DECEMBER 2000
UNIVERSITY OF WISCONSIN - MILWAUKEE

RADIATION SAFETY PROGRAM UPDATE

SECURITY OF RADIOACTIVE MATERIAL

The NRC expects vigilant adherence to rules requiring security of radioactive materials. It has stepped up its efforts to enforce those rules and will cite licensees for violations of those rules. As we have seen during our most recent NRC inspections, inspectors now routinely visit laboratories in the later afternoon or early evening hours to ensure facilities are secure during times of reduced occupancy.

All radioactive materials **MUST** be secured from unauthorized use, removal and vandalism at all times. Secure stock solutions of radioactive material and sealed/plated sources in a locked storage area and/or locked lab room whenever left unattended. Unsecured radioactive materials must **NEVER** be stored in an unrestricted and unposted room, area or facility. Unsecured material **MUST** never be left unattended. **REMEMBER**, the key is to restrict radioactive material access from anyone not authorized to use those materials at UWM.

Inventory control serves many purposes --- one such purpose is for security of materials. An accurate "in-lab" inventory is an essential element of security. It is difficult, if not impossible, to identify missing radioactive material when users are unsure as to the proper amount that is supposed to be present in the laboratory. Maintain an accurate, documented inventory of materials received, used and disposed. Radiation Safety provides forms to assist in keeping a documented inventory.

Properly labeling all sources of radioactive material, including waste containers, will also maintain security of materials in laboratories. Each lab is provided with distinctive yellow solid waste containers to prevent custodial staff from mistaking waste material as garbage for disposal as normal trash. Disposal of radioactive materials as ordinary trash is a serious violation of safety and environmental laws and would represent lapse in security of the material. EHS&RM routinely provides training to custodial staff that work in or around radioactive material laboratories; custodial staff are instructed to avoid items, containers, equipment and wastes labeled with radioactive material warning labels.

Notify Radiation Safety immediately if you suspect that radioactive materials are missing from your lab for any reason.

DOT REFRESHER TRAINING

When radioactive materials are transported via public routes (i.e., highways, airways, waterways, etc.), rules and regulations promulgated by the U.S. Department of Transportation (DOT) apply to protect members of the general public from radiation exposure which could result from an accident.

DOT requires that any worker who is involved in hazardous materials packaging and transportation receive initial training, as well as refresher training every three years. At UWM this applies to persons who are involved in the transportation of radioactive material to and from UWM facilities by motor vehicle,
to and from remote research facilities, and/or prepare packages of radioactive material for shipment.

An informational notice that will serve as DOT refresher training is being sent out this month to individuals on campus who are registered as trained DOT workers. If you are required to receive refresher training, please review that material giving particular attention to issues that may affect your operations. If you have questions about the transport of radioactive materials please contact Sharron Daly, UWM RSO, at 229-4275, email: sdaly@uwm.edu.

RADIOCHEMICAL STORAGE

You say the tritiated leucine you bought for $1500 in 1990 and put in the freezer is nearly as good as it was when you placed it there ten years ago? Not likely.

Chemical decomposition occurs naturally during storage of compounds. However, compounds labeled with radioisotopes typically decompose faster than their unlabeled counterparts. The **shelf-life**, the time during which a labeled compound may be used with confidence and safety, is important to both the user and the supplier. The purity at which a radiolabeled compound ceases to be of use depends greatly on the application. With radiochemical decomposition, it is important to consider the molar specific activity (mCi/mmol) because the molar specific activity gives an appreciation of the extent of labeling of a compound. Decomposition may be accelerated by free radicals produced from the radioactive decay energy. The observed decomposition rates of radiochemicals are more pronounced with compounds of high molar specific activity.

Recommended storage conditions are normally included in the leaflet accompanying each item. Even slight deviations from these conditions may result in more rapid decomposition. In general, compounds should be stored at low temperatures in the dark and liquid solutions should be stored unfrozen at concentrations less than 1 mCi/ml. Where instability dictates that solutions be stored frozen, it is best to avoid freeze-thaw type cycles.

