Mixing, Loading, and Application
After you complete your study of this unit, you should be able to:

- Describe how to protect the water source at the mixing site.
- Name types of protection you may need while mixing or loading pesticides.
- Explain what to do with empty pesticide containers.
- Name types of empty containers that can be rinsed, and describe rinsing methods.

- Describe ways to determine whether two pesticides can be safely mixed together for application.
- Name some pesticide application tasks for which you may need to wear more personal protective equipment than the minimum required by the pesticide labeling.
- Name actions to take when mixing, loading, and application activities are over.

- Describe what to do with rinsates from equipment cleanup.
- Describe personal cleanup after pesticide handling.
- List some benefits of record-keeping.
- Explain “closed system mixing and loading” and “enclosed application systems”.
- Explain when pesticide collection systems are appropriate, and list advantages of such systems.

**Terms To Know**

**Active ingredients** — The chemicals in a pesticide product that control the target pest.

**Acute effects** — Illnesses or injuries that may appear immediately after exposure to a pesticide (usually within 24 hours).

**Adjuvant** — Chemical added to a pesticide formulation or tank mix to increase its effectiveness or safety.

**Agitate** — To stir or mix.

**Alkaline** — The opposite of acidic, having a pH greater than 7.

**Back-siphoning** — The movement of liquid pesticide mixture back through the filling hose and into the water source.

**Chemical-resistant** — Able to prevent movement of the pesticide through the material during the period of use.

**Collection pad or tray** — A safety system designed to contain and recover spills, leaks, rinsates, and other pesticide-containing substances.

**Concentrates** — Pesticides that have a high percentage of active ingredient.

**Delayed effects** — Illnesses or injuries that do not appear immediately (within 24 hours) after exposure to a pesticide or combination of pesticides.

**Diluent** — Anything used to dilute a pesticide.

**Dilute** — To make less concentrated.

**Drift** — Pesticide movement away from the release site in the air.

**Exposure** — Coming into contact with a pesticide; getting a pesticide on a surface or in or on an organism.

**Formulation** — Pesticide product as sold, usually a mixture of active and inert ingredients.

**Fumigant** — Pesticide that is a vapor or gas that forms a vapor or gas when applied and whose pesticidal action occurs in the gaseous state.

**Labeling** — The pesticide product label and other accompanying materials that contain directions that pesticide users are legally required to follow.

**Leaching** — The movement of pesticide in water or another liquid downward through soil or other planting medium.

**MSHA** — Mine Safety and Health Administration.

**NIOSH** — National Institute for Occupational Safety and Health.

**Non-target** — Any site or organism other than the site or pest at which the pesticide is being directed.

**Personal protective equipment (PPE)** — Devices and clothing worn to protect the human body from contact with pesticides or pesticide residues.

**Pesticide handling** — Directly working with pesticides, such as during mixing, loading, transporting, storing, disposing, and applying, or working on pesticide equipment.

**Porous surfaces** — Surfaces that have tiny openings which allow liquid to be absorbed or to pass through.

**Release** — When a pesticide leaves its container or the equipment or system that is containing it and enters the environment. Release can be intentional, as in an application, or by accident, as in a spill or leak.

**Rinsate** — Pesticide-containing water (or another liquid) that results from rinsing a pesticide container, pesticide equipment, or other pesticide-containing articles.

**Runoff** — The movement of pesticide away from the release site in water or another liquid flowing horizontally across the surface.

**Scouting** — Regularly searching for, identifying, and assessing numbers of pests and the damage they are causing.

**Sensitive areas** — Sites or organisms that are particularly vulnerable to harmful effects from pesticides.

**Soluble** — Able to be dissolved in another substance, usually a liquid.

**Solvent** — A liquid, such as water, kerosene, xylene, or alcohol, that will dissolve a pesticide (or other substance) to form a solution.

**Target pest** — The pest toward which control measures are being directed.

**Toxicity** — Measure of a pesticide’s ability to cause acute, delayed, or allergic effects.
Mixing, loading, and application are the primary pesticide handling tasks. They are also among the most hazardous aspects of a handler's job. Never try to cut corners where safety is concerned, and do not assume that every job will be like every other. For example, even though you are familiar with a pesticide, take the time to read the labeling again each time you buy the product — important directions are changing more often than in the past, and new information may have been added.

**Safe Mixing and Loading Practices**

Pesticide handlers are most often exposed to harmful amounts of pesticides when mixing or loading concentrated pesticides. Handlers who mix and load concentrated pesticides with high acute toxicity have an especially high risk of accidental poisoning. By observing some simple precautions, you can reduce the risks involved in this part of your job.

### Select an Appropriate Area

Choose the pesticide mixing and loading area carefully. It should be outdoors or in a well-ventilated area away from unprotected people, animals, food, other pesticides, and other items that might be contaminated. Choose a place with good light, especially if you are working at night. Be particularly careful not to mix or load pesticides indoors unless lighting and ventilation are adequate.

### Protect Your Water Source

Protect your water source by keeping the water pipe or hose well above the level of the pesticide mixture. This prevents contamination of the hose and keeps pesticides from back-siphoning into the water source. If you are pumping water directly from the source into a mix tank, use a check valve, antisiphoning device, or backflow preventer to prevent back-siphoning if the pump fails. Backflow prevention devices are required by law in some areas.

