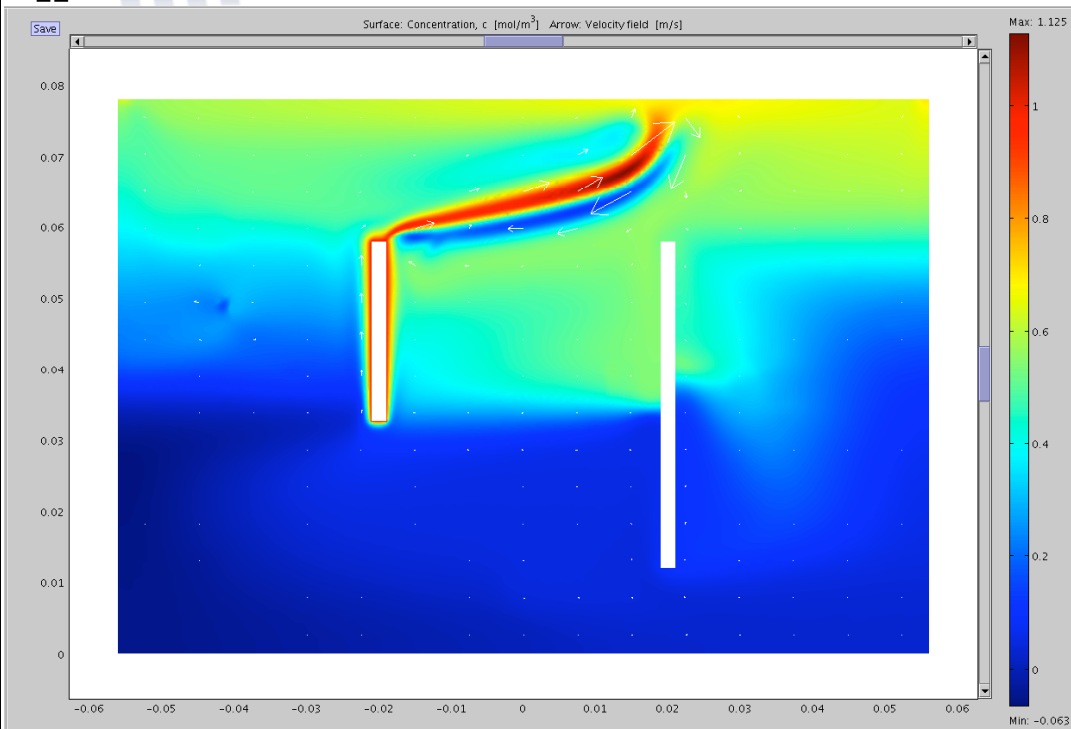


Simplified model





Results



- Very preliminary step that does not take into account many phenomena that are part of the EP process