Isotope	Typical Observed Decomposition Rates
H-3	1-3% per month
C-14	1 - 3% per month
P-32	1 - 2% per week
S-35	2 - 3% per month
I-125	5% per month

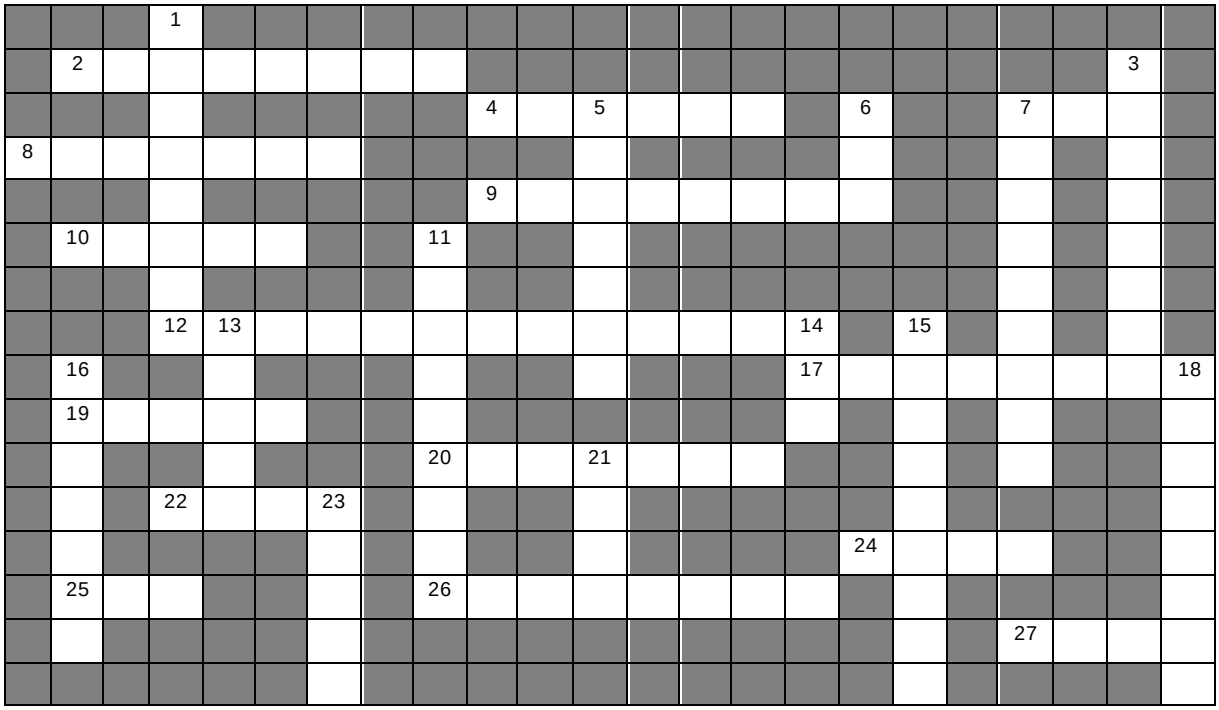
Radiochemical Decomposition Rates

Radiochemicals can decompose by at least 4 modes: (1) Natural decay is most likely the least important for ^{3}H and ^{14}C decomposition simply because the percent of radioactive atoms decaying per month is so small. (2) In primary decomposition, the ionizing radiation interacts with molecules of the labeled compound surrounding the decaying nucleus. Here the higher the specific activity, the greater the primary decomposition. One can add unlabeled (carrier) or other solvents to reduce the specific activity or increase the number of non-labeled molecules near each labeled molecule. (3) Secondary decomposition arises from the interaction of free radicals created by the radiation with labeled molecules. This is the most difficult decomposition mode to control and is easily influenced by environmental conditions. (4) Chemical and microbial decomposition also act on a radiochemical independently of radioactive decay.

While every radiochemical is shipped with specific storage instructions, there are a few principle guides that will help minimize decomposition:

1. Optimize storage conditions for chemical stability - e.g., correct pH, storage under inert gas, etc. Keep radiochemicals in the dark and protected from the adverse effects of any nearby chemicals.
2. Store at low temperatures - solutions of radiochemicals should be stored cold but unfrozen (e.g., aqueous solutions at +2EC, ethanol solutions at -20EC). Compounds of very low chemical stability should be stored at -140EC (the vapor above liquid nitrogen); compounds in their natural physical state should be stored at -20EC.
3. Dilute the specific activity - a compound at high specific activity will decompose faster than at lower specific activity.
4. Store as solutions - this effectively disperses the labeled molecules, decreasing the effect of secondary decomposition.
5. Avoid reopening of vials, and warming/cooling cycles - if a radiochemical is to be used over several weeks/months, it is best to have it subaliquoted in a number of vials, keeping those to be used later in the refrigerator or freezer until required.