Avoid mixing or loading pesticides in areas where a spill, leak, or overflow could allow pesticides to get into water systems. When mixing situations require you to use water from a faucet, well, stream, pond, or other water system, take special precautions. Place your mixing equipment where spills, leaks, and
overflows will not flow towards a drain or into the water supply. If necessary, install dikes or other barriers, or grade the soil to divert the flow. If you will be mixing or loading at the site often, consider installing a collection pad or tray.

Typical pesticide labeling statements that alert you to these concerns include:

*Care must be taken when using this product to prevent backsiphoning into wells. Check valves or antisiphoning devices must be used on all mixing and/or irrigation equipment.*

*Do not spill or empty into streams, ponds, or any other body of water.*

*Equipment should be equipped with automatic shutoff devices and valves to prevent backflow into the water source.*

**Personal Protective Equipment**

Before opening a pesticide container, you and those you supervise must put on the appropriate personal protective equipment. By law, you must use all of the personal protective equipment that the pesticide labeling requires for mixers and loaders. Consider using additional personal protective equipment in certain mixing and loading situations.

**Front protection**

If you may be splashed during mixing or loading tasks, or if you will need to lean against contaminated equipment during mixing or loading, consider wearing a bib-top apron made of butyl, nitrile, or foil-laminate material. The style of apron that includes built-in gloves and sleeves is especially protective. An apron:

- keeps pesticides off the front of your clothing,
- is cooler than a chemical-resistant protective suit, and
- is easily removed at the end of the activity.

**Face protection**

If you will be pouring liquid pesticide or adding dry pesticide to a liquid, consider wearing a face shield to keep splashes and wafting dusts off your face and out of your nose and mouth. A face shield is easy to put on, take off, and clean at the end of the day. If you need to wear a respirator, goggles or shielded safety glasses will fit better than a face shield.

**Protection from dusts**

When you will be pouring dusts for long periods of time or working under conditions where dusts might swirl up into your face, consider wearing a dust/mist filtering respirator to keep from
inhal ing the dusts. Choose a dust/mist respirator with NIOSH/MSHA approval. Also wear eye protection, such as shielded safety glasses, goggles, or a face shield, to keep the dusts out of your eyes.

**Protection from vapors**
If you will be handling pesticides that produce vapors that cause your eyes, nose, or throat to sting or that cause you other discomfort, wear eye protection and a vapor-removing respirator with NIOSH/MSHA approval.

**Opening Containers**
Do not tear paper or cardboard containers to open them. Use a sharp knife. Clean the knife afterwards, and do not use it for other purposes. Open containers of pesticides only when they are sitting on a flat, stable surface. If they are tipped on an angle or are in an unstable position, they can easily spill over or leak out when the seal is broken.

**Transferring Pesticides**
When pouring any pesticide from its container, keep the container and pesticide below face level. This will avoid a splash, spill, or dust from getting on your face or into your eyes and mouth. If there is a wind outdoors or a strong air current indoors, stand so the pesticide cannot blow back on you.

If you are siphoning the pesticide from the container to the tank, never use your mouth to get the siphon started. You could easily get a mouthful of pesticide.

**Spills**
To prevent spills, close containers after each use. Even if you plan to mix more pesticide soon, close the container tightly each time. Never leave a tank unattended while it is being filled. It may overflow and contaminate the area.

If you splash or spill a pesticide on yourself while mixing or loading, stop right away and remove your contaminated clothing. Wash thoroughly with a mild liquid detergent (or soap) and water as quickly as possible. Put on clean personal protective equipment. Then clean up the spill.

**Empty Pesticide Containers**
Even after it appears that all the pesticide product has been removed from a container, it usually is not truly empty. The pesticide that clings to the inside of the container can be dangerous to you, other people, and the environment. Take care of empty containers at once.

If containers are rinsable, rinse them as soon as they are empty. Return all pesticide containers to the pesticide storage area or the container holding area when you finish your task. Do not leave them unattended at the mixing, loading, or application site. Never give pesticide containers to children to play with or to adults to use.

If you have empty pesticide containers that cannot be refilled, reconditioned, recycled, or returned to the manufacturer, crush, break, or puncture them. This will make the containers unusable and may also save storage space. Dispose of containers in accordance with label directions and with Federal, State, tribal, and local laws and regulations. For more specific information on how to dispose of containers, see “Transportation, Storage, Disposal, and Spill Cleanup.”

**Nonrinsable containers**
You may not be able to rinse bags, boxes, and other containers of dry pesticides, because the container will not hold up to the rinsing. You also may not be able to rinse containers of ready-to-use pesticides, because there is no place to put the rinsate. The pesticide labeling may tell you not to rinse certain types of containers. These containers may be designed...
to be returned to the pesticide dealer or manufacturer for rinsing. Containers that cannot or should not be rinsed must be emptied as completely as possible. Shake or tap the container to remove as much of the pesticide product as you can. Drain containers of liquid pesticides for at least an additional 30 seconds.

**Rinsable containers**

When you are diluting pesticides, you should rinse the empty pesticide containers, unless the labeling directs you not to. Rinse containers as soon as they are empty, because the remaining residues can dry quickly and become difficult to remove. Such rinsing often saves money, because each rinse removes pesticide from the sides and bottom of the container and allows you to add it to the pesticide mixture.

If you rinse empty pesticide containers thoroughly, you usually can dispose of them as nonhazardous waste. Rinsed containers that are to be stored for later disposal should be clearly marked to indicate that they have been rinsed. There are stickers commercially available for this purpose.

