## HLWYM PEmails

**From:** McCartin, Timothy
**Sent:** Thursday, October 25, 2007 12:22 PM
**To:** Paul Bertetti; Patrick Laplante; Hill, Brittain; Pohle, Jeffrey; Bradbury, John; Rubenstone, James; Compton, Keith; Fedors, Randall
**Subject:** Re: Recycling Constraints

In general that is pretty much why the equation [C/Co = 1/(1-F)] is bounding:

1) becuase one we would most concerned why the concentration is the highest - you are most concerned while the incoming concentration stays at the high level - once the incoming concentration is smaller the effect will be reduced because you are adding the recirculation to a smaller amount in the aquifer

2) regarding the time to reach steady state will vary whether or not a nuclide is retarded - if one assumes 25 five years for water to get back to the saturated zone - each cycle would take 25 years for unretarded nuclides. the formulation can be used to evaluate the concentration after any number of cycles - if it takes about 10 cycles obviously it is 250 years to occur - if a nuclide had a retardation factor of 10 it would take 2,500 years.
3) yes if you recirculate everything for all times it goes to an infinite concentration in the limiting case - clearly this will never happen in that it is impossible to recirculate everything (there would be no dose if everything was returned) and the incoming concentration is limited by the inventory of the repository - the formula can still be used for bounding concentrations using more reasonable values for the fraction recirculated and determing the time required for this to occur to provide insights on the magnitude of the problem.

>>> John Bradbury 10/25/2007 11:46 AM >>>
The equation C/Co = 1/(1-F) where F is the fraction recaptured is an appropriate formulation for the simple system when the rate of influx equals the rate of outflux. My concern is that the equation doesn't bound the effect. As F approaches 1, C/Co blows up. Also, there is no consideration of time with this approach. How long does it take to reach the steady state condition?

I am trying to provide logical constraints for the amount of recycling. As was discussed in our meeting last week, I thihk we all agree that fields can be irrigated for only so long. Eventually the field is spent due to increased soil salinity. I found on the internet http://extension.usu.edu/files/agpubs/ag425-3.pdf that alfalfa is moderately sensitive to soil salinity. Based on this paper, and the conversion factor (500ppm = 1DS/m), the ECe (electrical conductivity from soil extraction) that doesn't stunt alfalfa growth is 2DS/m. The constaints are not so straightforward as they depend on a leaching factor. The example they provide in the article demonstrates that alfalfa can be irrigated with water having a TDS of 1500ppm and still be unstunted, as long as the leaching factor is 0.45 or greater. We can use the overwatering numbers in Amargosa Valley to determine the maximum salinity of the groundwater before crop yields drop.

I also note that EPA has a secondary maximum drinking water limit for TDS of 500ppm. The recycling process is essentially one of evaporation. I'm doing some PHREEQC simulations of evaporation to determine the effect on TDS. These calculations include consideration of precipitation. If the groundwater is saturated with respect to calcite or gypsum, evaporation won't result in increases in Ca, SO4, and CO3 concentrations. I'll do a PHREEQC calculation to see how much evaporation is needed to reach the TDS limit for the alfalfa constraint or 500ppm TDS for the secondary drinking water standard.
These limits support the conceptual model in which pumping wells move to different locations as the fields become spent. How often and where may be another question that we need to address.

**Hearing Identifier:** HLW_YM_Public_EX
**Email Number:** 30

**Mail Envelope Properties** (s7208a74.062)

**Subject:** Re: Recycling Constraints
**Sent Date:** 10/25/2007 12:21:44 PM
**Received Date:** 10/25/2007 12:22:36 PM
**From:** McCartin, Timothy

**Created By:** Timothy.McCartin@nrc.gov

**Recipients:**
"Paul Bertetti" <pbertetti@cnwra.swri.edu>
Tracking Status: None
"Patrick Laplante" <plaplante@cnwra.swri.edu>
Tracking Status: None
"Hill, Brittain" <Brittain.Hill@nrc.gov>
Tracking Status: None
"Pohle, Jeffrey" <Jeffrey.Pohle@nrc.gov>
Tracking Status: None
"Bradbury, John" <John.Bradbury@nrc.gov>
Tracking Status: None
"Rubenstone, James" <James.Rubenstone@nrc.gov>
Tracking Status: None
"Compton, Keith" <Keith.Compton@nrc.gov>
Tracking Status: None
"Fedors, Randall" <Randall.Fedors@nrc.gov>
Tracking Status: None

**Post Office:** NRNWMS05.NRC.GOV

| **Files** | **Size** | **Date & Time** |
|---|---|---|
| MESSAGE | 3578 | 10/25/2007 12:22:36 PM |

**Options**
**Priority:** Standard
**Return Notification:** No
**Reply Requested:** No
**Sensitivity:** Normal
**Expiration Date:**
**Recipients Received:**