**Title**: Specific Activity

**Purpose**: Primary purpose is to calculate the specific activity (units of radioactivity per gram) for a variety of radionuclides, either singly or as part of chemical compounds. This is a fairly complex spreadsheet, both on the main tab (Specific Activity) and in some of the subsidiary tabs.

**Theory**: Specific activity is a measure of the amount of radioactivity per unit mass – usually expressed in either curies per gram or Becquerels per gram. If the radionuclide is part of a compound you also need to determine what fraction of the compound is composed of the radionuclide.

The decay rate is calculated using the equation A=λN where A is the decay rate in units of decays per unit of time (time can be in seconds, minutes, hours, days, or even years). N is the number of radioactive atoms in a sample;  where GAW is the gram atomic weight (the number of grams that 1 mole weighs). The GAW for Co-60, for example, is 59.9338 grams per mole of Co-60, so 59.9338 grams of C0-60 contains 6.022x1023 atoms of this nuclide. The final term in the activity equation is λ, the decay constant, and is equal to the natural logarithm of 2 (approximately 0.693) divided by the nuclide’s half-life. For example, for Co-60 the decay constant is 0.693/5.27 yrs = 0.1315/yr – this means that, in a collection of Co-60 atoms, 0.1315 (13.15%) of these atoms will decay each year. Plugging this number into the first equation, the activity of one gram of Co60 is  . Since there are about 31 million seconds per year, this comes out to a decay rate of about 4.2x1013 decays per second; 1 Ci = 37 billion decays per second, so one gram of Co-60 has an activity of about 1132 curies.

If the Co-60 is part of a chemical compound, the activity concentration must be multiplied by the weight percentage of Co-60 in the compound. For example, a Co-60 radioactive source might be alloyed with other metals so that the Co-60 is 10% of the weight of the alloy. In this case, the alloy would have a specific activity of 113.2 Ci/g – 10% the activity concentration of the pure nuclide.

**You enter**: The radionuclide chemical symbol in Cell B8 and the nuclide number in Cell B9 (e.g. Co and 60 for Co-60).

If the nuclide is part of a mixture or chemical compound, enter the chemical formula in the appropriate cells on the right-hand side of the main spreadsheet (columns K, L, and M and beginning in row 11). The weight fraction of the nuclide is listed in column P; this value is entered into Cell C10.

The Percent pure isotope should be left as 100% for pure radionuclide; otherwise enter the % by mass from column P.

Enter the amount of activity and units (e.g. 1 mCi) in cells B14 and C14 to calculate the mass of nuclide that contains this amount of activity. OR

Enter the mass and units (e.g. 1 gram) to calculate the activity contained in this mass of radionuclide in the compound or mixture specified.

This spreadsheet contains nuclide-specific information for only a relatively small number of radionuclides. If information (atomic mass and half-life) for the nuclide in which you are interested is not entered into this spreadsheet, you will need to look up this information and enter it in the appropriate location (columns B, C, and D) in the “Nuclides” tab of this spreadsheet. ***Note: If you cannot find the exact mass (column B), it can be approximated by entering the atomic weight from the nuclide (e.g. the mass of U-238 can be approximated as 238).***

**The spreadsheet**: Calculates the specific activity of a radionuclide as a pure radionuclide or in a mixture in either SI or US units.

Calculates the weight of a given activity of radionuclide.

Calculates the weight and atom (mole) percentage of a radionuclide that’s part of a chemical compound or mixture.

**In addition**: There are tabs that provide conversion factors from SI to US units or from US to SI units.