Glass, metal, and plastic containers, plastic-lined paper or cardboard containers, and even unlined paper or cardboard containers that can withstand the rinsing process should be triple rinsed or pressure rinsed. The liquid you use for rinsing should be the diluent (water, kerosene, high-grade oil, or another liquid) listed on the pesticide labeling for diluting the pesticide for application. After rinsing, add the rinsate to your pesticide mixture.

**Pressure rinsing** is an alternative to triple rinsing. Some pesticide equipment, including some closed system mixing and loading equipment, is equipped with a mechanism to pressure rinse pesticide containers when they are emptied. The system usually operates by:
- inserting a high-pressure nozzle and hose into the container,
- rotating the nozzle and rinsing for at least 30 seconds, and
- draining the container thoroughly into the mix tank.

Some systems puncture the base or side of the container to insert the nozzle. Other systems insert the nozzle into the container's regular opening.

Typical pesticide labeling instructions about emptying containers include:

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**To triple rinse a container:**

1. Empty the container into the tank. Let it drain an extra 30 seconds.
2. Fill it one-fifth to one-fourth full of water.
3. Replace the closure and rotate the container for about 30 seconds. Invert the container so the rinse reaches all the inside surfaces.
4. Drain the rinse water from the container into the tank. Let the container drain for 30 seconds.
5. Repeat steps 2 through 4 two more times for a total of three rinses.
Triple rinse containers and dispose of rinsate in area just treated.

Triple rinse (or equivalent).

Completely empty bag into application equipment.

Triple rinse original container with fuel oil, kerosene or a similar type of petroleum solvent and dispose of rinsate by incorporation into the area just treated or by other approved means.

Combining Pesticides

Pesticide handlers often like to combine two or more pesticides and apply them at the same time. Such mixtures can save time, labor, and fuel. Manufacturers sometimes combine pesticides for sale as a pre-mix, but pesticide handlers also sometimes combine pesticides at the time of application.

Under Federal law, combining pesticides is legal unless the pesticide labeling of any of the pesticides involved instructs you not to combine them. However, not all pesticides work well when mixed together. They must be compatible — that is, mixing them together must not reduce their safety or effectiveness in any way. The more pesticides you mix together, the greater the chance of undesirable effects.

Some pesticide mixtures that are physically incompatible make the mixture difficult or impossible to apply and may clog equipment, pumps, and tanks. These reactions sometimes cause the pesticide to form lumps or gels, to become solids that fall to the bottom of the mix tank, or to separate into layers that cannot be remixed.

Sometimes the combined pesticides create a chemical reaction that cannot be seen by looking at the mixture. However, the chemical change can result in:

- Loss of effectiveness against the target pests,
- Increased toxicity to the pesticide handler, and
- Injury to the treated surface.

Some pesticide labeling lists pesticides (and other chemicals) known to be compatible with that formulation. Compatibility charts are available in some pest management recommendations, pesticide trade publications, and Cooperative Extension or industry recommendations. If you cannot find a chart that lists the compatibility of the two pesticides (or the pesticide and other chemical) that you wish to mix, test a small amount of the mixture before you mix large quantities.

Compatibility testing

First, put on personal protective equipment. Wear at least the equipment required by the labeling of any of the pesticides to be combined; protective eyewear; and chemical-resistant gloves and apron, both preferably made of foil laminate. Get a large, clean, clear glass container, such as a quart jar. Use the same water (or other diluent) that you will use when making up the larger mixture. Add the water and each of the products in the same proportions as you will mix them. Unless the pesticide labeling states otherwise, add pesticides to the diluent (usually water) using the "W-A-L-E" plan:

1. Add some of the diluent first.
2. Add Wettable and other powders and Water-dispersible granules.
3. Agitate thoroughly and add the remaining diluent.
4. Add the Liquid products, such as solutions, surfactants, and flowables.

5. Add Emulsifiable concentrates last.

Shake the jar vigorously. Feel the sides of the jar to determine if the mixture is giving off heat. If so, the mixture may be undergoing a chemical reaction and the pesticides should not be combined. Let the mixture stand for about 15 minutes and feel again for unusual heat.

If scum forms on the surface, if the mixture clumps, or if any solids settle to the bottom (except for wettable powders), the mixture probably is not compatible. Finally, if no signs of incompatibility appear, test the mixture on a small area of the surface where it is to be applied.

Applying Pesticides Safely

Every time you apply pesticides, you have two major responsibilities:

- Protecting yourself, others, and the environment, and
- Making sure that the pesticide is applied correctly.

Personal Protective Equipment

By law, you must wear the personal protective equipment and other clothing that the pesticide labeling requires for applicators. Consider using additional protection for some types of pesticide application tasks. You may need to weigh several factors before you can make good decisions about the personal protective equipment you should wear.

Hand-carried application equipment

When you carry the application equipment, such as hand-held sprayers or shake cans, you risk being directly exposed to the
pesticide. A dripping or partially
clogged nozzle, an unfastened cap,
a leaky hose, or a loose connection
are extremely likely to cause
exposure. Consider wearing extra
personal protective equipment to
protect the area of your body that
is in contact with the equipment.

If the application equipment is
carried in front, consider wearing a
sleeved apron, an apron with
built-in gloves and sleeves, or an
apron plus arm-covering gloves to
protect your front from leaks,
drift, and splashes.

If the application equipment is
a type that is carried on your back,
such as backpack, knapsack, or
trombone-style sprayers or dust-
ners, consider wearing a cape to
protect your back and shoulders
from leaking equipment.

