Radiation Review

UW - Madison Safety Department **Radiation Safety Program**

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http://www.wisc.edu/safety

Saving Money

Grant money is getting tighter and grant applicants are having to compete for relatively smaller pools of money. For that reason, it is unfortunate to see a PI waste money for some unnecessary or inappropriate radiation safety or radiation analysis product. This newsletter will be used to address several items by which a lab may save money with (essentially) no negative impact on their research productivity.

Survey Meters

Radiation Safety requires each PI to own a radiation survey meter. Not all meters provide you the best value for your dollar.

First, we recommend that each user purchase their meter directly from the manufacturer. This alone may result in as much as $200 per meter saving. Frequently a PI will buy a meter through a middle man or medical supply company. In the instances we have seen, the meter was exactly the same as one we recommend, however the (middle man) vendor stuck their own label on the meter and charged $250 more than the manufacturer charges for the exact same meter.

Second, researchers should review the Safety Department web page (http://www.wisc.edu.safety) under Radiation Safety. We have detailed various acceptable meters, the manufacturer's price and purchase address. Do not consider only price. While price is important, some meters (not listed on our page and not recommended by us) are either not durable enough, not capable of being calibrated per the UW's NRC license conditions, or not accurate enough for endorsement by Safety. If you purchase the wrong meter or a meter not suitable for your work, you will need to purchase another.

Remember, medical supply salesmen place their own and their company's best interest first and a building manager does not have the expertise in radiation safety to provide a sound recommendation. Call Radiation Safety or review our web page for advice. We have tried to list the best meters for the money from about 6 radiation instrument manufacturers.

Liquid Scintillation Cocktail

If you use liquid scintillation counters to analyze your samples, remember that the State Consolidated Stores stocks ***Biosafe II***, a very good brand of sewer disposable cocktail. Approximately 10 years ago, Safety conducted comparisons of the various cocktails then on the market. The ***Biosafe II*** cocktail stocked by Stores is an effective cocktail for counting most samples and it has not been labeled to be a hazardous chemical. Additionally, we believe this cocktail is cheaper to buy than any supplied by vendors.

Liquid Scintillation Cocktail is expensive. Radiation Safety buys more than $2000 worth of cocktail yearly to analyze wipe samples we take in audits of your labs. At one time we thought of reusing cocktail and for a three-month period we used "uncontaminated" cocktail two times. For us, that did **not** work and we have gone back to using cocktail only once per sample. Our experience was that background increased, quench increased, and statistical fluctuations were so great that we often questioned the validity of the results. We do not recommend reusing cocktail.

Although reusing cocktail may not be a viable option, reducing the volume of cocktail used per sample (e.g., from 10 ml to 5 - 7 ml) may be a way to save on cocktail. Because this solution is sample dependent, each PI must determine the smallest cocktail volume they can use for the lab's samples without sacrificing accuracy. The manufacturer's representative should be able to provide you with information to assist you.

Biosafe II, the cocktail we recommend is currently sewer disposable. Disposal of cocktail may also carry a small fee. Safety picks up cases of LSC vials on the Monday and Wednesday pickup run. There is a processing fee of either $6 per case for sewer disposable cocktail or $30 per case for organic (or "hazardous") cocktail vials. We believe that a "sewer disposable" cocktail can be found for nearly every counting situation. This $30 fee is thus a disincentive aimed at protecting the environment. Also, just because the cocktail has the word "safe" in it's name, that does **not** mean it is in reality a "sewer disposable" cocktail. Call Safety if you desire to purchase cocktail other than what is stocked by Stores. Safety can analyze a cocktail to determine whether there are listed hazardous chemical components. We don't want you to have to pay $30 per case when you may have thought you were buying a "safe" cocktail.

Smart Shopping

Often a PI has a lab worker buy certain items of supplies or equipment. While Stores usually stocks an economical product, these workers may either not be aware of Stores, not have a catalog, or just buy the item from the first catalog they open. One good way to save money is to have the person who will buy an item provide you with at least 2 suppliers and the cost of the item through Stores. Such a requirement will let all staff know that smart shopping is worthwhile and that you care about the money being spent.

Cerenkov Counting

Some beta emitting isotopes can be analyzed on an LSC without using any cocktail. The literature of several manufacturer's discusses counting high energy (E_{max} > 800 keV) beta emitters without cocktail or with only a little water,using a technique called cerenkov counting.

When charged particles travel faster than the speed of light in that medium (e.g., water, etc.) Cerenkov radiation (i.e., light) is produced. Cerenkov radiation allows some beta emitting radionuclides to be analyzed with a liquid scintillation counter without using cocktail. For Cerenkov radiation to be emitted, the beta particle must exceed a threshold energy (E_{th}) (in keV), calculated by:

$$E_{th} = \frac{511n}{\sqrt{n^2 - 1}} - 511$$

where n is the refractive index of the medium (i.e., n_{glass} = 1.5, n_{water} = 1.33). For example, if water is the medium, E_{th} = 263 keV, in glass E_{th} = 175 keV.

At the UW, the beta emitter which can best be assayed by Cerenkov counting is ^{32}P. It emits a beta particle with E_{max} = 1,710 keV.

Safety evaluated Cerenkov counting for a ^{32}P labeled compound. We used 5 mCi in a 10 ml aliquot of [a -P-32] UTP. The sample was assayed in a 20 ml glass vial with and without water added. Samples were counted at ambient temperature, in a Packard 1900, using a 5 - 1700 keV window. The DPM used was estimated by counting one sample in cocktail and assuming a 90% efficiency. As seen from the table, the results show that counting ^{32}P in a 20 ml vial, with 4 - 12 ml of added water gives optimum efficiency; however relatively good efficiencies exist for all samples. Typically the counting efficiency of ^{32}P in water is between 40 - 50% while in cocktail, ^{32}P efficiency is nearly 100%.

ml water	% Efficiency
0	30.8
1	42.2
2	44.1
4	48.0
8	46.8
12	46.9
16	46.3

Like any other assay method, Cerenkov counting has advantages and disadvantages. Advantages include simple sample preparation, less expensive, (i.e., cocktail is not needed), sample can be recovered, no chemical quench, and waste can be treated as solid if no water was added (no $6.00 per case fee). Disadvantages include lower efficiency, higher color quench, volume dependence (particularly for less than 2 ml of water), and medium dependence.

The biggest selection factor for using Cerenkov counting is **energy**. In order to achieve adequate efficiency, the average beta energy (approximately 1/3 E_{max}) must be greater than the required threshold energy, E_{th}. For practical purposes, this limits Cerenkov counting to beta emitters with maximum energies greater than 1 MeV. One common candidate for such analysis at the UW is ^{32}P.

Decontaminating Solutions

Many labs have gallons of Count-Off® or Rad-Con® liquid or spray decontaminating solution. This decon material is usually a high phosphate soap with other detergents added. While it works well, it is also somewhat expensive. Some inexpensive alternatives you may want to consider:

1. New technology cleansers (e.g., Dow Bathroom Cleaner®) work quite well. These newer soaps are specially formulated to attack contamination on most surfaces regardless of the type of contaminant.

2. Vinegar or other dilute acid are viable decontaminating solutions for spills involving ^{32}P, ^{33}P, or ^{35}S (do not use acids with ^{125}I contamination).

The principle of decontamination is to apply the decontamination solution to the identified contaminated area (be careful not to splatter the contamination around), allow the solution to penetrate the contamination (2 - 6 minutes), wipe with a damp paper towel, rinse. Meter to verify success. 650 cpm with a GM is acceptable for many for spills.

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