Analysis of radioisotope wipe samples using the Tennelec LB5500 spectrometer Report of Analysis

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Abstract

Filter wipe samples are collected semi-annually to check for radiation contamination of sealed radioactive sources by leakage. The activity of these samples is determined by using an alpha/beta gas proportional counter. Results are used to insure the safety of Kodak employees and to meet the requirements set by the New York State Department of Environmental Conservation.

Here we report the results from 142 wipe samples supplied by Linda Reibsome over the period from April 5, 2012 to May 8, 2012.

Note that in this analysis, three samples were numbered with the wrong accession number (3015, 3016, and 3029) in batch 2751 in the Eclipse software. Two of the envelopes were mis-labeled with the wrong accession number (132, and 3756.) These errors were manually corrected in the final .csv file with the approval of the client.

Introduction

Filter wipe samples are collected to check for radiation contamination of sealed radioactive sources for leakage. The activity of these samples is determined by using an alpha/beta gas proportional counter. Results are used to insure the safety of Kodak employees and to meet the requirements set by the New York State Department of Environmental Conservation.

The objective of this report is to document the analysis from Spring 2012.

Range and Sensitivity

The method can detect a wide range of activity. Most samples collected in this manner have low activity level. The lower limit is determined by measuring blanks with each set of samples. Recent blanks have both alpha and beta maximum activities below 10 pCi.

Results Summary

The full list of results from individual wipes is attached as a comma-delimited file, easily imported and sorted with Excel. A summary of the results is shown in the table below

Meas.	Min.	1Qu	Median	Mean	3Qu	Max.
Blanks α [pCi]	0.380	0.507	0.634	1.155	0.887	4.690
Blanks β [pCi]	1.658	1.842	2.118	2.824	2.579	8.289
Samples α [pCi]	0.127	0.761	1.648	22.280	10.580	936.100
Samples β [pCi]	1.197	2.210	2.763	5.980	4.237	156.500

Detector efficiency

The detector efficiency for Am-241 (95% confidence interval = 0.3586 ± 0.00069 for $n = 9$) and Cl-36 (95% confidence interval = 0.4935 ± 0.0022 for $n = 9$) are shown below in Figures 1 and 2.

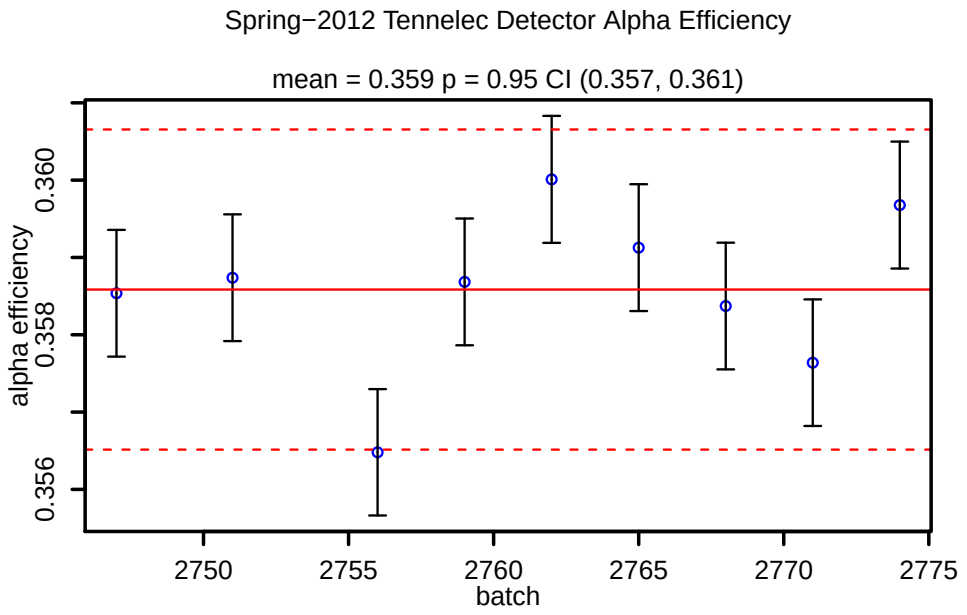

Figure 1: Detector alpha efficiency

Materials and Method

Standards

Two NIST-traceable radioactive sources of known activity are analyzed with each set of samples to determine the counting efficiency of the instrument. Currently, these include a CM-36 beta standard (Source RR-659, certified on Jan. 13, 2000) and an Am-241 alpha standard (Source 170-94, certified on Sep. 11, 1986).