If you carry only the nozzle,
consider wearing arm-covering
gloves or elbow-length gloves
with the cuffs taped or otherwise
sealed to the coverall sleeve.

**Entering the path of the released pesticide**

Many applications performed
while on foot cause you to walk
into the path of the pesticide you
are releasing. Whenever possible,
apply pesticides so that you are
backing into the untreated area,
away from where the pesticide is
being released. Under many
conditions, however, it is unsafe to
walk backwards in an application
site.

If you must walk into the path
of the released pesticide, consider
wearing shin-high or knee-high
boots, or protective footwear with
chemical-resistant pants. Spraying
a thick coating of fabric starch or
fabric stain protectant on the lower
legs of your coveralls can provide
a temporary barrier for low-
toxicity pesticides and also makes
the coveralls easier to clean.

When you apply pesticides
from a vehicle, try to use equip-
ment that releases the pesticide to
the rear so that you are located in
front of and above the area of
release and are moving away from
it. Sometimes, however, you may
have to use a vehicle that causes
you to drive into the path of the
pesticide that is being released.

Whether you are walking or
riding, if the pesticide is not
directed downward or if it remains
suspended in the air long enough
to cause exposure to the front of
your body, consider wearing an
apron or chemical-resistant suit. If
the pesticide mist or dust reaches
as high as your face, consider a
dust/mist respirator and eye
protection.

**Walking into a just-treated area**

Even when you apply a pesti-
cide from a vehicle, you may need
to walk into an area that you have
just treated. For example, you may
need to repair or adjust the equip-
ment or check the pesticide
dispersion. You probably will be
climbing over a contaminated rig
and walking through an area that
was treated only moments before.
Consider putting on additional
personal protective equipment
while you are out of the vehicle.
If the vegetation in the treated area is covered with pesticide spray or dust and is fairly short, consider shin-high or knee-high boots, or protective footwear with chemical-resistant pants. In this situation, as with walking into the path of the released pesticide, it may be useful to apply spray starch or fabric stain protector to the pants legs.

If the plants in the treated area are tall, consider wearing a chemical-resistant suit in addition to the footwear. If you cannot wear a chemical-resistant suit because of the heat, try a cape or an apron.

If spray is dripping or dust is falling from overhead, consider a hood or wide-brimmed hat in addition to the body protection and footwear. A dust/mist respirator and protective eyewear may be necessary, too.

**High-exposure applications**

Certain types of pesticide applications pose a special exposure risk, because they engulf you in pesticide fallout. They include:

- mist blower or airblast applications,
- aerosol and fog applications, especially indoors.

- some applications using high-pressure sprayers and power dusters,
- applications directed upward over your head, such as to tree canopies or roof caves,
- aerial applications that use human flaggers to mark the swath.

Whenever you work in these situations, large amounts of pesticide fallout are likely to be deposited on your skin and clothing, often to the point of completely drenching or covering you. Unless you are in an enclosed cab, you cannot avoid this exposure, even if you perform the application in conditions of little or no air currents.

In these situations, you should wear more personal protective equipment than the pesticide labeling requires for other types of applications. Only a chemical-resistant suit with a hood, gloves and footwear with sealed cuffs, and a full-face respirator or half-face respirator with sealed goggles can provide enough protection for these high-exposure applications.

**Applications in enclosed spaces**

Pesticides sometimes are applied in enclosed spaces such as warehouses, factories, homes, and other buildings; railcar, ship, and truck cargo areas; silos, elevators, and other grain storage areas; and greenhouses. When you use pesticides in enclosed spaces, you increase the risk of being exposed to the pesticide by inhalation. You may need to use a respirator even if you would not need one for the same application outdoors.

**Adjusting pesticide-coated equipment**

You may need to wear a protective apron while doing some types of equipment adjustments and repairs. Consider wearing a
vapor-removing respirator, even outdoors, if you must adjust fumigation equipment.

Immersing hands and forearms
Some application techniques, such as animal, plant, or seed dipping vats and spray-dip machines, require you to place your hands and forearms into the pesticide liquid or dust. With this exposure, consider a sleeved apron for full front and arm protection, and protective footwear. A face shield will protect against splashes or drifting dusts.

Applying in air currents
If you will be applying pesticides into or across wind or air currents, consider wearing extra personal protective equipment, because pesticide may be blown onto you. More body protection, protective eyewear, and a dust/mist filtering respirator may be appropriate.

Applying concentrates
You may be exposed to highly concentrated pesticides during some applications. Ultra-low-volume concentrates and fumigant formulations may be close to 100-percent active ingredient and often are highly toxic. Consider using extra personal protective equipment when applying concentrates, such as that required for mixing and loading of those formulations.

Application Procedures
Every time you apply a pesticide, follow these basic procedures to make sure that you are using the pesticide safely and effectively:

Deliver the pesticide to the target
Take the time to be sure that the pesticide is reaching the surface or space to which you are directing it. Pesticide that is deposited elsewhere is a waste of time and money and may harm the nontarget areas.

Check the delivery rate
Check to be sure that you are applying the pesticide evenly and in approximately the right amounts. No puddles of liquid
pesticide or mounds of dry pesticide should be deposited in the application area. Be especially careful in areas where you turn or pause. Many types of application equipment will continue to release pesticide even when not in motion.

