TO: 1.101
RE: a few pointers
Oct 4, 2005

These are some thoughts regarding preliminary designs, as motivated by today's class presentations.

Neutralization of porewater in a column will not stop when the flow stops, so periodically a column system will send a slug of 'hard' water into the system. This, however, is probably not all that bad (nor is an occasional small slug of somewhat acidic water).

NaOH neutralization is a good idea, but it is more complex and we haven't done microcontrollers yet. Unless you have done microcontroller work before and have some extra time, it may be best to go with a column approach for now.

Although many teams seem to favor C-33 at this point, AFG 10/40 and Vicil look like good materials too—give them a second look before deciding for sure on C-33. (remember, C-33 needs to be sieved out of the commercial material—somewhat tedious, and our supply is smaller. Also it may pour less readily than these alternatives)

An in-line pH sensor may not withstand much pressure—if you use one, it might be best to have it downstream of the flow-regulating valve.

Column maintenance is worth thinking about.

Since 1 psi corresponds to 70 cm of water, and we are working at pressures of tens of psi, you probably don't have to worry too much about changes of elevation in your design affecting flow appreciably. Likewise, you can probably neglect the velocity term in Bernoulli's equation (i.e. just deal with pressure head, and make sure that loss of head in the porous medium is within acceptable limits).

Try to avoid relying on a lot more empiricism—it is to this end that we measured neutralization times and hydraulic parameters. Based on the design parameters now in hand consider that:

Given water flow and neutralization time, it should be possible to compute the necessary pore volume (and hence total volume) of a column. This defines a relationship that includes column area and length.

Given water flow and allowable head drop, plus hydraulic conductivity, it should be possible to calculate another relationship that includes column length and area.

Jointly satisfying the above relationships should give you a simple column design that will work.

Do not lose sight of the requirement to provide adequate flow. Just because the pressure and residence time criteria alone can be satisfied by closing down the outlet valve and reducing Q until delP is small and Tr is long does not mean that this gives a satisfactory design.

Remember the KISS principle; it still applies in all branches of engineering. (The first three letters of this acronym stand for "Keep It Simple, …." The last letter usually does not apply to MIT people but is added for verbal emphasis and to make it spell KISS.)