LIQUID WASTE QUANTIFICATION BASIC

Laboratory personnel are required to quantify liquid radioactive waste prior to sewer disposal, as well as prior to collection for disposal by the EAS group of EHS. Several important steps/considerations are needed to do this accurately. The following procedure is for the most common isotopes in laboratories [single beta emitters] and liquid scintillation counting.

First, a representative sample must be taken. For example, one cannot take a sample from the top layer of a one gallon waste jug. This could yield very inaccurate results. The sample must be taken from each layer, or more simply, the contents of the jug must be circulated so that layers are not present when the sample is taken. If you wish to do this by inverting the jug, please be sure that the container cap is intact and fits the container tightly before inverting. After resuspending/mixing return the container to the upright position and open it carefully. Take a small sample, generally a one milliliter aliquot.

The one milliliter sample should be placed into the counting vial with an appropriate amount of an environmental safe counting cocktail [fluor]. This is most commonly 10 ml of fluor to one ml of sample. Be sure the vial is well closed and invert to mix sample and fluor.

Window settings on the LSC that are appropriate for the isotopes used in the lab must be used. A blank [background sample] must be counted. This should be made of the media or other main constituents of the liquid waste, but without the radioisotope. Ex. one milliliter of RPMI media plus fluor. The sample and blank are generally counted for one minute.

After obtaining the LSC printout, the background result should be subtracted from the sample result to get net counts per minute. If the sample and background were counted for longer than one minute, the net counts per minute would be obtained by:

\[
\frac{\text{gross [total] sample counts} - \text{gross [total] background counts}}{\text{number of minutes of count}}
\]

Next it is important to know the efficiency of the LSC for the isotope you are evaluating. This value can range from 50-70% to over 90-95%. The only way to determine the true counting efficiency of your LSC is to count a known radioactive standard. If you do not have a counting standard, please contact Radiation Safety.

If the efficiency of your LSC is determined to be, for example, 70%, the determination of the number of dpm [disintegrations per minute] would be:

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dpm = \frac{\text{cpm} \times \text{efficiency}}{0.7}
\]

For example, 15,400 cpm / 0.7 = 22,000 dpm.

Common efficiencies: 3H(60-70%), 35S and 14C (90%), 32P(95%), 125I (60%)

From dpm, one uses the correction \(2.2 \times 10^{-6}\) dpm per microcurie [uCi] to determine total number of microcuries in the sample. For example, 22,000 dpm / 2.2 \(10^{-6}\) dpm per uCi = 0.01 uCi.

The total number of microcuries per ml [sample] is then used to determine the total activity in the volume to be disposed. For example, if there are 0.01 microcuries per ml, and the container has 3000 ml, the total activity in the container would be 0.01 \(\times\) 3000 = 30 microcuries.

If you have any questions, please contact YOUR EHS Safety Advisor. For waste pick-ups call 785-3551.