When you have applied the pesticide to the first part of the area or space that is to be treated, check to be sure that approximately the correct proportion of pesticide has been used. If too little is being released, check the equipment openings for clogging or obstructions. If too much is being released, check for worn or stuck openings.

**Check for appearance**

As you apply, notice whether the pesticide you are releasing looks the way it should. Applications of wettable powders usually have a whitish color. If the liquid is clear, check to be sure that you are agitating the mixture enough to keep the wettable powder mixed with the water. Granules and dusts should appear dry and should not form clumps. Emulsifiable concentrates usually look milky. If the pesticide does not look right, be sure that you have the right mixture and that it is still blended evenly.

Check the appearance of the target area where you have just released the pesticide. If the surface is changing colors or is stained unexpectedly, stop and check whether you are harming the surface.

**Avoid nontarget organisms**

Before you apply a pesticide, clear all unprotected people from the area. It is illegal to allow them to be exposed to a pesticide application — either directly or through drift. Also remove any pets or livestock that are not being treated with the pesticide. Even when the pesticide application is a narrowly directed one, such as a crack and crevice treatment, keep people and animals out of the immediate area during the application.

Check the pesticide labeling to find out when people and nontarget animals can go back into the application area. The labeling of some pesticides restricts entry into treated areas for periods ranging from several hours to several days. Even if the pesticide labeling has no such instructions, do not allow anyone to enter the treated area at least until any dusts and mists have settled out of the air and any vapors have dispersed. After indoor treatments, consider ventilating the area with fans, vents, or open windows before you let anyone return. Whenever possible, encourage people to remain out of the treatment area for at least an hour after application.

**Avoid nontarget surfaces**

When possible, remove from the application site any items that should not be contaminated with pesticides. Cover or protect any items that cannot be removed from the area and that are not involved in the handling activity. Items that should be removed or covered include such things as food and food utensils; bedding; toys; seed; pet or livestock feed, water, or supplies; and other items that could transfer pesticides to people, pets, or livestock.

**Operate equipment safely**

Turn off your equipment whenever you pause for any reason. Take special care to turn it off before making any adjustments or repairs. When you stop application to take a break, to move to another site, or for repairs, depressurize any pressurized tanks. Turn off the main pressure valve on the tank and release any pressure remaining at the nozzles.

If you are applying pesticides at a distance from your equipment — at the end of a long hose, for example — be sure that unprotected people and pets stay away from the equipment. You may need to post a helper near it.

Check hoses, valves, nozzles, hoppers, and other equipment parts occasionally while you are applying. If you notice a problem, stop right away and fix it. Do not use bare hands or your mouth to clear nozzles, hoses, or hopper openings. Carry a small nylon brush for such jobs. Be sure that any tool used for this kind of job is never used for any other purpose.
After Mixing, Loading, and Application

As soon as you finish mixing, loading, or applying a pesticide, you should do a few important followup tasks. Take the time to clean up properly. Wash your pesticide equipment and then wash yourself. Return equipment to its designated place and safely store or dispose of all pesticide materials and other chemicals that you have used. Be sure that your work site presents no hazards to people or to the environment. Never leave the site unattended until everything has been cleaned up and put away. While you can still remember the facts, make a record of what you have applied and the conditions at the application site.

Equipment Cleaning

Always clean mixing, loading, and application equipment as soon as you finish using it — do not leave equipment with pesticides on or in it at the mixing and loading site or at the application site. When the job is completed and the tank or hopper is empty, return the equipment to the designated equipment cleanup area. Avoid washing equipment repeatedly in the same location unless you use a containment pad or tray. Over time, the flooring or soil in a frequently used area can become contaminated with large amounts of pesticides. This contamination increases the likelihood of harmful effects to people and animals who may contact the contaminated area and increases the likelihood of runoff or leaching into water systems. Also avoid keeping pesticide-contaminated equipment in one location all the time. Pesticides may move off the outside of the equipment and onto the floor or soil.

Do not assign a worker to clean pesticide-contaminated equipment unless that person has been instructed in the basic rules of pesticide safety. Remember that equipment cleaning presents as great a risk of exposure to pesticides as do many other pesticide handling tasks and that all parts of the equipment are likely to have pesticides or pesticide residues on them. When you clean pesticide-contaminated equipment, wear the personal protective equipment that the labeling requires for handling jobs, plus a chemical-resistant apron.

Benefits of correct cleaning

Sloppy cleanup practices are one of the main causes of equipment failure or malfunction. Never keep excess pesticides in your equipment for more than a short time. Even small amounts of pesticide residues that are left in equipment can damage it.

Liquid pesticides that are left in the equipment may quickly corrode the equipment and clog or corrode the nozzle openings. They may cause the equipment to leak or cause the nozzles to release too little or too much pesticide when the equipment is operated. Some liquid pesticides change if they are stored after being diluted and will not be suitable for application at a later time. Some will settle out and form a solid clump at the bottom of the tank that even mechanical agitation cannot remix. Others will separate into two or more separate liquids that cannot easily be remixed. Liquid pesticides that are allowed to stay in the equipment until they are totally dry may be impossible to remove completely at a later time.

Dry pesticides that become wet through humidity, rain, dew, or other moisture tend to clump and stick to the sides and hopper openings. They cannot be applied at a later time, and they cannot be easily removed from the equipment.

Cleaning procedures

After the equipment is empty, clean both the inside and outside thoroughly, including nozzles or hopper openings. Sometimes you may need to use the diluent used in the pesticide mixture (kerosene or high-grade oil), special cleaning agents, or water under pressure. In
other cases, ordinary water may be enough.