(Reprinted from The Radiation Review, February 2000)



ACROSS:

2. The dose rate from a radioactive source decreases as you increase your _____ from the source.
4. An area monitoring ____ may detect contamination and/or locate areas that need special attention.
7. Abbreviation for deoxyribonucleic acid.
8. A radioactive isotope of hydrogen which contains 1 proton and 2 neutrons in the nucleus.
9. All work with volatile radioisotopes must be carried out in a _____ _____ that has been approved by Radiation Safety.
10. An _____ particle is generally not a hazard unless it is inside the body.
12. Emission of light from an atom or molecule.
17. A quantity of X- or gamma exposure in air, measuring the ionization produced by their passage.
19. The goal of radiation safety practices is to keep all radiation exposures _____ (abbreviation).
20. All radiation symbols must be removed or ____ before disposing of decayed material to the normal trash.
22. P-32 should never be shielded with _____.
24. A ____ particle is a fast electron with a single charge.
25. Abbreviation for kiloelectron volt.
26. Electromagnetic ray emitted from the nucleus of an excited atom following radioactive disintegrations.
27. The length of ____ that you spend near a source of radiation will determine the radiation exposure you receive.

DOWN:

1. An atom which has the same number of protons but different number of neutrons of an element.
3. The time required for a radioactive substance to decay to one half of its original activity.
5. Radioactive materials in storage must be secured to prevent unauthorized _____.
6. The traditional unit of absorbed dose equal to 100 ergs/gram.
7. Device used to monitor external radiation exposure to workers.
11. Another method to reduce your radiation exposure is to utilize _____.
13. Historical unit of radioactivity equal to 3.7×10^{10} disintegrations per second.
14. Federal agency that regulates the use of by-product radioactive material (abbreviation).
15. Unit of activity in the International System (SI) of units which is equal to 1 nuclear disintegration per second.
16. Type of probe for a portable geiger-mueller survey meter.
18. All persons in a lab should be immediately _____ of a spill of radioactive material.
21. Smallest part of an element, made up of a nucleus containing protons and neutrons and surrounded by an electron cloud.
23. Internal rearrangement of neutrons and protons within an atomic nucleus resulting in the emission of decay products.

Answers on the EHS&RM we: http://www.uwm.edu/Dept/EHSRM/RAD

EMERGENCIES AND CONTAMINATION INCIDENTS

Often, radioactive material contamination incidents are not readily visible to a user at the time of occurrence. A volume as small as 10-20 ul of liquid stock contaminating a single floor tile can rapidly be spread by foot traffic and contaminate laboratories and adjacent areas. Yet, the actual act of "spilling" such material can be virtually invisible to the naked eye.

What does this mean to you? **ALWAYS** perform post-procedural contamination checks using a GM survey meter or other appropriate survey instrument -- when using H-3, use contamination swipes to perform these checks. Contamination checks are your primary means of defense. You **MUST** check:

- Yourself, including your labcoat and clothing.
- Your ungloved hands and your shoes.
- The immediate work areas where material was used.
- Floor areas near where material was used or carried.

Accidents can occur and will require immediate decontamination to prevent the risk of spreading the material. It is important for you to be familiar with appropriate spill response activities so you can react properly in the event of an incident in your lab. Spill response actions for both major and minor spills are posted in each radionuclide lab.

Spill response materials are provided to each lab to enable you to handle a minor spill of a few microcuries of activity when the radionuclide does not become airborne or when there is no personal injury. A major spill involving greater than 100 uCi of activity, when airborne contamination occurs, or personal injury or fire are involved will require additional assistance. Radiation Safety has established a 24 hour emergency response system to assist users in the event of an incident. Emergency contact numbers for the campus police and members of the radiation safety staff are also posted in each radionuclide lab.