Sample and Mounting

Samples and Blanks are supplied by a contractor on Whatman #1 qualitative filter paper or equivalent for performing wipe tests. The samples are submitted in small manila envelopes sample storage. Each envelope is labeled with the source accession number and the date sampled.

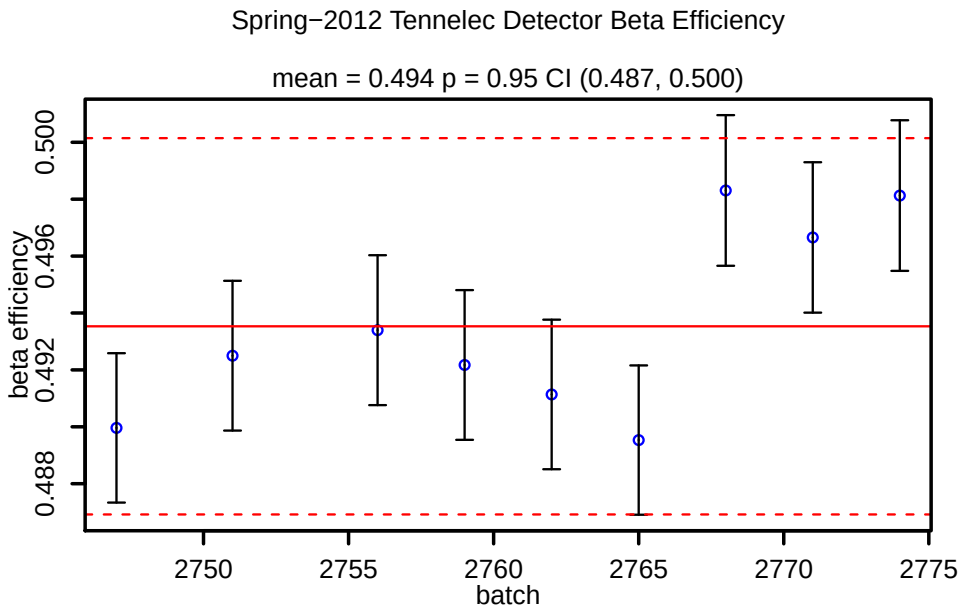

Figure 2: Detector beta efficiency

The sample filter is removed from the envelope with forceps, exposed side up, and mounted on a planchet in the center of a numbered Tennelec LB5500 sample holders.

Spectrum Acquisition

At the beginning of each batch of samples, a blank and two check standards (alpha and beta) are loaded into their numbered sample holders. These are combined with the samples mounted in their numbered sample holders.

The analyst creates a "Batch" file must in the Eclipse software that controls the Tennelec LB5500. The analyst does this by selecting "manage" from the pull-down menu at the top of the window, then selecting "samples", and clicking on "new". The analyst enters (and records) a numeric batch ID and sets the procedure to "smear". The analyst enters the sample ID (the Kodak accession number of the source tested or the standard ID) in the "lab ID" field.

When finished, the analyst saves and prints the batch file.

Finally, the analyst runs the batch by going to the "count" pull-down menu and selecting "Go". This causes each sample to be counted for ten minutes.

Spectrum Analysis

The Tennelec "Eclipse" software stores the results from running their stored procedures in a Microsoft Access database ("Eclipse.mdb") that is stored in the program directory on the control PC. A backup copy of this file is stored on a network file share after each semi-annual analysis is complete. This provides sufficient archival storage.

Data Reduction and Report Generation

All the data required for data reduction and report generation is stored in the "Eclipse.mdb" database and may be automatically retrieved and analyzed a custom script written using the Open Source R Statistical Programming language ("wipeTest.R").

The analyst simply edits title of the report and the vector of batch numbers to match batches in the Tennelec database. The analyst has the option of computing the efficiency using the standards from the batch file – an option we chose to use because of the large number of batches, or to use recent results which is appropriate for analysis of a few retests.

The module then retrieves all the data, computes and plots the mean detector efficiency for alpha and beta radiation if the option was selected, processes all the raw data, and outputs summary statistics and a results file sorted by accession number.