Collect the rinsate — the liquid that results from the washing process. If you do not have a way to reuse or dispose of the rinsate, limit the amount of material you use, so you will create less waste.

Wash with special care any vehicles, such as vans and trucks, that may be used for transporting unprotected workers or for family use. People have been poisoned by riding in vehicles that had been used to apply pesticides or to perform flagging for aerial applications.

Rinsates

Remember that the rinsates you create when you clean your equipment contain pesticides and can be harmful to people and the environment. Do not allow rinsates to flow into water systems, including sink or floor drains, rainwater culverts, wells, streams, lakes, and rivers. Do not create puddles that children, other unprotected persons, or animals could get into.

You may use equipment rinsate as a diluent for future mixtures of pesticides, if:
- the pesticide in the rinsate is labeled for use on the target site where the new mixture is to be applied,
- the amount of pesticide in the rinsate plus the amount of pesticide product in the mixture does not exceed the labeling rate for the target site,
- the rinsate is used to dilute a mixture containing the same pesticide or a compatible pesticide,
- you comply with other application instructions specified on the labeling, including any specific labeling instructions for application as an excess pesticide.

The rinsate cannot be added to a pesticide mixture if:
- the pesticide labeling does not list the rinsate as an acceptable diluent; for example, if the rinsate contains a strongly acidic or alkaline neutralizing agent,
- the rinsate contains strong cleaning agents, such as bleach or ammonia, that might harm the plant, animal, or surface to which the pesticide will be applied,
- the rinsate would alter the pesticide mixture and make it unusable; for example, if the pesticides are physically or chemically incompatible.

If you have any rinsates that you cannot use, dispose of them as you would excess pesticides.

Pesticide labeling instructions

Typical pesticide labeling statements that alert you to these concerns include:

Do not store spray solution in tank overnight.

Clean application equipment thoroughly after use by flushing with water in a safe place.

Do not contaminate water by cleaning of equipment.

Flush all application equipment with fuel oil, kerosene or a similar type of petroleum solvent immediately after use. Fill pumps and meters with new motor oil or a 50% motor oil/fuel oil mixture before storing. Do not use water. Dispose of rinsate by incorpora-
tion into area just treated or by other approved means.

**Personal Cleanup**

When you finish working with pesticides or pesticide-contaminated equipment, take time for personal cleanup. Wash the outside of your gloves first, before taking them off. Then carefully peel back your personal protective equipment to avoid getting pesticides on your skin. Remove any other clothing that has pesticide on it.

If you cannot take a shower right away, use a mild liquid detergent and warm water to wash your face, hands, forearms, and any other area that may have pesticides on it. As soon as you can — no later than the end of the work day — wash your whole body and hair thoroughly with a mild liquid detergent and plenty of warm water.

When you remove your personal protective equipment and work clothing, put it in a plastic box or bag until it can be laundered. Do not allow children or pets to play with these items. Do not wash work clothing and personal protective equipment in the same wash water with the family laundry.

**Recordkeeping**

Keeping records of pesticide use and application is a good idea. Records can establish proof of proper use. If an error has been made, records are helpful in finding the cause. They also can provide you with information to use in response to claims of excess residues or damages.

Good records can save you money. They allow you to compare the results obtained from using different pesticides, different formulations, and different equipment, and from applying
under various site conditions. You can improve your pest-control practices and your efficiency.

Records can help you reduce pesticide mistakes or misuse. If a pest is not controlled, if damage has occurred in the target area, or if a pesticide has moved off the target area and caused problems, you may be able to determine what went wrong. Records may help you to determine that a particular pesticide, a particular formulation, a type of application equipment, or some condition in the treatment area caused the problem. Then you can take steps to avoid such a situation in future pesticide applications.

Good records can help you reduce carryover by buying only the amount of pesticides you will need. Some pesticides do not store well for long periods of time, and disposal of excess pesticide can be very expensive.

Necessary information

The more information you keep on record, the more useful the records will be. Devise a standard form to be sure you write down all the necessary facts each time. Keep the forms handy so you will fill them out promptly — you may not remember all the information at a later date.

Record:
- Names of any handlers involved in the activity,
- Time of day and date of application,
- Location and description of treated area, including climatic conditions at the site,
- Treated surface (plant, animal, soil, water, structure, or other surface at which the pesticide was directed,
- Target pest,
- Equipment used,
- Pesticide used — brand name, common name, formulation type, percentage of active ingredient, and EPA registration number,
- Amount of formulation used (and amount of diluent or other adjuvants added, if any),
- Total amount of pesticide applied and the rate of application (pounds per acre, ounces per 100 square feet, etc.), if applicable,
- Size of treated area (total square feet, acres, or linear feet; room or structure size; number of animals, etc.).

Additional information

Every record form should have a space for additional comments. Use this space to jot down information for your own personal use or to record anything that was unique about the treatment. Record information about scouting or monitoring that may have been done. Write down what other pest management methods are being used and how successful the overall pest management strategy is. You can use this information to improve your pest management operations, either through better customer or worker relations or by saving money.

