Solving Complex Radioactive Decay Chains for Future Assessment and Cleanup Decisions

Galloway, Leslie D1; Bolus, KA4; Dolislager, FD1; Walker, S1; Bellamy, MB2

1The Institute for Environmental Modeling, The University of Tennessee, Knoxville, TN; 2Oak Ridge National Laboratory, Oak Ridge, TN; 3Office of Superfund Remediation & Technology Innovation

Leslie Galloway (galloway@utk.edu, (865) 574-7906)

ABSTRACT

There is a need to understand how radioactive activity changes with time on the activity measured in the past will be different from current and future levels. When a radionuclide decays, its activity decreases exponentially as a function of time. This decay has a characteristic time known as the half-life, above which a radionuclide can be considered secular. The radionuclides produced during decay are called progeny. The activity of each radionuclide in a decay chain is calculated iteratively by solving a differential equation whose solution is exponential in nature. The radionuclide decay rates evolve as a function of time. The activity of one radionuclide is equal to the activity of parent radionuclide times the exponential decrease factor. As a radionuclide decays over time, the activity of the parent is increased by the activity of its daughter. When the parent is depleted, the activity of the daughter is increased by the activity of the parent.

This study presents a hybrid forward-euler differential equation algorithm that can be used to solve complex radioactive decay chains. The algorithm is written in Perl and used with the open-source web-based charting utility plot.ly. In this work, the activities of chain members are solved by a hybrid forward-euler differential equation algorithm published by Leggett et al. This numerical integration method is used to estimate the chain activity. As a radionuclide decays over time, the activity of the parent is increased by the activity of its daughter. When the parent is depleted, the activity of the daughter is increased by the activity of the parent. The method for summing PRG values is displayed in Equation 2. The decay chain calculator is useful for determining the potential risk of radioactive contamination at a site. The decay chain calculator is useful for estimating the activity of radioactive contaminants.

RESULTS

In this work, the activities of chain members are solved by a hybrid forward-euler differential equation algorithm published by Leggett et al. This numerical integration method is used to estimate the chain activity. As a radionuclide decays over time, the activity of the parent is increased by the activity of its daughter. When the parent is depleted, the activity of the daughter is increased by the activity of the parent. The method for summing PRG values is displayed in Equation 2. The decay chain calculator is useful for determining the potential risk of radioactive contamination at a site. The decay chain calculator is useful for estimating the activity of radioactive contaminants.

SOFTWARE AND WEB INTERFACE

For more please visit Preliminary Remediation Goals for Radionuclides (PRG) at
https://plot.ly/javascript/

REFERENCES