Required records

Many States, tribes, and other local authorities require you to keep records of pesticide applications. Be sure you know what records you must keep and how long you must keep them. Many enforcement inspections look closely at recordkeeping, because records are a clue to the way an operation is being managed. Keep your records in a safe place where you can find them when you need them.
Safety Systems

Closed mixing and loading systems, enclosed application systems, and pesticide containment systems are excellent investments for pesticide handlers who handle large quantities of pesticides or who handle pesticides that are very hazardous to humans or to the environment. In some cases these systems may be required for handling certain pesticides or when pesticides are used in or near sensitive areas.

Closed Mixing and Loading Systems

A closed mixing and loading system is a system designed to prevent pesticide from coming in contact with handlers or other persons during mixing and loading. The labeling of some pesticides requires you to use a closed mixing and loading system when handling the product. This requirement usually appears on products that have a high risk of causing acute effects or that may cause delayed effects. Typical statements on the labeling of such products include:

**Must be transferred and mixed using closed-system equipment. Do not use open mixing vats or tanks, or open pouring.**

**Must be transferred into the spray tank through the use of a mechanical transferring device.**

Some States may require use of closed mixing and loading systems for pesticides with high acute toxicity.

There are two primary types of closed mixing and loading systems. One type uses mechanical devices to deliver the pesticide from the container to the equipment; the other type uses soluble packaging.

**Mechanical systems**

Mechanical systems are often a series of interconnected equipment that allows you to remove a pesticide from its original container, rinse the empty container, and transfer the pesticide and rinse solution to the application equipment without being exposed to the pesticide. The most common mechanical closed systems are for use only with liquid formulations.

Closed mixing and loading systems are often custom-made, using components from several commercial sources. Because pesticide container openings, shapes, and sizes vary, no single closed system can be used with all containers. The mechanical systems now available remove the pesticide concentrate from the original container in one of two ways — by gravity or by suction.

**Gravity systems** are sometimes called “punch and drain” systems. The unopened pesticide container is inserted into a chamber, which is then sealed. A punch cuts a large opening in the container, allowing all the material to drain into the mixing tank. A water nozzle attached to the punch sprays the inside of the container to rinse it thoroughly. The rinse water also drains into the mixing tank. The rinsed container is then removed for disposal.

A limitation of this system is that only full container quantities can be used. It is not possible to use part of the pesticide in a container and store the rest.

Some suction systems do not permit the resealing of partially

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**Advantages and Disadvantages of Closed Systems**

**Advantages:**
- Increased handler safety,
- Less need for personal protective equipment,
- Reduction of spills,
- More accurate measurement, which reduces overdosing and underdosing and may save you money.

**Disadvantages:**
- Some systems are expensive or scarce,
- Some systems are cumbersome,
- Some systems are not appropriate for many pesticides and many handling activities.
emptied containers. Another disadvantage of suction systems is that highly viscous pesticides (those that pour like molasses) are difficult to move by suction.

**Soluble packaging**

Soluble bags or containers are a much less complex type of closed-system mixing and loading. The pesticide package is designed to be placed, unopened, into the mixing tank. The container dissolves in the solvent (usually water) in the tank.

Disadvantages of soluble packaging include the risk of accidentally releasing the concentrate if the packaging is exposed to water or other solvents during shipping or storage, and the high risk of splashing as containers are added to the tank.

**Personal protective equipment requirements**

The personal protective equipment requirements for many pesticides may be reduced if you use a closed system:

- You may be allowed to substitute a long-sleeved shirt, long-legged pants, shoes, and socks for the personal protective equipment listed on the pesticide labeling.
- If the closed system is for the mixing or loading of concentrated pesticides, you may be required to wear a chemical-resistant apron and chemical-resistant gloves.
- If the system operates under pressure, you may be required to wear protective eyewear.

If you wear less personal protective equipment while using a closed system, you should keep at the mixing and loading site a set of the personal protective equipment that the pesticide labeling requires for regular mixing and loading activities. Then you will be prepared in case the closed system equipment breaks down or there is an accidental spill.

**Enclosed Application Systems**

You can reduce your exposure to pesticides by using enclosed systems to do some applications. An enclosed application system is an enclosure, such as a cab or cockpit, that surrounds the occupants and prevents them from coming in contact with pesticides outside of the enclosure.

When you will be working in an enclosed application system, pesticide labeling directions and current pesticide regulations may allow you to wear less personal protective equipment than is required for ordinary application. However, you must keep the required personal protective equipment inside the cab and wear it any time you get out of the cab in the treated area. Remove it before you get back into the cab. Either store the contaminated personal protective equipment outside the cab or place it in a chemical-resistant container, such as a plastic canister or trash bag, that can be closed tightly and taken inside the cab.

Enclosed systems for application include:

- enclosed cab — provides skin and eye protection,
- enclosed cab with an air-filtering ventilation system — protects against inhalation of dusts and mists, and protects skin and eyes,
- enclosed cab with a vapor-removing ventilation system — provides inhalation protection plus skin and eye protection,
- enclosed cockpit — provides skin, eye, and inhalation protection.

**Pesticide Containment Systems**

If you often mix and load pesticides in one place, or if you often clean equipment at one location, you may find a pesticide collection pad or tray a good investment. These pads and trays are designed to catch spills, leaks, overflows, and wash water and allow them to be recovered for reuse or disposal. Larger pads may be permanently installed, but smaller pads and trays can be portable.

These systems can save you time and money. They make spill cleanup easier, and they reduce pesticide waste by allowing you to reuse the rinse water and spill cleanup water. They also help prevent the harm that spills and runoff can cause to the environment or to people.

**Collection trays**

A collection tray can be used at mixing, loading, and equipment cleaning sites where only small amounts of pesticide are handled at a time and portable equipment is used. Such tasks often take place on a counter or bench. The tray can be made of sturdy chemical-resistant rubber or plastic, such as a boot or shoe mat. The tray must have a rim around it to collect spills and leaks and should have a spout where the contents can be poured off.

**Collection pads**

A collection pad is suitable for mixing, loading, and equipment cleaning sites where large quantities of pesticides are handled and large equipment is cleaned. Such operations often take place outdoors or in a large, open space in a building such as a warehouse or barn.
The collection pad should be made of a waterproof material, such as sealed, smooth concrete; glazed ceramic tile; or no-wax sheet flooring. Porous surfaces, such as wood, asphalt, soil, or carpeting, are not acceptable. The pad must be concave or must have curbs or walls high enough to hold the largest amount of spill, leak, or equipment wash water likely to be created at the site. It also must be equipped with a system for removing and recovering spilled, leaked, or released material — either an automatic sump system or a manually operated pump. Locate the collection pad where rainwater, irrigation water, and flood water cannot flow over it. Wash the pad at the end of each day’s use to prevent possible harm to the environment and to animals and unprotected people.

Test Your Knowledge

Q. What two precautions should you take to avoid getting pesticides into your water source at a mix-load site?
A. 1. Keep the water pipe or hose well above the level of the pesticide mixture, and use a device to prevent back-siphoning, if necessary.
2. Avoid mixing or loading pesticides in areas where a spill, leak, or overflow could allow pesticides to get into water systems.

Q. What four types of personal protection, beyond what you need during application, should you consider wearing while mixing or loading pesticides?
A. Front protection, face protection, protection from dusts, and protection from vapors.

Q. What should you do with an empty pesticide container?
A. 1. If containers are rinsable, rinse them as soon as they are empty.
2. Return all empty pesticide containers to the pesticide storage area or the container holding area when you finish your task.
3. Crush, break, or puncture empty containers that cannot be refilled, reconditioned, recycled, or returned to the manufacturer.
4. Dispose of containers in accordance with labeling directions and with any laws or regulations that apply.

Q. What are three ways to help you decide whether you can safely mix two pesticides together for application?
A. 1. Check the pesticide labeling. It may list the pesticides (and other chemicals) known to be compatible with the formulation.
2. Get a compatibility chart, which may be available from several sources.
3. Test a small amount of the mixture before mixing large quantities of the pesticides together.

Q. What types of empty pesticide containers can be rinsed?
A. 1. Glass, metal, and plastic containers.
2. Plastic-lined paper or cardboard containers, and
3. Unlined paper or cardboard containers that can withstand the rinsing process.

Q. What two methods of rinsing can you use?
A. Triple rinsing and pressure rinsing.

Q. Name four types of pesticide application that might require more personal protective equipment than that specified on the pesticide labeling.
A. 1. Hand-carrying application equipment.
2. Entering the path of the released pesticide.
3. Walking into a just-treated area.
4. Using high-exposure application methods where the pesticide may engulf you.
5. Applying pesticides in enclosed spaces.
6. Adjusting pesticide application equipment.
7. Immersing hands and forearms in pesticides.
8. Applying into or across air currents.

Q. What safety procedures should you follow each time you apply a pesticide?

A. 1. Deliver the pesticide to the target site.
2. Check the delivery rate.
3. Check for appearance.
4. Avoid nontarget organisms.
5. Avoid nontarget surfaces.
6. Operate equipment safely.

Q. When you are finished with a mixing, loading, or application task, what should you do right away?

A. 1. Wash your pesticide equipment and then wash yourself.
2. Return equipment to its designated place.
3. Safely store or dispose of all pesticide materials and other chemicals that you have used.
4. Be sure that your work site presents no hazards to people or to the environment.
5. Make a record of what you have applied and the conditions at the application site.

Q. What should you do with rinsate that you create when you clean your pesticide equipment?

A. Collect the rinsate. Reuse it, if possible, or dispose of it as excess pesticide.

Q. When you are finished with pesticide handling tasks, what steps should you take for personal cleanup?

A. Wash the outside of your gloves first, before taking them off. Then carefully peel back your personal protective equipment to avoid getting pesticides on your skin. Remove any other clothing that has pesticide on it. If you cannot take a shower right away, use a mild liquid detergent and warm water to wash your face, hands, forearms, and any other area that may have pesticides on it. As soon as you can — no later than the end of the work day — wash your whole body and hair thoroughly with a mild liquid detergent and plenty of warm water.

Q. Why should you keep records of pesticide applications?

A. 1. Records can establish proof of proper use.
2. Good records can save you money by improving your pest-control practices and your efficiency.
3. Records can help you reduce pesticide mistakes or misuse.

Q. What are closed mixing and loading systems?

A. Systems designed to prevent pesticide from coming in contact with handlers or other persons during mixing and loading.

Q. What are enclosed application systems?

A. An enclosure, such as a cab or cockpit, that surrounds the occupants and prevents them from coming in contact with pesticides outside of the enclosure.

Q. When should you consider installing a pesticide containment system?

A. If you often mix and load pesticides in one place, or if you often clean equipment at one location.

Q. What are the advantages of pesticide containment systems?

A. They can save time and money. They make spill cleanup easier, and they reduce pesticide waste by allowing reuse of rinse water and spill cleanup water. They also help prevent the harm that spills and runoff can cause to the environment or to people.